PUBLISHED BY
myForesight®

myForesight®

MALAYSIA'S NATIONAL FORESIGHT MAGAZINE

02/2015

MiGHT
Malaysian Industry-Government Group for High Technology

FUTURE OF PERSONAL ROBOTS

WILL THERE BE A ROBOT IN EVERY HOME?

KLESF

Kuala Lumpur **ENGINEERING science fair**

Mines International Exhibition & Convention Centre (MIECC)

An initiative under SCIENCE to ACTION

9 am to 5 pm

For School and Family Day Trip

ADMISSION IS FREE

30th October 2015 until 1st November

DISCOVERY

Hands-on

Technology & Industry

FUN

M 011 1888 9397 T (603) 9086 0288 Ext 118/119 F (603) 9019 3188 E info@klesf.net

www.klesf.net

Jointly organised by

AAET · UTAR · MiGHT · PUSAT SAINS NEGARA

Supported by

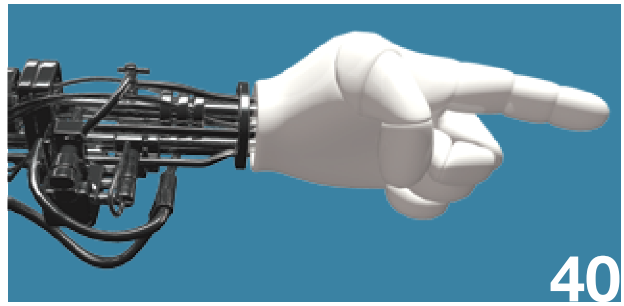
KEMENTERIAN PENDIDIKAN MALAYSIA · MOSTI · SKMM MCMC · MAJLIS PROFESOR NEGARA · AKADEMI SAINS MALAYSIA · ACCCIM

PUBLISHED BY
Malaysian Industry-Government Group for High Technology
Prime Minister's Department
3517, Jalan Teknokrat 5
63000 Cyberjaya
Selangor Darul Ehsan
www.might.org.my

FOR INQUIRIES
myForesight
Phone : +603 8315 7888
Fax : +603 8312 0300
E-mail : foresight@might.org.my
Website : www.myforesight.my

02/2015

inside myForesight



PP17630/12/2012(031478)

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 loyal 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.

● editor's note

Initial Thoughts

by RUSHDI ABDUL RAHIM
Director
myForesight
rushdi@might.org.my

In 20 to 30 years, machine intelligence will kill most middle-class jobs, as well as the broad prosperity that has characterized advanced economies since the 1950s.

Greetings and Salutations! And to our Muslim readers, it is still not too late to wish you Eid Mubarak!

I hope your interest in the future and foresight is as strong as ever.

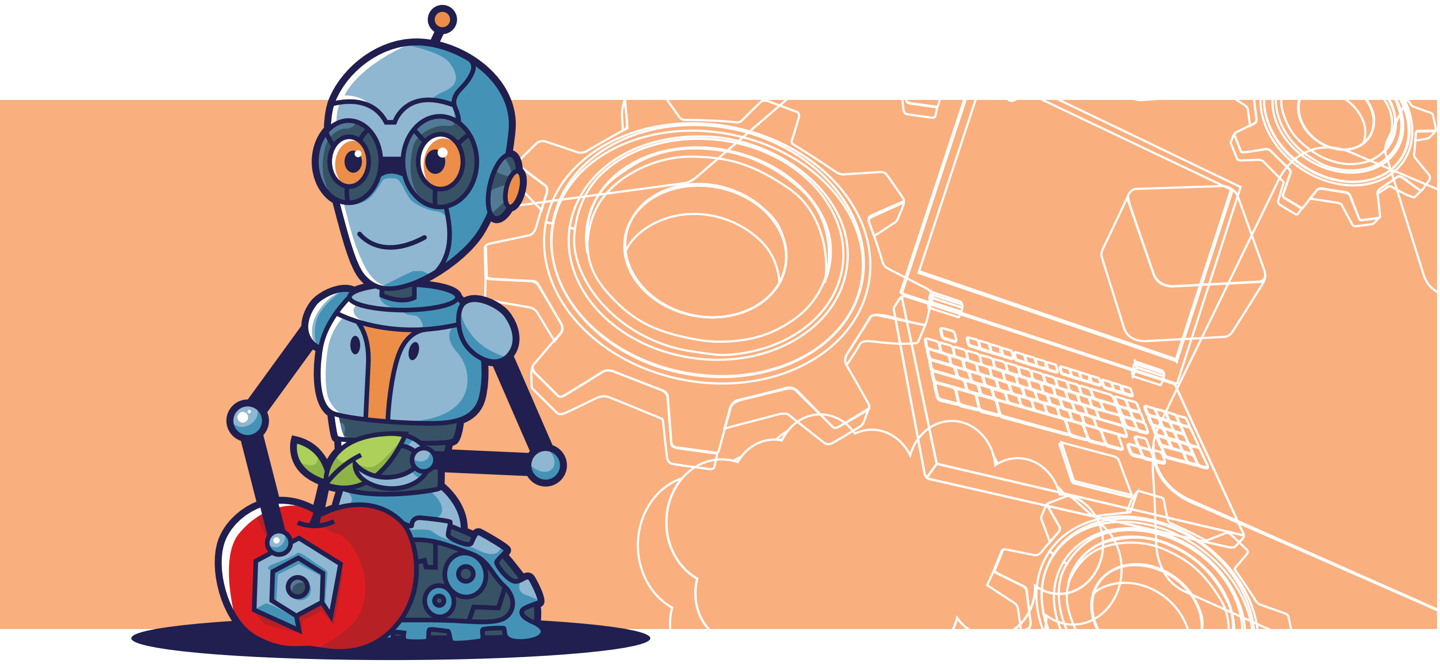
Speaking of interest, have you read Tyler Cowen's "Average Is Over"? – a controversial yet compelling forecast that argues that the modern world is on the cusp of a sea change, brought on largely by the rise of machine intelligence. Tyler is a professor of economics at George Mason University and a popular economics blogger.

He contends that automation of work and daily life will be the key force in a massive societal disruption that is just beginning to be felt. In 20 to 30 years, machine intelligence will kill most middle-class jobs, as well as the broad prosperity that has characterized America and other advanced economies since the 1950s. He believes the future will belong to a minority of people who have the talent and discipline to work effectively with smart machines.

Now, the key questions are: Will you be good at working with intelligent machines? Are your skills a complement to the skills of the computer, or would the computer do better without you? Worst of all, are you competing against the computer?

According to Cowen, people are starting to fall on one side of this divide or the other. Building on this central insight, Cowen evokes a wide-ranging vision of a sharply divided world in which most people either thrive at the top of the ladder or subsist on the lower rungs.

In work, wealth, education, residential geography, intimate relationships, and virtually every other aspect of life, the world will be increasingly divided into



winners and losers, haves and have-nots. The middle class will largely disappear, as people either push their way to the top or fall permanently behind.

I find this a very interesting take on our future.

Therefore for this edition of myForesight® we have compiled articles and opinion piece by wide range of stakeholders on Intelligent machines – The Robotics Future.

According to Robert Tai, the evolution of industrial robots into its current form is not by accident, but by necessity to improve safety and increase productivity. Even though the general perception is that the increase use of robotics will deprive people of job opportunities, most of the tasks undertaken by robots are increasingly complex tasks as well as unsociable work. Therefore he opines that collaborative robotics will be the mainstay of robotics development.

We've heard how people envision robots as domestic help to assist them with their everyday chores. At present, commercially, the closest thing we have to helping with domestic chores is the Roomba – a robotic vacuum cleaner. However, I imagine the likes of like "Bicentennial man" being a reality in the future. Robot designer Tijn Van der Zant is spot on when he highlighted that cultural differences around the world should be a factor in designing any in-home robot. Are we ready to get our Robocop and Baymax the friendly medical assistant? And can we rely on drones to watch over our property? Datuk Dr. Yusoff Sulaiman explained this in Robot in Our Lives.

Datuk Khalilur Rahman notes the importance of robotics and its potential, highlighting the need to prepare our industry and also our society of its acceptance in Malaysia.

His parting shot on the matter is "As much as we strive to develop robotic technologies to be better than humans, let us not forget to be better and responsible humans".

Do keep your opinion and insights coming. We are always ready to hear them if you are willing to share.

Rushdi Abdul Rahim
rushdi@might.org.my

As much as we strive to develop robotic technologies to be better than humans, let us not forget to be better and responsible humans.

leader's insights

Robots in our lives

In Person With...

Y.BHG DATUK DR. MOHD YUSOFF SULAIMAN

President & CEO of MIGHT

Where do you think our robotics industry is now?

Well, it all depends on what type of robots you have in mind. Are you thinking of robot the likes C-3PO in Star Wars? If you are talking about very humanoid robots, we are not there yet. Nobody is. Have a look at the article on dexterous robots and you will understand what I mean. But if you are talking about the use of robots in manufacturing, we already have that in some of our factories in Malaysia. There are so many advantages derived from the use of robotics in the manufacturing sphere that we could not ignore.

So robots are common place in the factory. What about in the home?

Again, it depends on what you are talking about. If you are thinking of very humanoid robots like Bicentennial Man, then no. We are a long way off from that. But some people have a Roomba vacuum cleaner in their homes which is a robot. It doesn't have hands and limbs but it does its job well. It just doesn't look human, that's all. But not all robots have to look human, do they? Even in movies like Star Wars, you have R2-D2 which isn't humanoid at all.

Datuk Dr. Mohd Yusoff Sulaiman is the President & Chief Executive Officer of the Malaysian Industry-Government Group For High Technology (MIGHT) an agency under the Prime Minister's Department. MIGHT is a Private-Public Partnership platform focused on harnessing technology for business.

He specializes in Technology Management and holds a Ph.D from Universiti Teknikal Melaka Malaysia (UTeM) and an M.Sc from the University of Wales, UK. He is currently the Chairman of MIGHT Technology Nurturing (MTN) and a few technology-related organisations including A-Bio Sdn Bhd, Putra Eco Ventures Inc (PEV) and MyBiomass Sdn Bhd. He sits as a Director to the Board of Malaysian Debt Ventures(MDV), Kulim Technology Park Corporation Sdn Bhd (KTPC), Aerospace Malaysia Innovation Center (AMIC), Malaysian Automotive Institute (MAI) and Melaka Green Tech Corporation (MGTC). He is the Secretariat Head for the Global Science and Innovation, Advisory Council (GSIAC) chaired by the Prime Minister of Malaysia.

He is a member of the Governing Board of the Malaysian Foresight Institute (myForesight), Malaysia-France University Centre (MFUC) and Regional Centre for Science and Technology Business Incubator (IRIS) appointed by UNESCO. He is a Fellow of the ASEAN Academy of Engineering & Technology (AAET) and the Academy of Sciences Malaysia (ASM).

Is MIGHT involved in robotics?

Of course we are. The world of high technology not only thrives but is dependent on robots whether in the manufacturing plant or providing services that only robots could deliver. In terms of sectors that we have worked on since 1993, from agriculture to pharmaceutical to aerospace, robots are used to increase production and quality whilst reducing cost per unit. We worked closely with local NGOs like Malaysia Robotics & Automation Society (MyRAS), public sector including Ministry of International Trade and Industry (MITI), local companies such as Dreamedge and international Centers of Excellence in South Korea, Japan, Germany and others.

Are we prepared education-wise for the upcoming robotics revolution?

I personally think that we need to do more and this is what we are trying to do through STEM Education under our Science to Action (S2A) Initiatives. For example, MIGHT together with MARA had organised a robotic workshop for our young engineers from a few selected school throughout Malaysia. Also, we have worked with the likes of Dassault Aviation to organise Unmanned Aerial Vehicle (UAV) design and operate competition among the university students. We need to instill the appreciation of robotics in our students so that this will be a subject they will want to pursue later on.

Do you think Malaysia have what it takes to be the global player of robotics?

Why not? As a country we have done well in many industries that we have gone into. I can't say we have actually failed in any sectors that we have put our energies into and there is no reason to doubt that we can succeed in robotics too. It's our job at MIGHT to make sure we succeed. But this will require us to develop a bigger pool of innovators, engineering designers, materials specialist, programmers and others.

Apart from the industry, everywhere in the world, people are using robotics in the military. What do you think about that aspect of robotics?

Technology can have dual-use; for both civil and military applications. It's inevitable that robotics are also used for military purposes too. The same robotics technology that controls the Roomba vacuum cleaner is also used to detect bombs in cave-like environment and replacing the human soldiers. Drones too have been used for innocent tasks of surveillance up to unethical targeting of individuals or facilities that are proven to be a threat. At MIGHT however, we are mostly interested in how robotics can be used for industry, to help make people's lives easier and perhaps also for educational purposes. That is what we are looking at.

We have maid issues now. Do you foresee that we will use robots instead in the near future?

In the future, yes. In the near future, no. Again, I point to you to the article on the dexterity – or lack thereof – of robots. We are still a long way off before we can get humanoid robots that could replace maids in the home. It's incredibly difficult to build a dexterous robot. That doesn't mean it won't happen. It will just take a lot of time. From another perspective, the rapid development in automation and robotics will allow people to work from home and reduce the need for maids to look after their children or doing household chores.

How far can robotics go in terms of making our lives easier or better?

Who knows what's in store for us in the future? We may be able to create a robot with an artificial intelligence to help take care of the elderly, for instance. And perhaps such robots can do a better job than human caretakers can. The potential of robotics can be mind-boggling. But it is something that the nation must master to meet its unique needs and bring ourselves equal to the leading nations of the world.

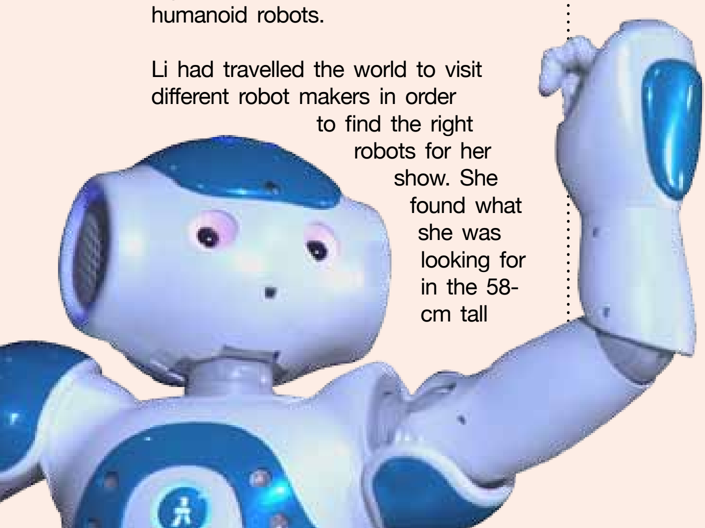
Dexterous Robots

– Still a long way to go

In the month of June, two notable but separate robotic events took place that. The first one was a dance-theatre work, aptly entitled "Robot" by Spanish choreographer Blanca Li that played at the Brooklyn Academy of Music's Howard Gilman Opera House.

The 90-minute performance, the first time it was held in the US after two years of touring in Europe, involved eight human dancers and seven humanoid robots.

Li had travelled the world to visit different robot makers in order to find the right robots for her show. She found what she was looking for in the 58-cm tall humanoid NAO robots made by the French firm Aldebaran.



According to the company, NAO has several unique features that make it very adaptable, including 25 degrees of freedom, for movement; two cameras, to see its surroundings; an inertial measurement unit, which lets it know whether it is upright or sitting down; touch sensors to detect human touch; and four directional microphones, to hear sounds.

This combination of features gives NAO the ability to detect its surroundings. Yet, it still took Li several months to coordinate their movements for her show.

Each robot had its own name and personality. And during the course of the show, each robot was taught to walk, dance, and interact with their human counterparts in a variety of way. Apparently, the interaction was not unlike that of a parent and child – and we're talking about a one-year-old child.

Yes, the robots were little more dexterous than a toddler. And just like a toddler first learning to walk, the robots kept falling down, over and over again. Sometimes they were able to get back up by themselves. Other times they required the assistance of their human partners.

The audience lapped it up and cheered on the robots as they stumbled around on stage. It was as if they were rooting for young children putting on a show for the first time.

Meanwhile, on a more serious tone, a robotics competition was also held in June. The DARPA Robotics Challenge, which was created in response to the Fukushima Dai-ichi nuclear disaster, is

designed to come up with robots to assist in disasters and other emergency situations. In short, it was designed to create robot rescuers that can go to places that are too dangerous for human rescuers to do so.

DARPA, by the way, is the advanced research arm of the US Defense Department.

A total of 24 teams from around the world took part in this challenge, where they were required to build, program and control their robots to undergo a series of eight tasks in a simulated disaster zone.

Among the tasks assigned were driving a car, opening a door, cutting a hole in a wall, traversing some rubble and climbing some stairs. And all this had to be achieved in under an hour.

This is not the first time the competition was held and while most of the tasks are repetitions of what were required the last time around, there were some new elements introduced which made the challenge all that much more difficult.

For example, power cords were no longer allowed so all the robots had to be powered by on-board batteries. Robots could also no longer be controlled through wires. All communication between their human handlers and the robot had to be done wirelessly.

The requirements in the final were also much harder than in the trials. For example, during the trials each team had 30 minutes to complete each of the eight tasks. In the final, all eight tasks had to be done wihin an hour.

During trials, the robots were also allowed to be hooked up to safety harnesses so that they wouldn't be damaged should they fall over. Now if the robot falls it has to either pick itself up or the team would be given a 10-minute penalty if they had to pick the robot up manually.

The grand prize of US$2 million was won by a team from the South Korean university KAIST. Their robot, DRC-Hubo, had managed to complete all the tasks within 45 minutes. Team IHMC Robotics from Florida won second place and US$1 million for its Running Man robot. And Tartan Rescue from Pennsylvania came in third, winning them US$500,000 for the CHIMP robot.

This year, the robots did far better than the year before so great strides were made in terms of balance, dexterity and adaptability. But, the harsh reality is that most of the robots kept falling over.

In robotics are two basic types of control: low-level control for coordinating the action of motors and high-level control for carrying out specific tasks (like picking something up with its robotic hands). The ideal robot for an emergency or disaster situation is that one that could do high-level control movements on its own, without any human control. In reality, almost all the high-level movements at the DARPA challenge were still performed by humans (albeit wirelessly).

The DARPA competition, much like the Robot dance performance, shows the potential in robotics yet clearly demonstrated how much robotics is still at its infancy stage. We are far from creating a robot that can move around nimbly on its own. It doesn't mean we won't get there. Obviously we will but it's still some time off in the distant future before we can expect robots like C-3PO in our midst.

cover story

by Rushdi Abdul Rahim
rushdi@might.org.my

FUTURE OF PERSONAL ROBOTS

WILL THERE BE A ROBOT IN EVERY HOME?

The introduction of the Roomba in 2002 seemed to herald the arrival of a new era in which robots would take over household chores and become ubiquitous: 'a robot in every home'. While the Roomba achieved notable success—selling more than 10 million units worldwide— and robotics technology has advanced considerably since the beginning of the century, the eagerly anticipated advent of multitask domestic robots has yet to arrive. Technological obstacles and cost barriers continue to hinder the introduction and wide-scale adoption of domestic robots.

Robots have certainly expanded their presence and their utility in industrial settings over the last dozen years. Yet household 'robots' have for the most part been limited to relatively simple, single-function machines designed to accomplish specific circumscribed tasks: one that vacuums; one that washes windows; one that cleans kitty litter; one that mows lawns; and so on. Although researchers, scientists, and inventors are making progress in the development of affordable, versatile, multi-task robots for home use, these robots have not yet arrived in the marketplace.

In order to master a variety of domestic tasks in human homes, robots will need to improve their ability to manipulate objects of different sizes, shapes and textures.

This article identifies and outlines the challenges that still face the creators of domestic robots; describes research and advances in robotics technology that demonstrates progress in meeting those challenges; and examines the business implications of these advances and the coming age of domestic robots.

THE DRIVERS

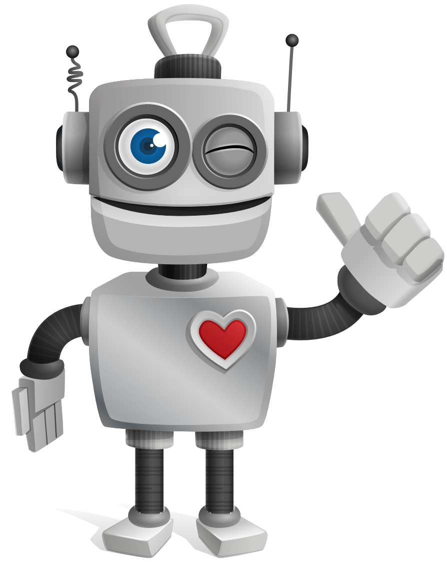
An array of social, demographic, and economic forces are driving the research and development of better, more versatile robots for home use. They include:

Time Pressure

With consumers feeling that time is scarce, robots would provide a highly valued service by taking over mundane household chores — doing laundry, washing dishes or loading dishes in the dishwasher, scrubbing tubs and toilets, cleaning floors and windows, straightening up, unloading groceries, shoveling snow and the like. Consumer research has shown, for example, that people spend more

Single Minded Robots

Household robots designed to accomplish single, highly specific chores have already established their place in the consumer market. Single-function or occasionally dual-function robots currently available can:



time doing laundry than any other household task.

Quality of Life

An ICM poll in 2011 found that 82% of consumers said they would use any product that increased their free time at home. Freeing up time spent doing necessary but repetitive – and for most people boring household chores by relegating them to robots would allow consumers to devote more time to more enjoyable activities – or to more career-related work.

Aging

The UN estimates that the number of people over age 65 will jump 181% worldwide between 2010 and 2050. The growing number of consumers who want to age in place – to remain in their homes rather than move to long-term care facilities – will heighten demand, not only for healthcare and personal-care robots, but also for robots that can handle chores that aging consumers find increasingly difficult to manage on their own.

Consumer Demand

The market for robots that perform household chores is already established and growing rapidly. Consumer robotics is currently a $1.6 billion industry — and task-oriented robots account for about half of that total. ABI Research projects that consumer robotics sales could reach $6.5 billion by 2017. Recent surveys have consistently found that a majority of consumers (55–61%) would like to buy a robot to do household chores.

Despite these drivers, multi-task robots have not yet reached the marketplace. However, ongoing research and development efforts are aimed at achieving this goal.

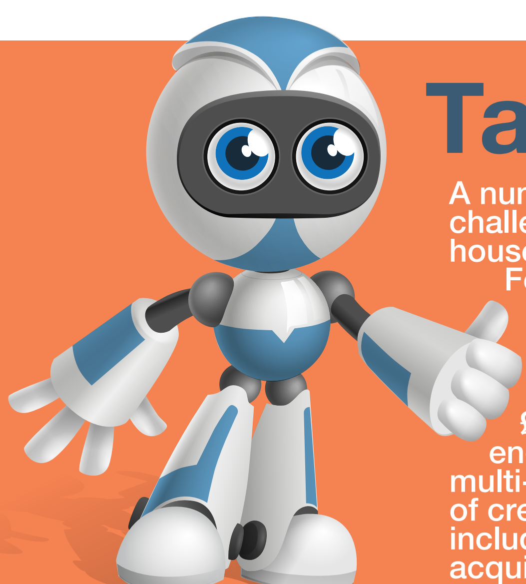
TECHNICAL CHALLENGES

Robots are becoming increasingly autonomous, intelligent, and responsive. Yet, before multi-task domestic robots can begin making their way into consumers' homes, a number of technical challenges must first be met.

> **To function effectively in the home where they will confront many variables and unforeseen occurrences, robots need to move freely, intelligently, and safely through their surroundings; an environment shared with human owners.**

Sensing

Domestic robots require real-world dynamic sensing and equipped with the intelligence to interpret sensor data. The more robots can sense, perceive, interpret, and interact with their immediate surroundings, the more functional they will be.



Taking The Challenge

A number of organizations and companies are tackling the challenges of developing robots that can perform multiple household chores. In Japan, for example, i-RooBO Network Forum, a consortium of 300 Japanese businesses formed in 2014, has announced that it is working on developing 100 kinds of robots to assist in daily chores and other tasks by 2020. In the UK, James Dyson, founder of the Dyson company, in 2014 announced the creation in London of a £5 million robotics center that will bring together British engineers and Japanese scientists in the attempt to create a multi-purpose household android. Others tackling the challenge of creating and/or improving chore-performing home robots include iRobot, maker of the Roomba, and Google, which acquired seven robotics startups in 2013.

Research and development aimed at improving the sensory capacity of robots is ongoing. In 2011, IBM forecasted significant enhancement of computers' sensing abilities — particularly vision, hearing, and smell — by the end of this decade. The growing availability of 3D sensors is already helping robots to improve perceptive abilities and more accurately place themselves within their surroundings. And one of the announced objectives of James Dyson's new London robotics center involves enhancing robot vision, allowing robots to better see and respond to objects around them.

Jibo, billed as the 'world's first family robot' and due to be launched by MIT Media Lab by the 3rd quarter of 2015, has a limited array of functionality – reading aloud, taking photos, delivering emails and reminders. Jibo does, however, use its cameras and other sensing devices to distinguish different objects and individuals. For example, it can identify faces and then behave differently to each member of a household.

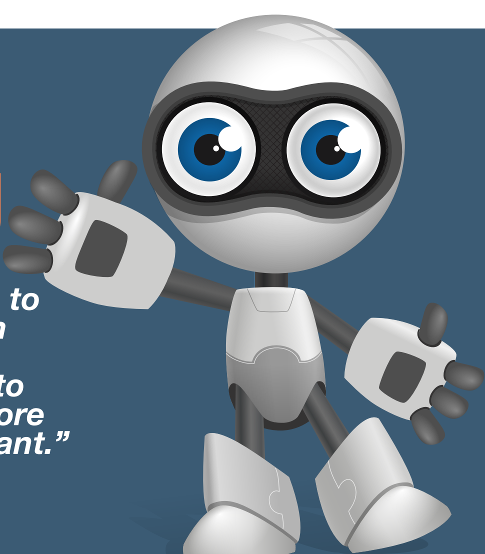
Honda's Asimo robot, now in its sixth iteration but not yet available for purchase, has steadily expanded its sensory abilities. It is able to recognize voices, sounds, and images since its first version in 2000. Asimo in subsequent versions has enhanced this ability — adding movement and gesture recognition, and sensors that provide visual and ultrasonic, as well as ground recognition inputs that enable it to maintain balance and stability by keeping a robotic foot perpendicular to any ground surface.

As an intermediate step to identifying a wide selection of objects, Georgia Tech researchers have developed a system using RFID tags that allows robots to search out and find specific hidden or 'lost' objects. The system involves labeling objects such as hairbrush, mobile phone, TV remote, medicine bottle, etc. with distinct ultra-high-frequency RFID tags. A robot equipped with two articulated antennas can then zero in on the signal sent by a tag and move toward it, thereby locating an object the user wants to find.

Multi-Tasking

"Over the next 10 to 20 years, we're going to see an evolution from single-task robots to multiple-task robots to robots that can be more like a personal assistant."

Philip Solis, Analyst, ABI Research



Manipulation

In order to master a variety of domestic tasks in human homes — environments that tend to be messier and less structured than factory floors — robots will need to improve their ability to manipulate objects of different sizes, shapes, and textures. With industrial robots, success in robotic manipulation has been achieved through high-precision motors, rigid links, and grippers. Yet these components would be unsafe, too heavy, and prohibitively expensive for home use.

Paolo Pirjanian, chief technology officer for iRobot, calls low cost manipulation the 'missing link in robotics'. As this comment suggests, iRobot is focusing R&D resources on developing robotic manipulation appropriate for home use, and at a cost viable for the home market. Whenever possible, for example, iRobot seeks to substitute plastic parts for steel.

Working with researchers at Harvard and Yale, iRobot has developed a dexterous three-fingered hand capable of holding a basketball or picking up keys from a tabletop. Researchers found that incorporation of rubber in the hand's joints introduced a springiness that improves the grip while eliminating the necessity of specifying the position of each finger in order to pick up different objects. They also found that three fingers seem sufficient to grasp and manipulate most objects. Both methods also accomplished the aim of lowering costs — and iRobot intends to apply the design advances made in its robotic hands to likewise improve the flexibility of robotic arms.

In addition to the iRobot advances, DARPA (the research agency of the US Pentagon) has improved robotic dexterity through a program called ARM-H. The program, which makes use of clutches to allow a single motor to control all three joints in a finger, also uses electrostatic forces to lock a joint in place.

An improved sense of touch can also contribute to enhanced dexterity. In September 2014, MIT announced the development of a new fingertip sensor that allows robots to gather real-time feedback on any surfaces they touch. The technology involves the application of GelSight — a rubber-like material that can map out any surface in microscopic detail when placed on it. Fitting it on a robot fingertip provides the finger with an enhanced sensitivity, which the researchers demonstrated by having a robot precisely plug a dangling USB cable into a USB port.

Mobility and Navigation

To function effectively in the home where they will confront many variables and unforeseen occurrences, robots need to move freely, intelligently, and safely through their surroundings; an environment shared with human owners. Robots need to be able to avoid obstacles and, unless confined to a single floor, ideally navigate stairs as well.

Although many robots have achieved mobility through the use of wheels, the development of robotic legs is increasingly seen as giving robots the ability to move around objects in a room as well as to negotiate stairs. Boston Dynamics, one of the robotics companies acquired by Google in 2013, creates a humanoid robot called Atlas that can walk across rough terrain and is even capable of running. Moreover, Atlas can quickly stabilize itself if knocked off-balance; it employs 'dynamic balance' — staying upright through continual motion — to maintain equilibrium. This technology, if scaled down and made more affordable, could prove useful in such crucial everyday functions as climbing stairs. It represents a significant leap forward in robot locomotion technology, one likely to have a strong influence on the future of robot mobility.

Developing the ability to walk is in itself not enough, of course, to make a robot suitable for home applications. Just as important is the ability to navigate and interact safely with a home environment. iRobot's Braava robot uses Northstar navigation, which projects infrared spots onto the ceiling as guidance markers. The company is also developing a system that combines a camera with inertial sensors like those in a mobile phone, using photographs as navigation landmarks. Combining photos with 3D mapping ability will enable greater autonomy by giving robots the capability to recognize and distinguish individual objects like doors, chairs, tables, kitchen appliances, etc.

In another navigational advancement, scientists at the University of California–Berkeley have created sensitive, tactile sensors for robots that resemble and function like

Just a Little Help

Image – Endgadget.com

The PR2 robot (pictured) from Willow Garage has demonstrated the ability to fold clothes after laundering and even to put garments on hangers. However, it does not yet have the sensors needed to distinguish between clean and dirty clothing, and it may not 'see' a sock or two in the back of the dryer.

> **Adding functions in order to develop multi-task robots increases their weight and cost, making them both too heavy and too expensive to be commercially viable in a consumer market.**

a cat's whiskers. The scientists anticipate that these 'e-whiskers' – high-aspect-ratio elastic fibers coated with conductive composite films of nanotubes and nanoparticles – will help robots feel their way around a space. The whiskers, 10 times more sensitive to pressure than earlier capacitive or resistive pressure sensors, allow a robot to detect obstacles just as a cat does, providing information that helps it decide in which direction to move. As robots improve their ability to map and understand their environment, this can also help establish a common language to enhance human-robot communication. Robots will understand, for example, what their owners mean when they say something like: "help me find my wallet" or "vacuum the bedroom on Monday".

Artificial Intelligence

Advances in the development of artificial intelligence will significantly contribute to the ability of robots to function in a home. In addition to needing the intelligence to recognize the objects they see, robots will need a 'structured deep learning' that will allow them to translate sensor data into appropriate action.

It's impossible to program a robot in advance to handle every situation that might possibly arise in an unprogrammed limitless home setting. For this reason, robots will need to be able to process new data, learn new skills, and make decisions about what actions to take in new situations. They need to be equipped with artificial intelligence tools that allow them to make appropriate decisions when the need arises.

Cloud computing will likely help expand the capabilities of domestic robots. Mapping a robot's immediate environment and developing its understanding of the thousands of objects in that environment requires vast amounts of storage. But storing the knowledge that a robot needs to function efficiently in the cloud will avoid burdening the robot with the need for extra storage.

Robo Brain – a project at Cornell and four other universities, sponsored by Google, Microsoft, the US Army and Navy, and the National Science Foundation, among others — aims to create a collaborative cloud-based system through which all future robots can access information. Aspiring to amass the sum total of all human knowledge, Robo Brain has already absorbed more than 120,000 YouTube videos, 100 million documents, and one billion images.

Access to a cloud-based knowledge bank will also make home robots more adaptable, allowing them to learn new things and master new tasks. Rather than robots having to be taught or programmed to do new tasks, Robo Brain will enable robots to 'learn' how the world works and make sense of new information. Its creators anticipate that Robo Brain will be usable on a large scale by 2017.

The University of Washington is also developing a system to facilitate robot learning. The Washington system would enable robots to crowdsource difficulties and new situations, allowing them to seek assistance in attempts to learn and master new tasks. Robots are programmed to consult an online community for input on the best way to accomplish a new task. The robot then analyzes and chooses the best alternatives offered by the community.

> **Although mapping a robot's immediate environment and developing its understanding of the thousands of objects in that environment requires vast amounts of storage, storing the knowledge that a robot needs to function efficiently in the cloud will avoid burdening it with the need for extra storage.**

Cost

Although prototypes have demonstrated that useful humanoid robots can be built, they remain affordable only to government agencies and the large business and corporations.

- Atlas, Boston Dynamics' agile, mobile, walking robot, costs more than US$ 1 million.

- Honda's Asimo is not for sale, and monthly rental costs are reputed to be in the six-figure range.

- UBR-1, a one-armed robot from Unbounded Robotics, costs US$35,000.

- Baxter, a robot from Rethink Robotics that handles simple, repetitive chores, costs US$22,000.

With the cost of robots so high, research is currently focusing on driving down the price of components used to create robot legs, arms, hands, and even machine intelligence. Using less expensive technology would put the price of domestic robots in the reach of some consumers. By making robots more affordable would thus greatly expand the consumer market for them. A major factor in the high cost of robots is the expenses involved in manipulation. Developing less expensive robot hands and limbs that still deliver manipulation skills would therefore help bring costs into consumer's range.

Lower-cost solutions to manipulation are being developed. Rich Mahoney, SRI International's director of robotics, believes that current price-cutting advances in manipulation suggest that solutions could be developed for less than US$1,000 – bringing the overall cost of robots into the range of consumers. DARPA's ARM-H program, for example, employs a cheaper, lighter and more efficient clutch mechanism to deliver lower-cost robotic hands. Reducing the number of fingers in a robot hand has also cut costs considerably. If manufactured in at least a few thousand, a three-fingered hand developed by iRobot cost an estimated US$3,000 — less than 10% of the US$35,000 price tag of other robotic hands with similar capabilities.

Weight and Energy Efficiency

Two final problems that need to be tackled before multi-functional robots become appropriate for home markets are weight and energy efficiency.

While robots that have already been launched in the consumer market are relatively lightweight, virtually all of these robots are limited to performing just one or two tasks. Adding functions in order to develop multi-task robots adds to the weight and cost of the robots, making them both too heavy and too expensive to be commercially viable in a consumer market.

Energy inefficiency, which necessitates the use of massive batteries, adds significantly to the weight of robots. The Atlas, for example, requires 15 kilowatts of electricity — a massive amount of energy that severely limits its practicality due to the weight of the battery and affordability due to the high cost of such a large battery for home use. To make robots practical for home use, power consumption will therefore need to be dramatically reduced. A research team at the nonprofit SRI International is working with DARPA to redesign the Atlas robot to increase its energy efficiency. The team is replacing the hydraulics that move the robot's joints with lighter, more efficient, and cheaper electric components. This, they believe, can maintain its capabilities while reducing the robot's power usage by at least 20 times.

BUSINESS IMPLICATIONS

- Companies working in adjacent spaces should monitor robotics progress even if they have no plans to enter the field or make direct use of robots. These technological developments will involve advances in such areas as sensors, machine learning, and information technology which will have potential to be applied in adjacent areas of technology.

- When the robot industry masters the technological challenges and establishes a market for home robots, it will also create secondary market – maintenance, service, monitoring, and repair of robots. A market may also open up for services to 'robot-proof' homes, making them safe environments in which robots can operate without damaging themselves or other property.

- If the pricing of robots comes down very gradually, making them affordable only to the wealthiest consumers, a leasing or rental model may provide a useful interim step that paves the way for eventual sales as prices continue to come down. Renting a robot maid, for example, could be cheaper than or at least cost-competitive with hiring a human housecleaning crew. Offering robots to rent or lease could whet the consumer appetite to own robots as they become more affordable.

- The expansion of robotic applications into the home depends heavily on the development of new capabilities in human-robot interaction. Researchers and businesses with new technologies to offer in this arena will find companies eager to incorporate them.

- As Google's recent acquisition of robotics companies suggests, the proliferation of robots into the home will likely lead to a new source of data on how consumers live. Like Google cars, Google robots will increase demand for data that Google and others can supply and provide data and insights about how consumer lives. The intimate data that robots can provide will open up privacy concerns and implications of big data. With domestic robots taking their place in a growing number of homes, consumers may respond negatively to perceived and actual intrusions into their privacy.

- The development of domestic robots that can handle home chores will facilitate the desires of a rising number of senior consumers who want to age in place. Enabling more aging consumers to live in place will create new needs for other sensor networks for monitoring and safety or personal-care robots to bathe or groom consumers, and also heighten demand for single-serving meals and other products intended for older consumers who live alone.

- As sensory capabilities improve, future security robots will transform the security industry. In addition to patrolling the perimeter of a residence, security robots may be able to use chemical sensors to detect a fire or gas leak, as well as hearing and vision to detect a break-in.

- Consumers will likely set the bar for robot safety very high, demanding safeguards to ensure that the machines they allow into their homes do not harm occupants, invited guests, or pets. Consumers will not tolerate 'clumsy' robot operations that cause damage to property either.

- Nonetheless, robot error — whether caused by mechanical or technological failure or by operator error — could lead to substantial liability issues. Robot malfunctions and operator error will therefore create new areas for home insurance and liability coverage — insuring against damage done to persons and property by robots as well as damage done to robots.

Adding functions in order to develop multi-task robots increases their weight and cost, making them both too heavy and too expensive to be commercially viable in a consumer market.

REFERENCES

1. *Roxie Hammill and Mike Hendricks, "More Dreaded Chores Outsourced to Robots (They Do Windows)," New York Times, March 2014*
2. *Tom Simonite, "Three Questions for iRobot's CTO Paolo Pirjanian," MIT Technology Review, April 2014*
3. *Bobbie Johnson, "Will Household Robots Ever Change Our Lives?" The Guardian, December 2014*
4. *"Twelve Robots That Have Invaded American Homes," Boston.com, December 2014*
5. *Chuck Tesla, "The Robot Revolution—The Rise of Domestic Robots," Tumotech, May 2014*
6. *Will Knight, "Your Retirement May Include a Robot Helper," MIT Technology Review, October, 2014*
7. *"Consortium Sets Sights on Robots That Do Household Chores," Nikkei Asian Review, July 2014*
8. *Adam Withnall, "A Robot in Every Home: Dyson Enters Race to Provide 'Advanced Household Androids' for All," Independent, February 2014,*
9. *Will Knight, "Google's Latest Robot Acquisition Is the Smartest Yet," MIT Technology Review, December 2013*
10. *Will Knight, "Why Is Google Buying So Many Robot Startups?" MIT Technology Review, December 2013,*
11. *Colin Jeffrey, "JIBO Family Robot Wants to Join the Household," Gizmag, July 2014*
12. *Clark Estes, "The World's First Family Robot Could Be Like HAL in Your Home," Gizmodo, July 2014*
13. *Stu Robarts, "Honda's New ASIMO Robot Is All Grown Up," Gizmag, July 2014*
14. *Brian Coxworth, "RFID Tags May Help Household Robots Locate Hidden Objects," Gizmag, September 2014*
15. *Andrew Liszewski, "This Laundry Bot Will Only Eradicate Stains, Not Humans," Gizmodo, December 2014*
16. *Tom Simonite, "Cheaper Joints and Digits Bring the Robot Revolution Closer," MIT Technology Review, April 2014*
17. *Stu Robarts, "SaviOne Robot Butler Starts Room Service Deliveries This Week," Gizmag, August 2014*
18. *Stu Robarts, "Cat-like Whiskers Could Help Robots Navigate," Gizmag, January 2014*
19. *Paul Gilster, "Why Robot Home Helpers Are Likely Years Away," News & Observer, August 2014*
20. *Stu Robarts, "Robo Brain Uses the Web to Teach Robots Human Knowledge," Gizmag, August 2014*
21. *David Szondy, "Crowdsourcing Could Help Robots Learn New Tasks Faster," Gizmag, June 2014*
22. *Stu Robarts, "Robo Brain Uses the Web to Teach Robots Human Knowledge," Gizmag, August 2014*
23. *Stephen Clemenger, "Bio-likeness: Getting the Feel of Our Robotic Future," Gizmag, July 2014*
24. *"A Robot In Every Home", Future in Focus, December 2014*

viewpoints

by Ahmad Helmi Abdul Halim
helmi.halim@mimos.my

Francis Goon
wk.goon@mimos.my

Jamal Hamzah
jamal.hamzah@mimos.my

Yoong Siew Wai
ysiew.wai@mimos.my

MIMOS Internet of Things: Innovation Ideas

MIMOS Corporate Market Strategy (CMS) is the department to formulate the market driven research activities in MIMOS. CMS is instrumental in leading the National IoT Strategic Roadmap development process together with expert panels from Industry, Government agencies & Academia.

Intelligent Home

Safe, Secure, Suitable and Sustainable Living for Everyone

Home is a place where we spend quality time with our family and relax after a hectic day. Today, we want our homes to not only fulfil our most basic need – shelter – but to also provide a safe, secure and suitable living environment. We like our homes to 'understand' and 'serve' us better. With the advances in the Internet of Things (IoT), our homes can become more aware, more adaptive and more responsive to our needs.

With IoT, homes will be more personalized. Living quality and the experience of the occupants will be elevated. Correspondingly, people will become more dependent on their homes and home systems. Home life will become more engaging, more convenient, and more fun; and home will become the preferred location for core activities such as work, education and entertainment.

Smart and Secure Home

In future homes, keyholes will be excluded from door designs and the residents' smartphone will become the 'gatekeeper'. Smartphones will be the key to enter and lock the home.

No more worries about leaving house keys inside, and the chance of locking oneself out of the home is almost zero.

Starting from the time one parks the car at a designated parking space, the home will start to initiate the authentication and authorization access process to secure it from possible break-ins or unauthorized entries. When one reaches the main door of the home, the smart door will communicate with the smartphone and verify the identity. Upon verification, the door will unlock itself and the home will welcome and configure the internal home setting in accordance to one's profile of the day – including lighting, temperature and entertainment.

If any unauthorised person attempts to enter the house from different access points, a security alarm will be triggered and messages will be sent to the security control room and the house owner. No one will be allowed to enter the home unless authorized.

Image/source: http://automateyourhome.org/10-reasons-to-automate-your-home/

Wellness at Home

A home should be a safe place, especially for aging parents who may have health or mobility issues. There are also many seniors who prefer to stay at home, live independently and privately. IoT technologies respond to this trend by providing a familiar, comfortable and secure environment, while allowing seniors to retain a sense of independence.

As people age, many will encounter functional limitations and an increased likelihood of illnesses such as osteoporosis, arthritis, heart disease, hypertension and diabetes. A conventional home environment may not be able to meet the needs of infirm seniors, and unsuitable home environments have become a dominant cause of injuries among the elderly, with falls in the home topping the list.

Failing memory among seniors have also caused a number of them to forget important tasks such as turning off the stove or putting out the candles, which can lead to home fires.

IoT technologies can be leveraged to ensure a living environment that accommodates the mental and physical decline that will most likely occur among the aged. Technology developers have already introduced appliances, gadgets and devices that can ensure safety for the aged, enhance their quality of life, as well as reduce healthcare costs through injury and disease prevention and early intervention.
IoT-enabled homes not only preserve one's sense of independence but can also provide supporting services such as:

- Wearable devices that perform continuous and timely monitoring of vital signs and physical conditions of senior citizens. The data gathered from single or combined smart medical devices can be channeled to a medical service provider or caregiver periodically or at a specified time interval.
- Gait monitoring systems that collect in-home movement patterns. When unusual movement patterns are detected, an alert will be sent to family members' communication devices and a prompt for an emergency call will be issued.
- Alarm and reminder systems for stove, water tap and electrical appliances to ensure the safety of home residents.

Image/source: http://boomersolutionswv.com/wp-content/uploads/2013/05/system-comp-trans-hr03-13.png

Smart Housekeepers

When approaching the end of a business day, a working mother will start to feel lethargic just thinking about all the chores awaiting her at home. With IoT, smart home appliances can ensure all chores run smoothly. The home itself can turn into a 'housekeeper' which orchestrates all appliances to perform assigned tasks, giving a peace of mind to the owner. An IoT-enabled 'housekeeper' can include smart appliances such as:

- Smart washing machine which can perform full-load washing at the most cost-effective time of the day.
- Smart vacuum clearer which cleans and disinfects the floor as the home knows one of the family members has sensitive skin.
- Smart shower that adjusts the water temperature and pressure to meet one's bathing needs, corresponding to the activities of the day as well as environmental conditions.
- Smart air-conditioning system which adjusts the house temperature to one's desired condition when one reaches home.
- Smart lighting that configures the brightness and contrast of the room to suit one's mood.

- Smart fridge that keeps tab on one's food and grocery inventories, and order replenishments from the grocery store.

Quantified Lifestyle

With sensors embedded in a wide spectrum of home fixtures, the home knows all residents' personal information and preferences, helping people make smarter decisions in their daily activities.

The utility bill is the second largest component of consumer expenditure, accounting for 21.7 percent of total household spending; the largest component being food and beverage, which accounts for about 23 percent of total household expenditure[1]. Leveraging on IoT technologies, a household with IoT-enabled appliances can monitor energy usage and achieve substantial savings on utility bills.

A smart home dashboard can record energy consumption data and adjust a home setting accordingly, including dimming lights, tweaking heating and cooling system, and turning off idling appliances to reduce energy consumption. Refrigerators can self-manage and self-adjust during peak energy times – turning up the coolness when rates are down and cutting back when they are high. In time, they may also be able to notify owners via mobile phones and tablets if the door is left open.

1 Bank Negara Annual Report 2010. Available from : http://www.bnm.gov.my/files/publication/ar/en/2010/cp01.pdf

Image/source: http://www.marsdd.com/news-and-insights/the-evolving-digital-utility/

Connected Healthcare

Inclusive and Continuous Precision Healthcare Services

Continuous profiling and monitoring for high risk patients with chronic health problems through Internet of Things (IoT) makes it possible to enable everyone to overcome health challenges and be able to live independently. Connected healthcare, through IoT, enables an integrated end-to-end healthcare delivery system with interoperable and seamless health information and knowledge. It provides for better healthcare service coordination at the right time and the right place for the right individual, and minimises potential healthcare errors.

Aged Care

Worldwide, demographics are changing where 16 percent of the global population will be aged 60 and above by 2050. The longer people can remain mobile and care for themselves, the lower are the costs for long-term care for families and society-at-large. With proper healthcare programmes and facilities, people can remain healthy and independent well into old age and can continue to contribute to their communities and families.

Statistical evidence reveals that senior citizens are particularly susceptible to infection and chronic diseases. The increasing needs of senior citizens to live independently, but require frequent medical attention, along with a need for more nursing home facilities, challenges present healthcare systems. The need for senior care drives the global long-term care services market, valued at US$1.02 billion in 2013, and is expected to reach US$2.34 billion by 2020 at a CAGR of 12.7 percent during the forecast period of 2013 to 2020, in addition to US$3.92 billion[2] for healthcare wearable devices.

Seniors require healthcare services within close proximity and familiar environments[3]. IoT developers have developed wearable devices that can continuously and/or periodically monitor vital signs and physical conditions of a senior – without leaving home. The data gathered from single or combined smart medical devices can be channelled to a medical service provider or caregiver periodically or at specified time interval. Equipped with this near real-time holistic information, the medical provider or care giver will be able to administer the next course of action according to the progress or severity of an individual's health condition. This establishes an interactive and cooperative platform to empower patients and their families to be partners in their own care.

Image source: http://www.lovinghandsseniorcare.ca/

2 Orange. 'Infographic - wearable tech boom in healthcare'

3 Research and Markets. (2015).' Global Long-term Care Software (Nursing Homes, Home Health Agencies, Assisted Living Facilities) Market - Forecast to 2019'. Accessed from http://www.prnewswire.com/news-releases/global-long-term-care-software-nursing-homes-home-health-agencies-assisted-living-facilities-market---forecast-to-2019-300024375.html

Care for the 'Under-Cared'

With the proliferation of wearable devices, of which 60 percent are healthcare related, the idea of using technology as means of motivating and tracking an individual's activity and wellness status has taken the world by storm. Rural communities encounter difficulties in accessing well-established healthcare facilities due to geographical distance and challenges. But, with smart healthcare devices serving as interaction points, individuals in rural or remote areas can share their health condition or record from smart devices with medical professionals who, in turn, can offer health remedies via remote consultation or virtual coaching.

Intelligent Medication Adherence

Medication adherence contributes 30-50 percent to treatment success. Poor adherence to prescribed medication – such as missed dosage, taking a wrong dosage or stopping medication without consulting a doctor – can result in the reduction of treatment benefits, induce hospitalization or readmission, and obscure the clinician's assessment of therapeutic effectiveness. This scenario is prevalent among senior citizens on ongoing medication for chronic conditions such as diabetes, heart complications, hypertension and asthma. Medication adherence continues to draw more attention as the cost and use of medication continues to increase and the advances in medication treatment for various diseases continue.

IoT can address prescription medication non-adherence by dispensing medication into smart bottles or boxes (packages) that track medication adherence, and the system can be paired with wearable devices to monitor vital signs. The smart packages enables tracking of consumption status – any missed dosage will trigger a voice or text reminder, and any non-adherence will alert the medical provider, caregiver or other family members. This is apart from the wearable devices providing evidence of any adverse health conditions due to the medication. This information will enable medical professionals to provide countermeasures or interventions to improve medication consumption behaviors. Better information and communication will increase patients' engagement and involvement in their own healthcare, and their satisfaction with the level of care and loyalty to their health care providers besides reducing medication non-adherence, its associated costs and health risks.

Intelligent Drug Delivery

Studies show that an average of four out of 10 people do not adhere to prescribed medication. This group is highly human- and instrument-dependent through the use of syringes, external pumps, pills and other equipment, which could jeopardize the treatment regime. IoT can minimize the non-adherence by providing an intelligent drug delivery system which comprises a close-loop delivery system. A wearable device can incorporate a biosensor to measure an array of biometrics such as heart rate, hormone levels and temperature. The information captured will be analyzed and the wearable device will slowly disperse the medication automatically and painlessly through micro-needles. The intelligent drug delivery system will monitor an individual's body and offer targeted medication with the right dosage at the right time. This will minimize the individual's effort and reduce human error.

Image source: https://www.pinterest.com/valeriust/medical-technology-tecnologia-m%C3%A9dica-nanomedicina/

Intelligent Infectious Disease Surveillance and Monitoring

The global spread of H1N1, SARS and Ebola pandemic has demonstrated the need for more effective disease surveillance and response capacities which is further accentuated by high mobility and globalization of travel and trade. Existing operations are highly human-dependent, where healthcare workers are deployed to epidemic areas for outbreak investigation, response and management, and outbreak communication. Responsive and proactive healthcare services are of utmost importance for reducing the risk of communicable diseases and death in affected populations. Data and sample collection on the disease environment is an essential step to prevent, protect against, control and facilitate public health responses to the spread of diseases.

IoT technologies can be used to help control or isolate cases and monitor diseases, and prevent secondary spread of infections by identifying and managing contacts appropriately through remote and the continuous capturing of information. The deployment of smart devices to monitor the environment and wearable devices to track people movement will assist health authorities to effectively conduct their investigation. IoT will provide finer granularity in multi-model data on weather-related occurrences, human habitat, natural ecology, hospitalizations, immunizations and symptoms, and visibility on a patient's physiology. By having visibility of the source of an outbreak and identified vectors of an epidemic outbreak, countermeasures can be aimed at specific links in the chain of infection, the agent, the source, or the reservoir for effective intervention and containment of disease outbreaks, as well as increase the safety and response of healthcare workers.

Image source: http://www.belfasttelegraph.co.uk/news/world-news/ebola-virus-outbreak-sierra-leone-and-liberia-announce-army-enforced-quarantine-zones-and-housetohouse-searches-to-round-up-suspected-victims-30474621.html

IoT impact on Malaysia GNI

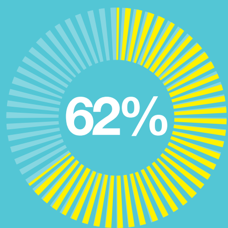
		2020 Total : RM 9.5B	2025 Total : RM 42.5B	New Industry To Be Created
Analytics, Apps & Services Layer 4	Software & Solution Developers	RM 7.5B	RM 34.0B	• Outsourcing service - Solution services - Analytic Services - Software testing services - Security service • Application development
Storage & Cloud Layer 3	Network Service Providers	RM 0.5B	RM 2.1B	• IoT Network infrastructure • Software development • Storage service • IoT based Cloud Computing services
Communication & Networking Layer 2		RM 0.5B	RM 2.1B	
Things, Hardware, Power, Protocols Layer 1	Manufacturing	RM 1.0B	RM 4.3B	• ODM/OEM - Customised product • Smart Manufacturing • Certification and testing

Internet of Things is an Industry Game Changer

Source: MIMOS 2014

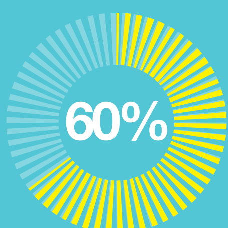
IoT Enablers\ and Challenges

5 key technologies enabling IoT deployment

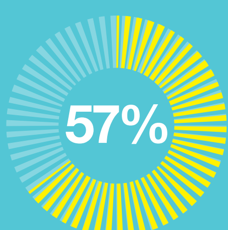


Security

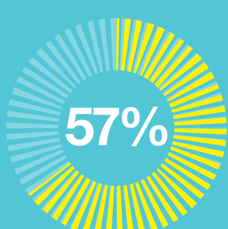
Openness of data



Support services

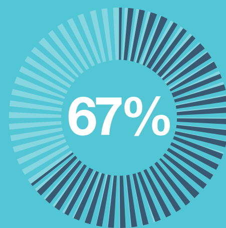


Flexibility & extensibility

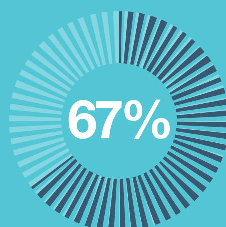


Ease of implementation

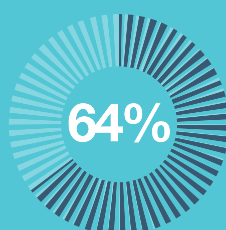
5 Challenges



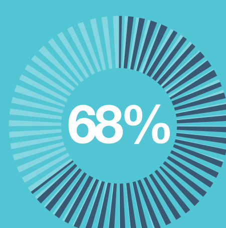
Regulations



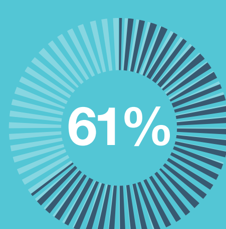
Security



Privacy



Standard

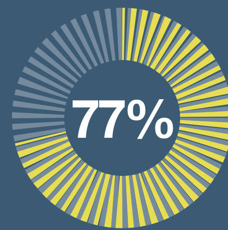


Sustainable business model

Source: IoT Technical Working Group, 2014;, Total respondents, N=41

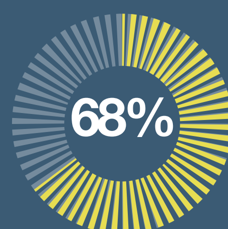
IoT ADOPTION

5 elements drive Malaysian industry's IoT adoption

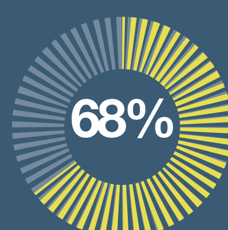


Growth of data

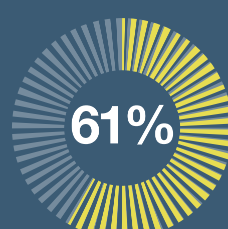
Enabling service industry



Potential to drive operation cost down

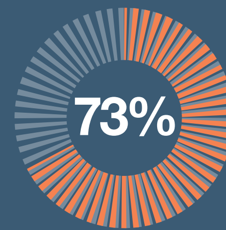


Novel M2M solution

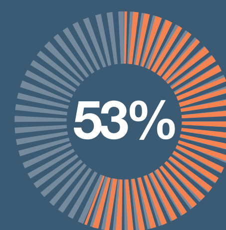


High smart phone penetration

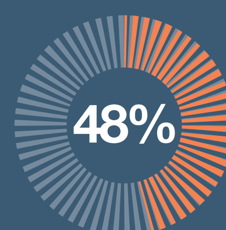
5 early adopters



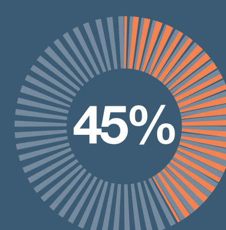
Transportation/ Logistics



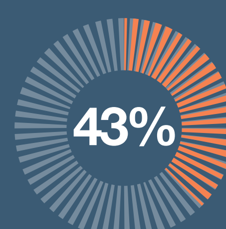
Banking, Finance & Insurance



Manufacturing



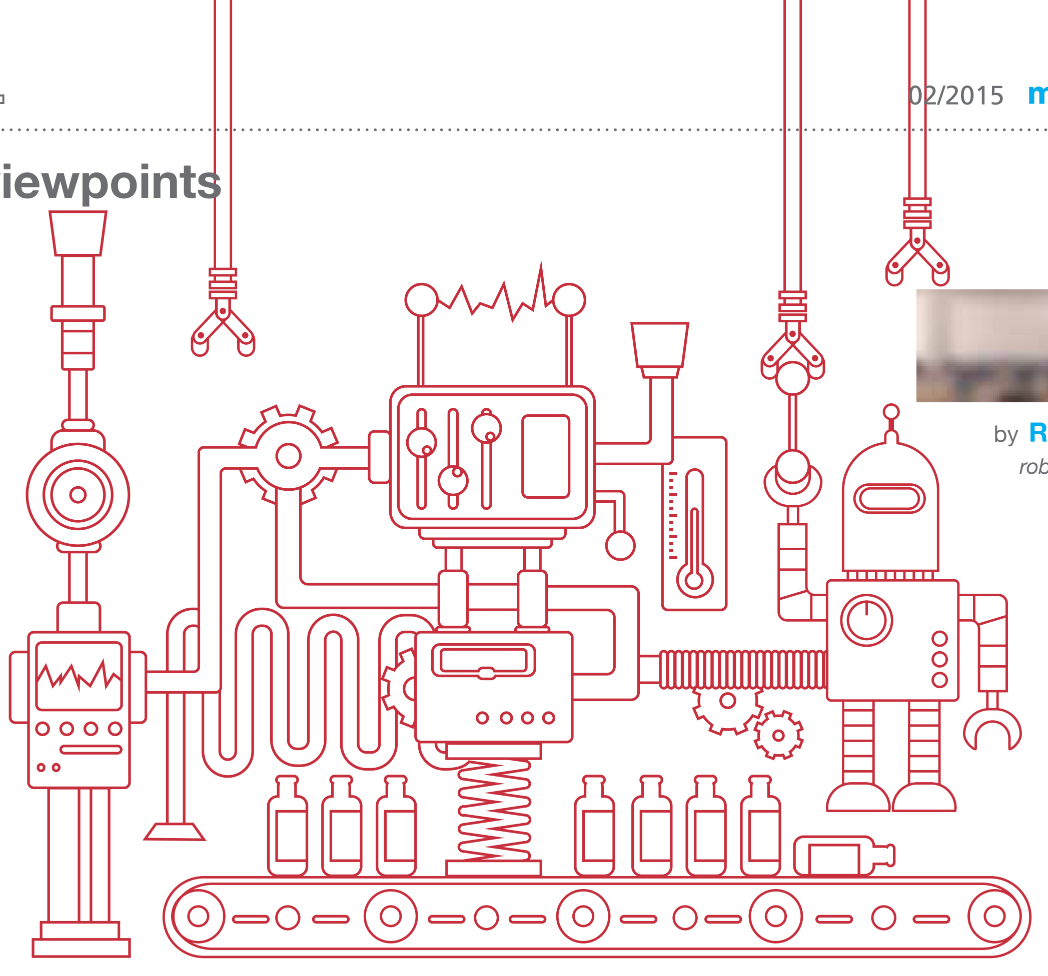
Healthcare



Agriculture

Source: IoT Technical Working Group, 2014;, Total respondents, N=41

viewpoints



by Robert C.V Tai
robert@might.org.my

Collaborative Robots, the Rise of a New Generation

Robotics has come a long way since the dawn of IRB-6 by ASEA (now known as ABB) in 1975. Being the world's first fully electrically-driven and microprocessor-controlled robot, the IRB-6 was the epitome of the robotic world then, and has since paved the way for a new industry of industrial robots to emerge. Four decades on since IRB-6, what has changed?

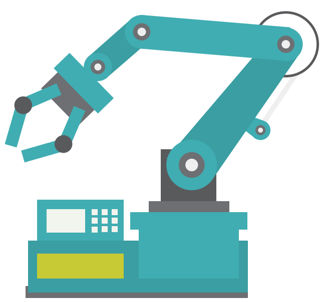
Just about a decade ago, industrial robots were not much different from IRB-6 except for increased payload performance, higher accuracy, more computing power, and greater dexterity. They still possess limited intelligence, are insensitive to the environment that they operate in, are very expensive, and they require specialists to programme, operate, and maintain them.

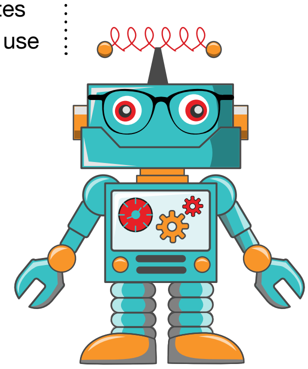
Until recently, industrial robots were confined within cages to ensure the safety of human operators who also share the same workspace as them. Safety was, and still is, a major cause of concern mainly because of the immense force that industrial robots can exert, and their limited ability to sense and be aware of the environment in which they operate in.

As industrial robots evolve, there is a growing need for human operators to work freely and in close collaboration with them in order to increase production efficiencies and to expand the robots' role in the manufacturing process. In such a collaborative mode, the ability for robots to sense human activities within its operating environment in real-time and to react accordingly, becomes a crucial safety requirement.

With the advent of new technologies such as vision systems, artificial intelligence and advance sensors, industrial robots can now be configured to work collaboratively with their human counterparts in the same working environment without the need for a protective barrier. However, the way industrial robots are being applied in a collaborative mode needs to be governed by international safety standards such as the ISO/TS 15066 which dictates strict rules and guidelines for the use of sensing technologies and the way industrial robots are configured.

To further improve the safety of industrial robots, they are now being equipped with force torque sensors that detect impacts or abnormal forces. These force torque sensors will automatically stop the movement of the robotic arm upon detecting a possible accident with human operators. The force limiting device will ensure that only a minimal amount of force is being exerted onto the person. So, even if an accident is unavoidable, it won't cause serious injuries. Such robots are termed 'force limited robots'. Coupled with other environmental sensing and safety technologies, a new generation of collaborative robot has been born, and is generally referred to as 'cobot'.





Old Generation	New Generation (Cobots)
Blind and unaware of surroundings	Sees and understands people and the environment which it operates on
Dangerous	Safe
Compete on precision and repeatability	Focused on flexibility and ease of use
Task must be restructured for that solution	Task done just as a human does it
Requires external components and integration	Fully integrated and self contained
Requires expert programmers	Can be trained by ordinary people
Expensive	Unbelievable inexpensive

Source: HumaRobotics

Diagram 1.0: Comparison of cobots against the traditional (old) generation of industrial robots

The ability for robots to sense human activities within its operating environment in real-time and react accordingly becomes a crucial safety requirement.

In contrast to the run-of-the-mill industrial robots, cobots are much smaller, lighter, more agile (degree of freedom), safer, easier to operate (programme), and cost significantly less. That said, cobots' payload capacity is relatively lower (around 3kg), hence they are more suitable for lighter tasks. The fact that cobots are specifically designed to operate in close collaboration with humans within a human-centric environment, the potential for their applications beyond the traditional industrial (or manufacturing) environment is tremendous.

Most importantly, the cost of adopting robotic solutions to a given problem has since been reduced significantly with the introduction of cobots. A typical cobot system now costs around €30K, which is relative affordable to most small and medium-sized enterprises (SMEs). With the lower initial investment and a shorter payback period, the adoption rate is set to accelerate as cobots move beyond the current stage of 'early adopters' and into the next stage of 'early majorities' in their technology adoption lifecycle.

Within the manufacturing environment, cobots complement the existing applications of industrial robots by fulfilling processes that are traditionally manned by human operators. Diagram 2.0 illustrates this new role of robots in the manufacturing process.

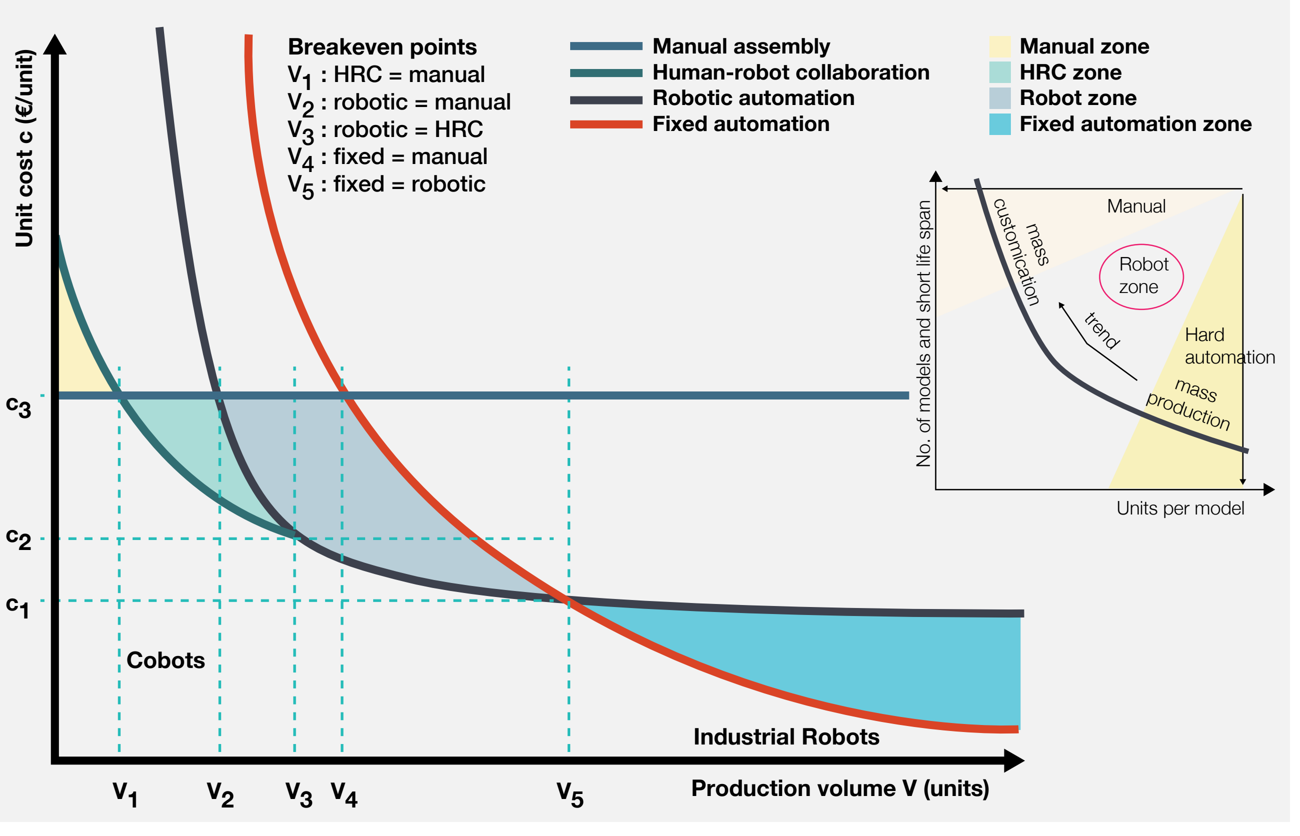


Diagram 2.0, new trend in the application of robots in the manufacturing process.

The trend of industrial robots is to fulfil the automation gap between mass production and mass customization. Mass work for products with high-volume and low unit costs such as newspaper printing and the bottling of soft-drinks will continue to be manufactured by hard automation machineries. Towards the other end of the spectrum is mass customization where every product being produced is unique to the requirement of individual customers. Mass customization processes are traditionally operated by human operators as they have the dexterity and intelligence to perform the required tasks. The production volume of mass customization processes are generally low and the per-unit-cost is usually high.

Industrial robots have traditionally been applied to operate near the mass production spectrum where the focus is to leverage on the repetitive nature of robots to mass produce complex parts and assemblies at relatively low cost. Until the arrival of cobots, the production of highly-mixed and highly-complex parts and assemblies were mostly fulfilled by human operators. With its agility, fast change-over, easy-programmability, and collaborative nature; cobots have given industrial robot manufacturers the opportunity to expand the role of robots towards the production of highly complex and customized products alongside human operators in the HRC-Zone (see Diagram 2.0).

By applying robotic automation towards the mass customization spectrum, manufacturers' reliance on manual labour can be reduced whilst quality is maintained and productivity improves. Future manufacturing facilities will see cobots scattered around production lines, working hand-in-hand with human operators, while heavier industrial robots will continue to perform what they do best – repetitive, dangerous, and heavy lifting tasks.

"With the advent of new technologies such as vision systems, artificial intelligence and advance sensors, industrial robots can now be configured to work collaboratively with their human counterparts in the same working environment, and without the need for a protective barrier.

Beyond the factories, robotic technologies are now flourishing in a wide variety of form-factors and across different fields of applications. Besides industrial robots, service robots are set to grow significantly in the near future, especially in key markets like Japan. A service robot is a new form of robot that performs useful tasks for humans (or equipment), as defined by the International Federation of Robotics (IFR). They normally operate in an unconfined and often human-centric environment, to provide services for either personal or professional applications. Examples are domestic servant robot, automated wheelchair, and rehabilitation robots.

Having evolved from the time-tested and trustworthy industrial robots, many technologies associated with cobots can be extremely applicable in service robots. Cobot's high agility, contact sensitive, and force limiting features will be the prerequisites for service robots to operate in a human-centric environment. Where safety is paramount, vision system deployed in cobots for environmental sensing and collision avoidance can be applied to prevent unintended accidents and injuries.

The evolution of industrial robots into their current form is not by accident, but by the necessity of improving safety and increasing productivity. Touted as the next generation of industrial robots, cobots are set to push the technological envelope in robotics, and expend robotics into non-traditional applications such as professional services and consumer electronics. Although the application of cobot as a robotic product may be limited to the manufacturing shop-floor, its technologies are applicable across different types of robots and applications. Irrespective of how industrial robots will evolve, cobots and their associated technologies are likely to play a catalytic role today in expanding robotic technologies beyond the manufacturing plants, and into our everyday lives.

• viewpoints

by YBhg Datuk Khalilur Rahman Ebrahim
Executive Chairman,
System Consultancy Services Sdn Bhd

Rebooting ROBOTICS

When George Lucas introduced R2-D2 and C-3PO to the world, little did he realise the effect he would have on generations after. Much like how the communicator devices in Dick Tracy and Star Trek inspired the mobile phones we hold in our hands today, we are ever inching forward towards a time where the visions from science fiction are becoming reality. Moreover, the field of robotics is no longer confined to just humanoid looking androids; it exists in our everyday lives in various forms, sometimes in less obvious (and perhaps less threatening) roles. For example, using a different perspective, CCTV is the 'eyes' of a robot that is widely used for security and surveillance purposes. In homes, instead of having a vacuum cleaner handled by a person, there is already robot that could do the cleaning on its own. These technologies are robots – with data collection and, to a certain degree, intelligence behind it.

Malaysia is second to none when it comes to adopting technology. We are among the most advanced in literacy among our neighbouring countries. We are also, in some ways, ahead compared to certain developed countries in the world in terms of infrastructure. However, Malaysians are sometimes hindered by our own culture. As much as we love technology, are we using it right?

REDEFINING ROBOTICS IN A SOCIAL SETTING

Robotics can play various roles to keep us safe; as watchful tools and systems to prevent and respond to crime and threats. In the case of the London bombing, the authorities were able to utilise information gathered via various devices and systems as sources of evidence. These inputs are bias-free and precisely recorded in real time resulting in immediate apprehension of the culprits. During the tsunami in Japan, both public and authorities utilised mobile devices in spreading information and aids to the victims. In the recent flood in the East Coast, social media was faster than radio and TV in reporting situations on the ground.

Malaysians love social media. (To be fair, the whole world does so much so that Google has patented plans for a software robot that can learn how you react and then mimic and suggest responses to help people cope with their social media load). But Malaysians, for the most part, love to share 'live' happenings, particularly crime and incident related, to their peers and families, resulting in the fast and vast spread of unverified news. As a result, we get a constant flow of 'live reports'; some true, but most are either biased, presumptuous or outright hoaxes to incite the public. How can the public tell the difference? For example, 'kidnappings' that turn out to be marital disputes, or posted images of alleged 'robbers' that turn out to be random citizens? And who will update, in the case that the events are indeed true, that the perpetrators are caught or the case solved? There have been cases where missing persons reports continued to be shared via social media months after the person have actually been found.

However, acknowledging the advancement of mobile technology and the power of the public, we can always turn our disadvantages to more positive uses. For example, the RakanCop mobile application that encourages the community to be part of public policing to help combat crime in the nation could be an effective way of encouraging public awareness and quick response. The public now have a platform that will directly connect them to the authorities;

namely the police, to immediately report crimes that happen to them or others. Such a platform is meant to be simpler, straight forward and less time-consuming compared to the usual reporting process at the police station, in order to encourage the public to be the eyes for the cops and keep the criminals at bay. An application such as this on the public front, combined with technologies on the law enforcement side, can also help to reduce response time and help provide first-hand information and evidence. We could gain much benefit by leveraging on robotics, especially with regards to our own safety and response to crime, perhaps up to the level where enforcement of law is enhanced in ways we never thought possible. A mobile (or CCTV) picture of the scene, after all, could be worth a thousand words.

> **The field of robotics is no longer confined to just humanoid looking androids; it exists in our everyday lives in various forms, sometimes in less obvious roles.**

MANUFACTURING, SAFETY AND SECURITY

Industrial manufacturing robots provide many benefits that companies require to stay competitive. There are repetitive jobs that the robots can cover more efficiently compared to manual labour. In fact it is impossible to manufacture advance devices like mobile phones without robots. The miniaturised components cannot be handled by humans without the assistance of robots. In medicine, robots are extensively used to perform surgery, imaging and analysis. In Malaysia's foreign labour case, industrial manufacturing robots could reduce national capital outflow. Industrial manufacturing robots do not require an hourly wage, holidays or training. Other than the cost of maintenance, a company pays for a manufacturing robot once. The initial cost of an industrial manufacturing robot can seem daunting, but the return on investment (ROI) can quickly be realized after implementation.

Robotics or automation can also be crucial in security services, where 'dull' and 'dangerous' could interchange in a split second. Mobile robots today can autonomously make surveillance tours within the premises, detect and interact with humans appropriately, carry sensors to detect toxins or smoke, and connect to central systems for regular reporting and alerts.

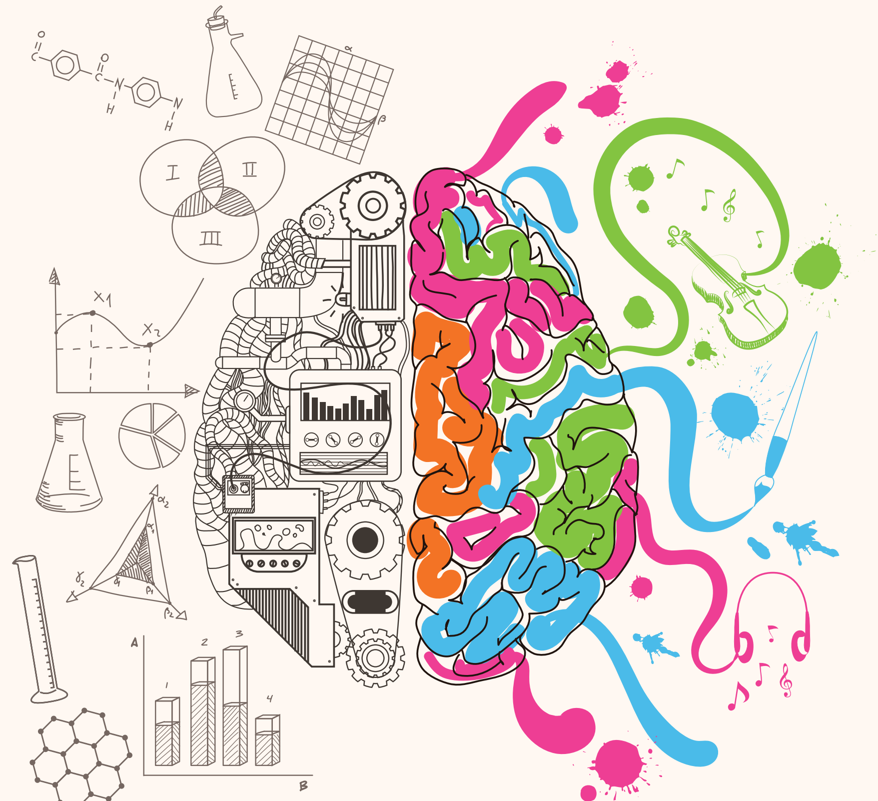
Even in defence, robotics such as AGV (Autonomous Ground Vehicles), UAV and drones play significant roles in improving our results and response time against threats. UCAVs are the weapons of choice in the recent conflicts by advance nations. Around the world, the utilisations of remote reconnaissance robots to test conditions, structural integrity or provide intelligence in various environments are now all too common. It is no longer a question of technology catching up with our needs; the robots are able and ready. Are we willing to adapt and adopt?

A POSSIBLE FUTURE FOR MAN AND MACHINE

In order for Malaysia to move forward with robotics in any industry, we have to build our competitive edge by capitalising on our unique strengths – a united and multi-racial society, a good education system and English literacy, well equipped infrastructure and skilled human capital. Most importantly, we need to develop this competitiveness from within. For that, we need to have the right policies to encourage Malaysians – students and the industry players alike – to venture further into this sector and invest in our own country and, therefore, our own future. We should change our mind-set in order to support local productions to ensure continuous sustainability of the industry. Local manufacturing, training and services should benefit the nation in the long run and it should be the main thrust in respective policies. We may look at Japan, China and Korea where people prefer to use products that are locally produced instead of imports, their actions have helped boost their economy and develop strength among their people as examples. Of course, changing people's mind-set is not an overnight process, but such a mind-set shift could be a game-changer to Malaysia, now more than ever.

However, as surely as the field of robotics continue to grow, we must not forget our role and purpose. The man in the loop is also critical behind the technology to maintain and keep them checked and in line. Robotics, in whatever shape or form, should be our complement, not our replacement. At the end of the day, robotics may become our super-enhanced eyes, ears and limbs; but good level human 'heads' are still needed to interpret all that data into intelligence and positive actions. After all, robotics is here to stay. And as much as we strive to develop robotic technologies to be better than humans, let us not forget to be better and responsible humans too.

by myForesight Analytics



ROBOTICS ROADMAP

– Tracing and Planning the Development of Robotics Technology

Robots that were originally introduced to assume 'dirty, dull, and dangerous' jobs, have now been in commercial use for 50 years. The adoption and development of robotic technology is driven by the demand for increased economic productivity, the desire to improve quality of life, and the need of security forces and agencies.

Although robotics technology has developed tremendously in several other countries such as Germany, Great Britain, Japan, etc., USA is still recognised by many as the pioneer and considered as one of the most advanced in robotics field. Therefore, any attempt to trace or plan the roadmap of robotic technology, particularly for a developing nation like Malaysia, may have to look at the US Robotics Roadmap as referral.

What is US Robotics Roadmap, when and how was it developed, and what were the factors taken into consideration?

In 2009, the Computing Community Consortium and the Computing Research Association, spurred by technology developments enabling the application of robots beyond traditional manufacturing uses, sponsored a group of leading US academic robotics researchers to create a technology roadmap for robotics. In 2013, researchers from many of the same institutions, working with industry users and government program managers in a project sponsored by the Robotics Virtual Organization (VO), updated the roadmap. Five workshops were held. Each workshop focused on a different application area. The areas of examination were:

- Business and application drivers of robotics growth
- Technology gaps that must be filled to deliver solutions to robotics users
- Basic research required to fill those gaps

The output of the workshops offered a preferred future for robotics in each area. Three most important application areas are manufacturing, health and medicine, and service.

In the capability roadmap, the report offered examples of possible five-, ten-, and fifteen-year milestones for each identified robotics capabilities.

ROBOTICS FOR MANUFACTURING

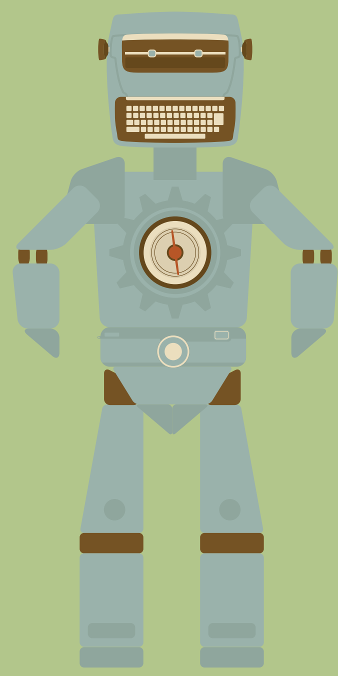
Although manufacturing accounted for 14% of US GDP and 10% of employment, the US balance of trade in manufactured goods was dropping at the rate of $50 billion per decade. According to the Robotics VO roadmap, robotics has the potential to make US manufacturing more cost competitive and more flexible; create jobs and improve working conditions; and facilitate the repatriation of manufacturing activities.

Why robotics for manufacturing?

Both economic and technical needs are driving the growth of manufacturing robotics.

- Development of robotic manufacturing technology is essential to maintain the US global lead in worker productivity but Korea, the EU, and Japan each invest more than the US non-defence budget for robotics, manufacturing, and related research.
- Aging workforce: the ratio of workers to retirees will continue to fall, and the supply of workers will be increasingly limited. Robotics can make up for some of the gap in skilled employees by making employees more productive.
- Next-generation products with embedded computers and sensors will require microscale and nanoscale assembly that human workers cannot perform.
- Vignettes from the Robotics VO roadmap illustrate attractive use cases for manufacturing robotics.
    - A robot-assisted auto assembly line could be rapidly reconfigured to accommodate model changes and changes in parts specifications.
    - A robot working in a small-job shop with five human employees could quickly manufacture custom, one-of-a-kind medical devices — following instructions, operating tools and machines, cleaning up spills, and asking for assistance when instructions are unclear.

Key Findings



- Robots have the potential to improve manufacturing productivity; support the repatriation of manufacturing; make healthcare more available, effective, and affordable; and provide assistance at work and at home.
- Substantial developments in robotic technology will be required to drive applications from the controlled environment of the factory floor to unstructured, dynamic environments like healthcare facilities and the home.
- New capabilities will be required in many areas— including human-like dexterous manipulation; sensing and perception; human-robot interactions (HRIs); understanding of human behaviour; navigation and planning; cognition; learning; and safety.

Capabilities roadmap

To fulfil its potential for manufacturing, robotics will require a variety of critical new capabilities.

Robotics capability in manufacturing	Milestone		
	Five-year	Ten-year	Fifteen-year
Adaptable and reconfigurable assembly	Set up and program basic robotic assembly line operations in 24 hours.	Set up and program basic robotic assembly line operations within an eight-hour shift.	Set up and program basic robotic assembly line operations in an hour.
Autonomous navigation will be required as robots deliver raw materials and parts for manufacturing, and handle distribution and logistics throughout the supply chain.	Autonomous vehicles operate safely in modern, well-lit cities and construction zones.	Autonomous vehicles have limited off-road capabilities and cope with unanticipated behaviour by other vehicles.	Autonomous vehicle capabilities will be indistinguishable from those of an experienced human operator.
Human-like dexterous manipulation	Low-complexity hands demonstrate “robust whole-hand grasp acquisition.”	Moderate-complexity hands allow grasp acquisition and “limited dexterous manipulation.”	Complex hands grasp and manipulate objects now commonly encountered or used by human workers in manufacturing settings.
Perception for unstructured environments. This will allow robots to function in more flexible manufacturing situations, e.g., when moving between locations and tasks, doing custom work, or interacting with human workers.	The ability to function in an unstructured environment typical of small-scale batch manufacturing.	The ability to function in small lot manufacturing	Perceptive capabilities that enable one-of-a-kind manufacturing.
Ensuring safety when robots work with humans is essential, but will require “democratization” of robots—making robots attractive and available so that they are integrated into society and so that reasonable risks and responsibilities of working with robots become accepted.	Broadly implemented, easily programmed safety functions for fixed and mobile factory robots.	Robots respond automatically to expected and unexpected human behaviours in the workplace.	Systems recognize and adapt to human behaviours in unstructured environments

The report also offered milestones for green manufacturing, model-based integration and design of supply chains, nano-manufacturing, and robotics training.

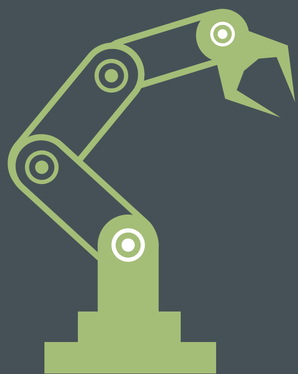
ROBOTICS FOR HEALTH AND MEDICINE

The need for robotics in health and medicine is motivated broadly by three overarching factors: the need to improve access to healthcare, the need to improve outcomes, and the need to focus on prevention.

Why robotics for health and medicine?

Underlying drivers include aging population, the increase in chronic diseases, the need for personalized care (e.g., for stroke patients or those diagnosed with autism), and the increase in cases of lifelong dependency on healthcare. Improved healthcare could enable elderly and disabled individuals to contribute, or continue to contribute, to the workforce. Robotic technology has the potential to improve:

- Healthcare **access**, e.g., through the use of telemedicine to



Robotic Hands

DARPA recently demonstrated a three-fingered, robotic hand that can unlock and open a door, pick up a laminated card from a tabletop, and grip a 50-pound weight. When fabricated in batches of 1,000 or more, the estimated cost per hand is US$3,000 — an order of magnitude lower than robotic hands with similar capabilities have cost in the past. Part of the savings comes from the fact that the system uses off-the-shelf sensors from the Microsoft Kinect system "to zero in on the object's location before moving in to grab the item." The hand still requires a human operator, though the eventual goal is to create an autonomous system.

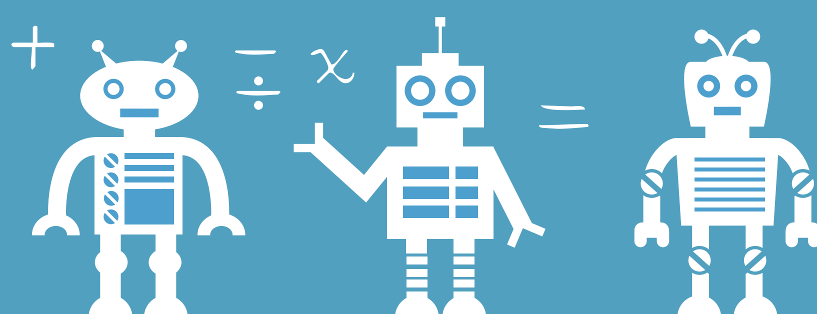
extend access to underserved or inaccessible sites.

- Healthcare **affordability**, offering better cost-benefit ratios and leading to improved productivity of the general workforce.
- Healthcare **quality** including better risk-benefit ratios, less-invasive procedures, and fewer side effects.

The Robotics VO Roadmap suggested a variety of potential applications of robotics in health and medicine, some of which has been implemented:

- **Surgery** in which robots extend the physical capabilities of surgeons and execute pre-planned procedures. For example, a surgeon could use a miniature robotic surgical instrument, along with imaging technology, to reach and remove cancerous tissue from an internal organ.
- **Replacing lost function** such as via intelligent orthotic and prosthetic devices. For example, a prosthetic arm and hand might offer control through a brain-machine interface and provide force, texture, and temperature feedback to a patient.
- **Recovery and rehabilitation** in which robotic systems provide sensory-motor therapy to stroke victims; this could include dynamic interactions such as personalized motivation and coaching based on real-time sensor data.
- **Behavioural therapy** provided by socially assistive robotics, e.g., supervision, coaching, and cognitive exercises to assist the growth and development of a child with an autism spectrum disorder.
- **Personalized care** for the aged or other populations with special needs, e.g., promoting aging in place, offering companionship, and helping to delay the onset of dementia.
- **Health and wellness promotion**, in which robotics can play a role along with computers, wearable devices, and in-home sensors, e.g., to assist and motivate a diabetic user to exercise, eat properly, and conduct daily blood-glucose monitoring.
- **Research**, e.g., data-gathering or simulation of biological systems.

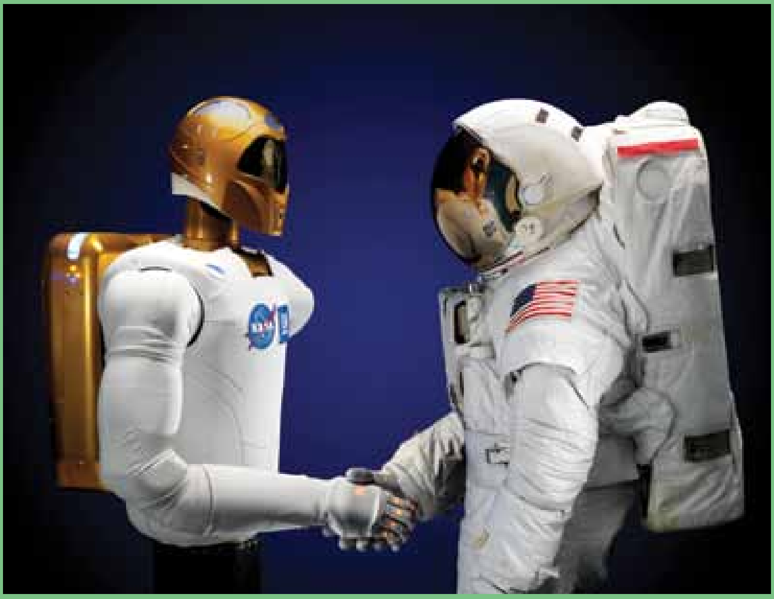
Education for Robotics



To make the most of the upcoming revolution in robotics technology need robot-savvy workers at all levels — from trained robot operators, to engineers who design robotic equipment, to researchers who develop new theories. Developing such a workforce will require establishing new robotics programs at the secondary, university, and graduate levels.

To take full advantage of manufacturing robotics, it is important to design products from the beginning to take full advantage of automated manufacturing. Thus both education and on-the-job training in design for manufacturing and design for automation will also be essential.

Understanding Human Behaviour



Natural interaction between humans and robots requires that the robots be able to assess and interpret the emotional state of their human counterparts. This is especially important in healthcare where the emotional state of the patient may be fragile and supportive emotional interactions can have a major impact on outcomes.

Understanding human behaviour requires the integration and modelling of data from sensors on the robot, on the humans, and in the environment, including data about facial expression, voice, bodily motion, and physiology. The robot must be able to sort out conflicting information, e.g., between tone of voice and facial expression.

Progress in this technology will enable robots to interpret human behaviour from smaller numbers of less obtrusive sensors in environments that are increasingly unfamiliar and dynamic.

– Image: Arenamontanus (Flickr)

CAPABILITIES ROADMAP

Many new capabilities will be required for robotics to fulfil its potential in health and medicine.

Robotics capability in health and medicine	Milestone		
	Five-year	Ten-year	Fifteen-year
Physical human-robotic interaction places stringent demands on the basic abilities to sense, perceive, and act.	“More effective two-way exchange of information and energy between the human and the robot.”	Intuitive, transparent interfaces.	Robot assistance that enables human performance beyond ordinary human limits
Effective **social interactions** between people and robots will require sophisticated understanding and use of complex behaviour patterns.	Autonomous one-time or short-term HRIs in specific domains following appropriate norms.	Longer interactions in broader domains, including “prescribed intervention/ therapy within precisely specified domains.”	Multiple interactions in broad domains, with behaviour that adapts to changes over time.

Context-appropriate guidance and variable autonomy will allow robot and user to work together in a flexible command hierarchy.	HRIs in controlled environments with a fixed command hierarchy, in which the human makes the high-level decisions.	Integrated systems in which roles shift based on command decision or the nature of the task.	"Context-driven variable autonomy" in unstructured environments, e.g., support of the activities of daily living for a patient at home.
Information map–guided interventions will integrate robotic surgical activities with a "map" of all available data, especially three-dimensional imaging data.	Robots that are compatible with ultrasound and MRI and allow robotic procedures to be carried out during imaging.	Information maps updated from real-time data and surgical databases; interfaces that effortlessly connect the surgeon to both the information map and the robot.	Control systems that understand surgeon intent; "automated surgical assistants that use fully real-time image-to-model generation."
High-dexterity manipulation will enable minimally invasive surgery with flexible, snake-like, dexterous robotic probes. Increased dexterity will also enable assistive robotics.	Simple abdominal endoscopic surgical procedures via the stomach. The endoscope would be inserted through the mouth into the stomach; make a small hole in the stomach to reach the site of the abdominal surgery; complete the primary surgery; and repair the stomach on the way out. Robotic endoscopic surgery of this type within the stomach has already been demonstrated.	Highly dexterous snake-like robots and tetherless, centimeter-scale surgical robots.	"Groups of tetherless millimeter- and micron-scale robots" that drill through tissue or navigate blood vessels to perform surgery where needed.

The Robotics VO report also provided milestones for robot-mediated health communication; automated understanding of human state and behaviour; quantitative assessment, diagnosis, and training; models of individual users; sensor-based, automated acquisition of health data; and robot safety.

ROBOTICS FOR SERVICE

Service robots assist people at work, at home, and at leisure. Professional service robotics support workplace tasks in "agriculture, emergency response, pipelines, the national infrastructure, forestry, transportation, professional cleaning, and various other disciplines." There are currently more than 110,000 professional robots in service. In contrast, personal service robots help at home, offer leisure fun, or help individuals with physical or mental limitations. The largest categories are vacuum cleaners (more than 6 million iRobot Roombas sold) and leisure robots (more than 4 million sold). Despite early success, "applications and solutions incorporating full-scale, general autonomous functionality" are likely 10–15 years in the future, though more limited applications are ripe for current development.

Note that the service robotics category overlaps with both robotics for manufacturing and robotics in health and medicine.

Why robotics for service?

Aging is an important driver for the development of service robotics. Professional service robotics will effectively multiply the shrinking workforce in developed nations like Japan, supporting economic growth, while personal service robotics will enable and extend personal independence and function. In addition to healthcare and manufacturing, the most important markets for professional and personal service robotics will be:

- **Workplace assistance** beyond manufacturing. For example, in the field of agriculture, automated crop spraying and harvesting have been prototyped; Caterpillar is developing

Modeling Users

Each patient is unique. It is especially important in healthcare applications that robots build models of each individual with whom they interact. Moreover, these models must be continually updated as the patient's health status changes. Successful modelling will require gathering data from sensors in the environment as well as patient data from external sources such as healthcare records, Internet databases, and patient self-tracking.

Interpreting the data will require the robot to deal with the messiness of incomplete data, data from multiple sources, data from multiple sensory modalities, and data that change over time.

autonomous haul trucks for mining operations.
- **Energy and the environment** including automated energy exploration and automated environmental monitoring. For example, Shell has already begun using UAVs to assist in oil exploration in the Arctic.
- **Automotive and transportation** including driver assistance, automated public transit, autonomous personal and fleet vehicles, and smart highways.
- **Homeland security and infrastructure protection** including automated inspection and maintenance of bridges, pipelines, and other critical infrastructure; for example, robots are used to automatically inspect and image wastewater systems.
- **Entertainment and education** especially in inspiring students' interest in science, technology, engineering, and mathematics.

It is interesting to note that service robotics represent a natural extension of the Internet from sensing at a distance to acting at a distance.

Drones in Agriculture

Robots are already making an impact in agriculture.
- Yamaha introduced an unmanned helicopter for crop spraying in 1990. By 2010, 30% of Japan's rice fields were sprayed robotically by drone aircraft.
- CropCam is "a radio control (RC) glider plane equipped with a Pentax digital camera, controlled by an autopilot along with pre-programmed ground control software," and useful for aerial surveys in agriculture, forestry, and other applications.

CAPABILITIES ROADMAP

If service robots are to meet their potentials in professional and personal settings, sophisticated new capabilities will need to be developed.

Robotics capability in health and medicine	Milestone		
	Five-year	Ten-year	Fifteen-year
Mobility and manipulation require the robot to integrate physical movements with perception, control, and cognition.	Navigate and perform pick-and-place operations in unstructured 2D environments; create or learn semantic maps (maps with description of included places and objects); undertake reasoning of moderate complexity.	Plan and execute tasks when starting from limited knowledge of the environment; build knowledge of the environment; modify the environment to accomplish tasks; detect and recover from some failures.	Function in novel, unstructured environments using map-building, exploration, planning, environment-modification, and reasoning.
Real-world planning and navigation. Robotic systems will tackle problems associated with coordinating and optimizing robot fleets, where the current state of the art is fleets of 1,000 to 10,000 units completing 10,000 to 100,000 tasks per hour.	Planning and control algorithms will take into account statistical uncertainty in the parameters describing the system of which the robots are a part.	Robots use sensor readings to determine how and when to update their "underlying statistical model" and plans, enabling "loosely supervised operation for periods of months." When service robots face a situation that requires re-planning, machine learning allows them to take advantage of planning done previously by other fleet members.	"Large, efficiently searchable repositories of robot plans shall become available on a planetary scale."

Cognitive abilities will need to allow robots in "non-engineered environments" to learn new skills as users demonstrate them, acquire new models of the environment, and interact with users.	Learn skills through gesture and speech recognition.	Learn complex sequences from users; recover from simple errors.	Recognize human intent and adapt skills to assist the user.
Perception skills must be extended from geometry, object recognition, and semantic understanding to more complex properties of objects and environments, such as "object affordances"—what a robot can use an object for.	Service robots integrate environmental information over time and "perceive task-relevant characteristics" of many types of objects.	Basic perception in dynamic environments, including the capability to perceive human activities; learning and adaptive capabilities that enables operation over extended periods.	Service robots integrate several sensory modalities to build models of novel environments and operate effectively over long periods in dynamic, cluttered spaces.
Physical, intuitive HRI and interfaces must allow interaction with the service robot by those with little or no training	The ability to train robots for simple tasks using "multimodal dialog" such as speech and physical movement/ gestures.	Demonstrate programming by demonstration for complex tasks like meal preparation.	Demonstrate operator programming for complex missions in a time comparable to the length of the job.
Skill acquisition will be accomplished through a variety of strategies.	Robots will be able to learn basic skills by observation, trial and error, and demonstration and make minor adaptations.	Acquire more complex skills, combine skills, and match applicable skills to specific situations.	Continuously acquire and improve skills and transfer them across tasks and situations.

Apart from technological advances, successful utilisation of service robotics also requires appropriate government regulations, industry standards, independent certification processes, and consideration of liability issues.

BASIC RESEARCH PRIORITIES

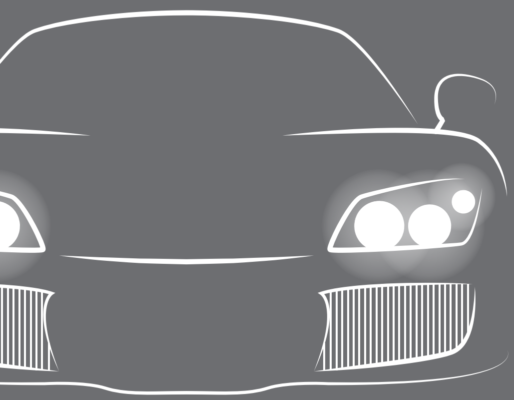
While the three broad uses of robotics reviewed offer distinct sets of specific applications, it should be clear by now that there is considerable overlap among the lists of capabilities required to enable those applications. Developing those capabilities will require progress in a number of fields of basic research — fields that apply across manufacturing, health and medicine, and service robotics.

- **Architecture and representations.** Robot operating systems must integrate low-level perception-action functions with high-level cognition. They must also allow for representations of environments, skills, and people; for reasoning and learning; for social interaction; and for failure recovery. Until today, there is no universally accepted architectural framework for such systems.
- **Control and planning.** Issues including the control of physical contact and force for medical robots, control of systems with many degrees of freedom, and planning in dynamic and uncertain environments that include human interaction and sensor feedback.
- **Formal methods.** Mathematical methods for specifying, developing, and verifying systems can aid in integrating robot systems, verifying safety, and modelling HRI. Reducing costs and expanding frameworks to more complex systems would encourage wider use of formal methods.
- **Learning and adaptation.** Robots must be enabled to learn by teaching, demonstration, and imitation. In manufacturing, more sophisticated learning could reduce the need for expensive engineering of the robot's working environment.
- **Modelling, simulation, and analysis.** The development of sophisticated robotics requires models of engineered systems, especially manufacturing systems as well as models of human physiology and behaviour.
- **Novel mechanisms and high-performance actuators.** Developments will extend beyond mechanical performance to enable

Robotic Wheelchair

Researchers at CHIBA Institute of Technology have prototyped a robotic wheelchair capable of negotiating obstacles such as curbs and some steps. The user directs the chair with a joystick; the chair automatically sizes the obstacle, redeploys wheels for use as feet to make the climb, and keeps the user level during transit.

Autonomous Vehicles



Numerous high-profile efforts are developing technology for self-driving cars. Advocates cite safety as a primary benefit. But consumer acceptance may be a bigger barrier than technology.

Both consumer acceptance and development of appropriate regulations may begin with driver-assistance technologies such as out-of-lane warnings or automatic braking when a crash is imminent.

operation at the microscale and nanoscale, materials compatibility with magnetic resonance imaging (MRI), safety improvements, and challenging human-augmentation applications.

- **Perception** will be a key skill as robots must learn to operate in unfamiliar environments and with unfamiliar objects. Robots will also need to understand human perception in order to communicate effectively, and to perceive and understand human activity in real-time.
- **Robust, high-fidelity sensors and measurement science.** Important development fields include "bio-compatible/implantable sensors, force/tactile sensing, and sensors that allow tracking and navigation." New sensors need to function well in difficult, changing environments, e.g., situations with low or variable light.
- **Physical HRI.** As robots interact directly and physically with humans, important design criteria should include safety and function that appears natural. For example, haptics technology should make the robot "transparent" to a user performing surgery remotely.
- **Socially interactive robots.** This area may present some of the most difficult technical challenges. Humans and robots must be able to understand and interpret one another's behaviour and intent. This requires bidirectional interaction through verbal and nonverbal communication channels. A full span of social interaction is required if robots are to be adopted long-term. For example, healthcare robots must be able to "obtain the user's trust and sustain the user's interest."
- **Measurement science.** Measurement methods, reference data, and standards are crucial to technical progress.
- **Cloud robotics and automation for manufacturing.** Cloud robotics makes use of cloud computing to assist robots by storing maps and images, performing complex modelling and planning, sharing information and experience between robots, and providing human guidance when requested.

BUSINESS IMPLICATIONS

- The clear trajectory is for robots to move from controlled, carefully engineered settings on factory floors toward less structured settings in which they will interact more often and more naturally with humans. Businesses of all kinds should begin to envision a future when robots will likely play a role in settings outside manufacturing and to consider what this will mean for their operations.

- The proliferation of robots in health, medicine, and service applications could create consumer backlash just as automated call-response systems have generated cries for the return of knowledgeable human customer service representatives. Businesses considering the application of robots in human-contact applications must carefully consider whether consumers are ready to accept them and what factors in robot design are most important in increasing consumer acceptance.

- Businesses that operate automated voice and online systems for customer interaction should consider whether developments in robot social-interaction technology could improve automated customer service.

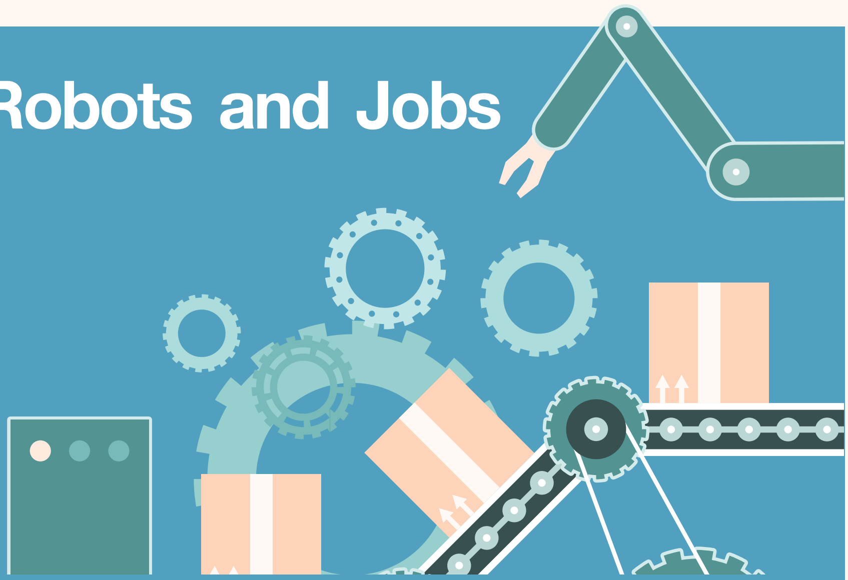
- Robots that function on the microscale and nanoscale will make it possible to manufacture products that humans are unable to assemble. Manufacturers will have the opportunity to consider a broader range of designs when planning new products.

- When manufacturers acquire new production capacity, they will face difficult choices: They may be better served if they choose robotics over traditional infrastructure because robotics can be more flexibly repurposed for new products and become obsolete less rapidly. However, as robotic technology is rapidly developing, the robots themselves could be outpaced by new designs in relatively short order. Additionally, companies that "employ" robots will be open to criticism about displacing workers.

- The expansion of robotic applications in health, medicine, and service depends heavily on the development of new capabilities in human-robot interaction. Researchers and businesses with new discoveries and technologies to offer in this arena will find an eager audience.

- Robotics has the potential to deliver customization and personalization of goods through more flexible manufacturing

Robots and Jobs



Do robots create or destroy jobs?

Several recent commentaries suggest that automation overall is responsible for decline in available jobs, though this view has been criticized as short-sighted. Gudrun Litzenberger, General Secretary of the International Federation of Robotics (IFR), citing a recently updated IFR report, argues, "Certain jobs may be reduced by robotics and automation but the study highlights that consequently many more jobs are created!" (It must be noted that the newly created jobs often require different skills than the jobs lost.)

Meanwhile, a recent report from the UK's Royal Society for the Encouragement of Arts, Manufactures, and Commerce estimated that onshoring of jobs, or decisions not to move jobs offshore, could add 100,000 to 200,000 jobs to the UK economy over the next 10 years. One of the co-authors of the report said that absent the impact of robotics, the number would be closer to 300,000.

and logistics, as well as to deliver professional services in healthcare and other arenas. Robotics could even provide consumer experiences — by understanding and adapting to the dynamic needs and situation of the people with whom the robot is interacting, e.g., by configuring an automobile interior or office space to meet the current needs of the occupants.

- As the use of robotics in healthcare has the potential to help control the growth of healthcare costs, demands for work in this area will likely increase.

- Sensing and perception technology that is being developed for robotics for manufacturing, health, and service applications (for example, the technology to understand human emotions and intentions) will also find application in public safety and national security. The use of this technology in any context will heighten privacy concerns which will shift from "who is watching me, and when?" to "what are the capabilities of those who are watching to infer about me?"

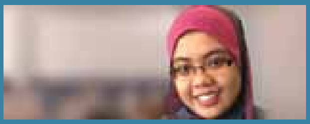
- In a recent keynote speech at an autonomous vehicles conference, Bryan Reimer of MIT "warned that the public is far less accepting of mechanical failure than human error." This means that the bar for robot safety will be extremely high and suggests that even when robots operate more safely than human operators they replace, robot error could lead to substantial liability issues.

- Development of robotics requires successful basic research in a number of fundamental scientific arenas, including mathematics, information technology, sensors, perception, learning, and human behaviour. The potential for spin-offs into adjacent areas of technology is quite great. Therefore, companies working in adjacent spaces should monitor robotics progress carefully even if they have no plans to enter the field or make direct use of robots.

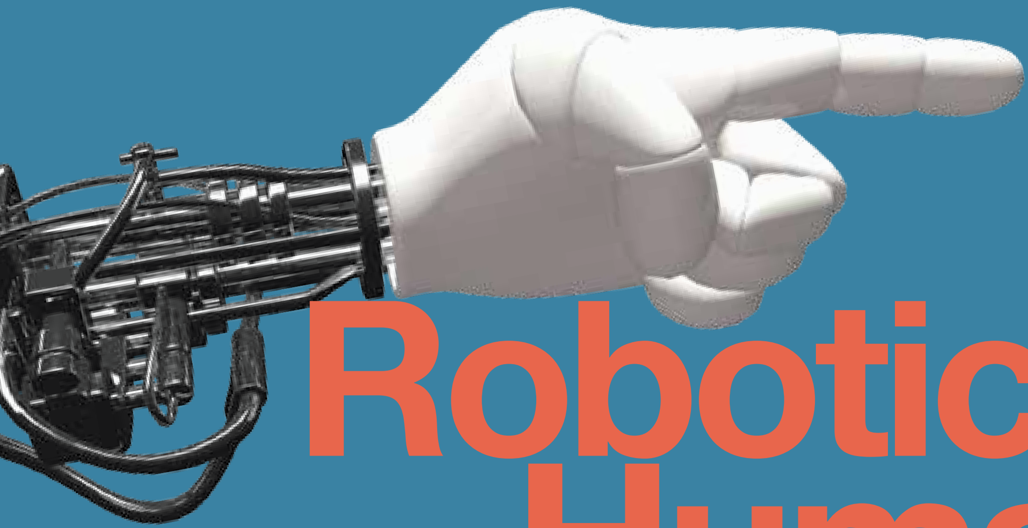
REFERENCES

1. *"From Internet to Robotics," Computing Community Consortium, May 21, 2009, www.us-robotics.us.*
2. *"A Roadmap for US Robotics: From Internet to Robotics, 2013 Edition," Robotics VO, March 20, 2013, http://robotics-vo.us.*
3. *Jason Dorrier, "DARPA's Robotic Hand Can Unlock and Open Your Door," Singularity Hub, May 17, 2013, http://singularityhub.com.*
4. *Jason Dorrier, "DARPA's Robotic Hand Can Unlock and Open Your Door," Singularity Hub, May 17, 2013, http://singularityhub.com.*
5. *"Plenary Lectures," ICORR 2013, viewed July 2013, http://depts.washington.edu.*
6. *"Flexible Robotic Endoscopy Allows for Scarless Surgeries via Mouth," medGadget, July 7, 2011, www.medgadget.com.*
7. *Spencer Ackerman, "Drone Boosters Say Farmers, Not Cops, Are the Biggest US Robot Market," Wired, February 5, 2013, www.wired.com.*
8. *"Images on Demand," CropCam, viewed July 2013, www.cropcam.com.*
9. *"FIRST Robotics Competition," FRC, viewed June 2013, www.usfirst.org.*
10. *David Szondy, "CHIBA Robotic Wheelchair Turns Wheels into Legs," Gizmag, October 17, 2012, www.gizmag.com.*
11. *Jayne O'Donnell, "Self-Driving Cars Could Have a Long Road to Acceptance," USA Today, June 14, 2013, www.usatoday.com.*
12. *Thomas Frey, "Fastest Way to Create New Jobs? Automate Them Out of Existence!" The Futurist, February 22, 2013, www.wfs.org; Steve Lohr, "More Jobs Predicted for Machines, Not People," New York Times, October 23, 2011, www.nytimes.com.*
13. *Bill Lydon, "IFR: Robots Improve Manufacturing Success & Create Jobs," International Federation of Robotics, February 28, 2013, www.ifr.org.*
14. *Mark Wembridge and Andrew Bounds, "UK Onshoring 'Minimal and Restricted to Smaller Companies'," Financial Times, June 2, 2013, www.ft.com.*
15. *Jayne O'Donnell, "Self-Driving Cars Could Have a Long Road to Acceptance," USA Today, June 14, 2013, www.usatoday.com.*

viewpoints



by **Natrah Mohd Emran**
natrah@might.org.my



Robotics for Humanity

In 2003, Henry Evans became quadriplegic and mute after a stroke-like attack. Though paralyzed by the attack, Evans is not helpless as he now uses a telepresence robot created by Chad Jenkins and his team that gives Evans the ability to navigate space and execute simple tasks which are impossible without robotics technology. New and previously unthinkable possibilities to live and contribute help him to finally decide that life is still worth living.

Evans uses tracking devices, supplied by a company called Ma-dentect, that convert tiny head movements into cursor movements and enables him to use a regular computer. With the ability to access the computer, he is able to control and manoeuvre the aerial drones and travel around. Life routine such as shaving, opening refrigerator and doing tasks around the house become possible.

For about two years, Robots for Humanity had developed ways for Evans to use the PR2 assistive robot as a body surrogate.

Image credit: www.robotics.gatech.edu

Shaving time - Henry Evans, who lives with quadriplegia and his assistance robot

New robotics, tweaked and personalized by a group called Robots for Humanity, can help the disabled live their life with minimum human assistance.

His experience demonstrates how new robotics, tweaked and personalized by a group called Robots for Humanity, can help the disabled live their life with minimum human assistance. The technology in the case of Evans could be replicated to benefit the humanity.

A presentation in a film at TEDxMidAtlantic in October 2013 clearly demonstrated the potential of robotics technology to close the gap between a normal person and a person with disability.

This is kind of future scenario that similar with the Avatar epic science fiction film.

Another success story of robotics technology involved that enable renowned British physicist and author, Stephen Hawking. The robotics technology enables Hawking to continue contribute the world of knowledge today.

Hawking lost his ability to speak in 1985 during a trip to CERN in Geneva when he had pneumonia. At the hospital, he was put on a ventilator. To help him breathe, the doctor had performed a tracheotomy which involved cutting a hole in his neck and placing a tube into his windpipe. As a result, Hawking irreversibly lost the ability to speak.

The ability to communicate again is through the utilisation of a small sensor which is activated by a muscle in his cheek. He uses this sensor to type characters and numbers on his keyboard. SwiftKey's technology has been integrated into his current system so that it can accurately predict whole words, rather than just characters. The time and effort required by Professor Hawking to type is significantly reduced, allowing for a much easier, speedier experience for him.

The development of robotic technology in Malaysia saw the construction of an artificial limb with mechanical digits. Early this year (2015) a Malaysian boy, Muhammad Muqri, who was born without fingers on his left hand had the artificial limb fixed to his left arm. The limb cost less than RM100 and took about 20 hours to make using a 3-D printer.

On the economic front, Malaysia Healthcare Travel Council (MHTC) had received the award of "Medical Travel Destination of the Year" in 2015. Imagine the potential in medical tourism if technology such as this could restore 'normal life' to a disabled person and give more independence to elderly folks. Welcome to the world of robotics for humanity!

REFERENCES

1. *Henry Evans and Chad Jenkins: Meet the robots for humanity, TEDxMidAtlantic, Filmed October 2013, http://www.ted.com/talks/henry_evans_and_chad_jenkins_meet_the_robots_for_humanity?language=en*
2. *Joao Medeiros, How Intel Gave Stephen Hawking a Voice, 13th January 2015, http://www.wired.com/2015/01/intel-gave-stephen-hawking-voice/*
3. *The Straits Times, Malaysian boy born without fingers gets new mechanical limb, built for only $37, 1st February 2015, http://www.straitstimes.com/the-big-story/asia-report/malaysia/story/malaysian-boy-born-without-fingers-gets-new-mechanical-limb*
4. *The Star, Malaysia named Medical Travel Destination of the Year, 24th April 2015, http://www.thestar.com.my/Business/Business-News/2015/04/24/Malaysia-named-Medical-Travel-Destination-of-the-Year/?style=biz*

Image credit: www.straitstimes.com

viewpoints

by Nadia Sullivan
nadiasullivan@might.org.my

Drones Beyond Military

In the Kruger National Park of South Africa, a family of black rhinos move quietly away from the water hole toward a resting place in the bush. They are among the last of their kind as the species are being hunted to near extinction.

The horn of rhino is one of the most valuable materials on earth, worth more than six times the value of gold on the streets of Asia, particularly in Vietnam and China where it is believed to have great medicinal power. Whilst criminals exploit the myth and environmentalists race to educate potential consumers about the fallacy of its curing power, rhino horn has become a fashionable commodity and is selling for as much as US$100,000 per kilogram. It topped the black market trading of wildlife that is estimated at US$19 billion in 2012.

Monitoring the detecting poaching activities is a hard job in Kruger National Park which covers an area of 7,580 square miles. Apart from the large area of coverage, poachers are supported by a modern and well-funded intelligence network that includes human sources, signals intercepts, and aerial surveillance. More than a thousand rhinos were illegally poached throughout South Africa between January and December 2013, and the number is increasing every year.

FIGHTING TECHNOLOGY WITH TECHNOLOGY

Poachers and rangers are not the only people in Kruger. Tourists flood the area hoping to get a glimpse of rhinos and elephants before they are gone. Permits are issued by the rangers along with RFID tags that enable the rangers to keep track of visitors in the park at all times. Rangers also carry RFID tags so their locations are accessible back at park headquarters.

Leveraging on advanced technologies provides hope for protecting the park's resident species. Aerial drones has been introduced during Wildlife Conservation UAV Challenge in 2013, and the Challenge had created a new class of aircraft with multimode sensing and on-board decision making that optimized the ability to detect and control poaching in Kruger. The drones are similar to those deployed ahead of ground forces in a battlefield to detect the presence of enemy soldiers. However, detecting poachers and planning engagements has become complicated procedures in an area the size of Kruger Park.

Building on technologies developed for the smartphone industry, a team of enthusiastic people are working on integrated sensors, computers, and graphical processors into compact avionics. Combining the compact avionics with revolutions in additive manufacturing, they are able to compress the time from concept to flight for prototype aircraft from years to days and decrease the cost for developing new small aircraft from millions to just a few thousand dollars.

MODUS OPERANDI

Drones receive response from the RFID tags on the rhinos while thermal imaging sensors detect humans' presence within five miles of the rhino family. An aircraft, probing with magnetic sensors, is able to detect the presence of weapons and send encrypted alerts via the park's new IP Canopy. Poachers almost always respond with bursts of gunfire when they believe they are being detected or under attack. The aircraft processes the sound profile of the recorded gunshots and sends an alert describing the types of weapons and precise location. The scenario often ends with the arrival of rangers who quickly apprehend the exhausted poachers who are nearly out of ammunition.

GAME CHANGING TECHNOLOGIES

Almost similar with the game changing technologies such as the Internet and GPS, drones would leap from the military to the civilian sphere and become universal consumer items. According to a study by the Association for Unmanned Vehicle

Systems International (AUVSI), the development would have great economic impacts as it could generate US$13.6 billion in domestic economic activity and create 70,000 jobs in the US. By 2025, drones could generate US$82 billion and create nearly 104,000 new jobs.

Today's drones require less maintenance compared to earlier models, are more fuel-efficient and weatherproof, and can stay much longer in the air. The current world record is more than 80 hours in the air for a gas-powered drone, and more than two weeks for a solar-powered one. They can be flown either by remote control or automated flight systems.

CLIMATE CHANGE

In US, The Department of Homeland Security uses drones for border monitoring and drug interdiction, and NOAA and NASA use Global Hawks to monitor climate and the emergence of large storms. Police departments around the country are using them for surveillance and public safety. For example, in Mesa County, Colorado, police used a Draganflyer X6 drone to fly over a burning building and video the hotspots in order to trace the direction the fire was spreading.

"Almost similar with the game changing technologies such as the Internet and GPS, drones would leap from the military to the civilian sphere and become universal consumer items.

Japan began using UAVs in its agricultural sector around 1990, after the concept won a government competition to find solutions to Japan's aging farmer population. Use of drones spread rapidly, and by 2010, Yamaha's RMAX helicopter and copycat versions accounted for 30% of crop dusting in Japan. Farming applications have driven a thriving UAV industry, with more than 14,000 drone permits issued to date.

BORDER SECURITY ISSUES

Malaysian Crime Prevention Foundation (MCPF) categorised the security measures currently implemented in the Malaysian border, especially in its territorial waters, as 'not so effective' following the Lahad Datu incident.

It urges the government to not only proceed with the project to erect perimeter fencing along the border, but also install closed-circuit television cameras (CCTVs), and enhance surveillance using drones to strengthen border security.

CHALLENGES

A range of factors are slowing UAF market's development such as regulatory and technical challenges, public opposition on some fronts, and liability issues.

- Regulating air traffic so that UAVs pose minimal risk to people and property on the ground or in the air.
- Creating procedures to certify the air-worthiness of UAVs
- Completing installation of the NextGen air traffic control system, a satellite-based replacement for America's antiquated radar-based system.

UAV CHALLENGES IN MALAYSIA

The incident of an unmanned aircraft which 'invaded' the Kuala Lumpur International Airport air space in March 2015 triggered controversy. It was a test case for the Malaysian aviation and privacy laws which are still unprepared for the influx of drones.

However, advantages outweigh controversies as the government realises the advantages of using UAV, from agriculture to surveillance, monitor traffic, and crowd control. An eye in the sky is amazing and gives a lot of valuable information.

The Malaysian Maritime Enforcement Agency (MMEA) was also reported by local news media last 2014 as considering the use drones as eyes in the sky to fight crime, smuggling and intrusion at sea. The agency's director-general, Maritime Admiral Mohd Amdan Kurish, said the agency expected to rely on fixed-wing and rotary-wing unmanned aerial vehicles (UAVs) as part of its strategy.

Purchasing and operating an UAV in Malaysia is regulated by the Aeronautical Information Circular (AIC) 4/2008 dated Feb 18, 2008, produced in pursuant to the Civil Aviation Act 1969. AIC stipulates that all purchases of UAF must be with the approval of the Department of Civil Aviation (DCA), UAV or drones are not allowed to be operated in crowded spaces or in restricted air zones, and maximum height of allowable flight is 122 meter (400 feet).

REFERENCES

1. *"Approval Needed to Operate Drones in Malaysia", The Ant Daily, 6 June 2015, http://www.theantdaily.com/Main/DCA-approval-needed-to-operate-drones-in-Malaysia.*
2. *Nidhi Subbaraman, "The Drones Are Coming… but Our Laws Aren't Ready," NBCNews.com, February 20, 2013, www.nbcnews.com.*
3. *"Robotic Technology to Preserve Wildlife : A Scenario", The Futurist,March-April 2014, Volume 48, No. 2, World Future Society*
4. *"MCPF vice-chairman: Border issues need to be addressed immediately", 31st May 2015, The Sun Daily, http://www.thesundaily.my*
5. *"The Rise Of Drones: Is The 'Eye In The Sky' Invading Our Privacy?", 27th May 2015, Malaysian Digest, http://malaysiandigest.com Malaysian Digest, http://malaysiandigest.com*

• viewpoints

by Mohd Hasan Mohd Saaid
hasan@might.org.my

Robotics Automation Manufacturing

In the next 40 years the world will be transformed by demographic changes. According to a United Nations report in 2013, the current world population of 7.2 billion is projected to increase by one billion over the next 12 years and reach 9.6 billion by 2050. The ratio of working-age people to retirees will be very different from what it is today. There will be a significant increase in the population older than 65 years. Policy makers are worried about the impact of this development on social security.

Whilst employers are concern about the effect of the shrinking of the working-age population on budgets and type of services they can offer, and how to attract and retain younger talent; Oxford Martin Programme releases the result of a study that would change the whole job market scenario. The study, titled “The future of employment: how susceptible are jobs to computerization?” predicts that 47 percent of US jobs would be under threat from computerization. The study states that improvements in sensor technology will offer enough big data to engineers to help solve problems in robotic development that were previously holding back the field. Jobs such as recreational therapists, emergency management directors and healthcare social workers to library technicians, data entry operators and telemarketers could be under serious threat.

Earlier, in 2013, McKinsey Global Institute projected that sophisticated algorithms could substitute for approximately 140 million full-time knowledge workers worldwide, and predicted that many low-wage manual jobs could diminish over time.

PLAUSIBLE SCENARIO OF ROBOTICS AUTOMATION

Improvements in sensor technology will offer enough big data to engineers to help solve problems in robotic development that were previously holding back the field. Fraud detection, pre-trial research in legal cases, stock-trading and patient-monitoring could soon be done by utilising software as algorithmic improvements would enable robots make better judgement compared to humans.

Not too long ago, self-driven vehicles were considered a far fetch idea. Today it is a realistic possibility. And, an algorithmic vehicle controller is able to monitor its environment to a degree that exceeds the capabilities of any human driver. Algorithms are thus potentially safer and more effective drivers than humans.

AUTOMATION IN MANUFACTURING

Productivity per worker needs to improve and production should be cost effective.

In the United States, whose manufacturing activity comprises a

*O*NET variables that serve as indicators of bottlenecks to computerisation.*

Computerisation bottleneck	O*NET Variable	O*NET Description
Perception and Manipulation	Finger Dexterity	The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.
	Manual Dexterity	The ability to quickly move your hand, your hand together with your arm, or your two hands grasp, manipulate, or assemble objects.
	Cramped Work Space, Awkward Positiony	How often does this job require working in cramped work spaces that requires getting into awkward position?
Creative Intelligence	Originality	The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem
	Fine Arts	Knowledge of theory and techniques required to compose produce, and perform works of music, dance, visual arts, drama, and sculpture.
Social Intelligence	Social Perceptiveness	Being aware of others’ reactions and underdstanding why they react as they do.
	Negotiation	Bringing others together and trying to reconcile differences.
	Persuasion	Persuading ohters to change their minds or behavior.
	Assisting and Caring for Others	Providing personal assistance, medical attention, emotional support, or other personal care to others such as coworkers, customers, or patients.

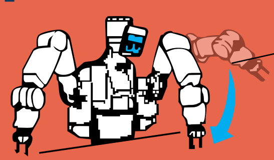
Source: The University of Oxford’s Dr. Michael A. Osborne and Dr. Carl Benedikt Frey of Oxford Martin School.

Table 1: The three bottlenecks to jobs being computerized.

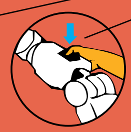
How to Train a Robot in Seven Easy Steps

Baxter also works right out of the box. Typically, it takes 18 months to integrate an industrial robot into a factory operation. With Baxter, it's about an hour. Baxter requires no specialized programming. A factory floor worker with only a high-school diploma, someone who has never seen a robot before, can learn to train Baxter to do simple tasks in five minutes. If you're a manufacturing engineer, you can go deeper into the menu system and adjust and optimize settings for different tasks. More-complex tasks require a bit more training.

1 Select training mode.

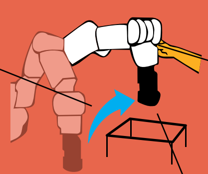


2 Grab one of Baxter's arm and swing its "hand" over the widget, and click to indicate that this is the object to be grabbed.



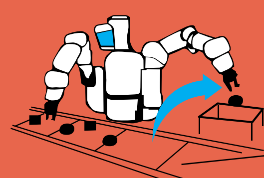
3 A camera in Bexter's hand will center on the widget and display the image on the screen; confirm with a click that is this the right sort of object.

4 Baxter will grab the object. Swing the arm over the four corners of the box, and click to indicate this is the destination for the widget.



5 Click to confirm that Baxter is to insert the widget into the box.

6 Baxter will put the box, using sensor to guide the widget in. Click to confirm that this is the entire task.



7 Run the conveyor. As long as widget appear in roughly the same area. Baxter will identify, grab, and box them. Its facial expressions will indicate if it is struggling or working smootly.

US$2 trillion portion of its economy, is able to increase workers' productivity by about 3.7% per year for the last 60 years by keeping the higher-value-added manufacturing activities at home and let the lower-value-added manufacturing activities go elsewhere. The manufacturing of simple goods is constantly moving to the location with the lowest wages.

The definition of "elsewhere" has changed over time. After the end of World War II, there was an abundance of low-cost labour in Japan, so that was the "elsewhere" for manufacturing businesses. But as the Japanese economy recovered and the standard of living went up, the cost of making goods also went up. So low-cost manufacturing moved to South Korea. After the miracle of South Korea, it moved to Taiwan. When the standard of living there also went up, manufacturing moved to the province of Shenzhen in China.

Businesses are constantly chasing this low-cost labour — people who are willing to do difficult work producing low-value products with low wages. As the standard of living goes up in these places, education expands. That's a good thing. But from the perspective of a manufacturer, a more intelligent and skilled workforce simply has less interest in these types of jobs. For example, iRobot, the company that produces Roomba robot vacuum cleaners in Shenzhen, was unable to increase production by adding another line because most of the workers had gone off to college.

Where will manufacturing activity go next? Thailand has had a tremendous industrial revolution in the last 30 years, as have Indonesia and Malaysia. Eventually, manufacturing will run out of places where there is low-cost labour.

The option is to automate low manual jobs. This is where industrial robotics has become the focus point.

Robotics automation in manufacturing is a complex and controversial subject in terms of sustainability and safety of humans, environment and businesses.

"Fraud detection, pre-trial research in legal cases, stock-trading and patient-monitoring could soon be done by utilising software as algorithmic improvements would enable robots make better judgement compared to humans.

Malaysian producers have strong research and development (R&D) capability and a high degree of automation in production that reduces the reliance on manual labour and provide better consistency in product quality.

Asimov's Three Laws of Robotics address these issues:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given to it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Asimov later adds a fourth law, known as 'zeroth law' to the list: A robot may not injure humanity or, through inaction, allow humanity to come to harm.

Is Malaysia one of the 'elsewhere'?

Probably not: Manufacturing accounted for 24.5% of Malaysia's GDP in 2013, ranking it second only to the service sector. Manufacturing sector in Malaysia is led by the electronics and electrical products (E&E) cluster. According to Oxford Business Group, in a report titled "Malaysia 2014", Malaysian producers have strong research and development (R&D) capabilities and a high degree of automation in production that reduces the reliance on manual labour and provide better consistency in product quality.

A NEW ROBOT FOR A NEW ROBOT ECONOMY

The first industrial robot developed in the United States went to work in 1961 in Ewing, New Jersey, GM factory. Called the Unimate, it operated with a die-casting mould placing hot, forged car parts into a liquid bath to cool them. At that time industrial robots could not be equipped with computers as computers cost millions of dollars and filled a room. Sensors were also extremely expensive. So robots were effectively blind, very dumb, and did repeated actions following a trajectory.

By The Numbers

Baxter is cheaper and more quickly deployed than are traditional robots. In a decade, it might be able to tackle tens of millions of manufacturing and services jobs.

How much it costs

BAXTER
$22,000, all in

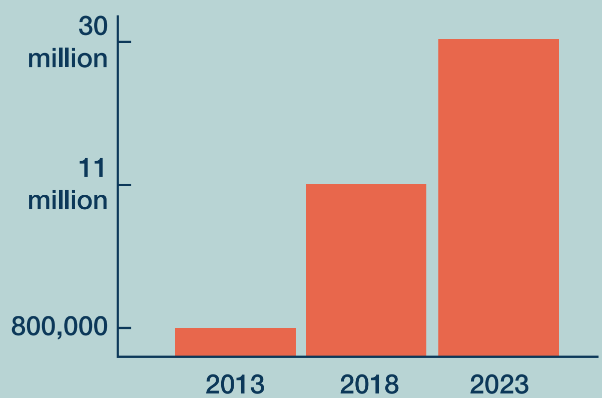
TYPICAL INDUSTRIAL ROBOT:
$100,000,
plus another
$200,000
or more in programming cost

How long it takes to get running

BAXTER
1 hour
to unpack and set up, plus five minutes to train on the first job

TYPICAL INDUSTRIAL ROBOTS:
Months

How many jobs Baxter could potentially replace in the U.S.



(Source: http://www.inc.com)

Industrial robots have not actually seen much innovation since the Unimate. These machines perform well on very narrowly defined, repeatable tasks. But they are not adaptable, flexible, or easy to use. Nor are most of these machines safe for people to be around.

Today, 70% of the industrial robots in existence are in automobile factories. They are either in the paint shop or the body shop. In a car factory, the body shop would be full of robots, but with no people; whilst at the final assembly would be human workers but no robots. Industrial robots and people don't mix.

These machines are often heralded as money savers for factory owners and operators. But the cost to integrate one of today's industrial robots into a factory operation is often three or five times the cost of the robot itself. It is a job that demands programmers, specialists, all sorts of people. And safety cages would have to be constructed around the robots so that the robots don't strike people while operating.

Unlike human workers who can detect when they are about to hit something with their eyes, ears, or skin, most of these machines have no sensors or means to detect what is happening in their environment. They are not aware. All of this speaks to a larger and fundamental flaw with the way factory bots are built today.

In an increasingly interconnected world, industrial robots have not followed the information technology revolution. In our march to the future, we somehow left robots behind. There are no robots suitable safe and cheap enough for small businesses.

In the US alone, there are more than 300,000 small manufacturing companies with fewer than 500 employees. Almost none of these firms has an industrial robot, for some of the reasons outlined earlier. Almost all of these firms have relatively small production runs. That means they are constantly changing the design and manufacturing procedures for what they produce.

Some of these companies produce a wide variety of goods for other companies. They are sometimes called "job shops". They specialize in manufacturing a type of product that can be highly customized to an individual client's needs. In a typical factory with an industrial robot, a production run is rarely less than four months. For these "job shops", a run can be as short as an hour. These 300,000 very small companies are the potential market for affordable industrial robots.

In September 2008, a company called Rethink Robotics was formed. It announced its first product launch – a robot named Baxter, a new type of industrial robot that sells for US$22,000 – on September 18, 2012.

Baxter is very different from existing industrial robots. It doesn't need an expensive or elaborate safety cage, and factory operators don't need to put it in a part of the factory where it is segregated from the rest of the workers. It is safe to share a workspace with.

Baxter also works right out of the box. Typically, it takes 18 months to integrate an industrial robot into a factory operation. With Baxter, it is about an hour. Baxter requires no specialized programming. A factory floor worker with only a high-school diploma, someone who has never seen a robot before, can learn to train Baxter to do simple tasks in five minutes. A manufacturing engineer would be able to go deeper into the menu system and adjust and optimize settings for different tasks. More-complex tasks require a bit more training.

Baxter is outfitted with a variety of sensors, including depth sensors as well cameras in its wrists, so it sees with its hands. It is constantly building and adjusting a mathematical model of the world in front of it, allowing it to recognize different objects.

Baxter is built for manufacturing, but its potential extends beyond factory work: It may revolutionize the use of robots in research settings. In the 1990s, the availability of low-cost mobile robots allowed thousands of researchers to work on a problem known as SLAM, Simultaneous Localization and Mapping. That led ultimately to the Google self-driving car. Now for the first time, thousands of researchers will be able to afford two-armed robots, which may lead to similarly important new research. Some of that research will seem crazy, silly, or even dumb, but out of that we will see new applications for two-armed robots interacting with people.

These applications exist in health care and eldercare, and a wide variety of other areas. We'll find thousands of uses for this robot. We've only just begun.

Jobs requiring perception and manipulation, creative and social intelligence are those least likely to be disrupted by robotic innovations. Jobs that involved consulting other people, negotiating agreements, resolving problems and co-ordinating activities require a great deal of social intelligence, which computers are unlikely to take over. Most management, business, and finance occupations which are intensive in generalist tasks still need human intelligence.

REFERENCES

1. *http://www.google.com/imgres?imgurl=http://www.inc.com/uploaded_files/image/How_to_Train_a_Robot2_20466.jpg&imgrefurl=http://www.inc.com/magazine/201210/david-h-freedman/the-rise-of-the-robotic-workforce.html&h=990&w=1600&tbnid=nl5ZKbnjL2BQ9M:&zoom=1&docid=U3VI_-pPBkv2jM&ei=TaxdVcLtMNONuAS8toOgDA&tbm=isch&ved=0CB0QMygZMBk4yAE*
2. *The Futurist Magazine*
3. *http://mset.org.my/myraig/pdf/myRAIG/AUTOMEX_Keynote_Talk.pdfv*

viewpoints

SCIENCE to ACTION

FameLab MALAYSIA 2015 - Celebrating Science

Science is part of almost every aspect of our lives. It is not an otiose issue as science makes extraordinary things possible. It tells us about the past, helps us with the present, and creates ways to improve our future. Scientific endeavour should not unfold quietly at the sidelines but instead should be a fundamental part of the game. Now more than ever, scientists must engage with the public and aggrandise science to make it great.

FameLab is an initiative aim to close the gap between scientists and the public. It is an exciting competition to find the new voices of science and engineering across the world. It is a communications competition designed to engage and entertain by breaking down science, technology and engineering concepts into three minute presentations. Contestants from around the world take part armed only with their wits and a few props that they can carry onto stage.

FameLab was started in 2005 in the UK by Cheltenham Science Festival

and has quickly become established as a diamond model for successfully identifying, training and mentoring scientists and engineers to share their enthusiasm for their subjects with the public. Participations are open for young people who have interest to preach and share their ideas about any topics related to science, technology, engineering and also mathematics.

FameLab works by identifying, training and mentoring young scientists and engineers to enable them to communicate effectively in the media intensive environment in which we all live. It is the only science competition to cross international boundaries the likes of World Cup of Science Communication. The result is a vibrant network of exciting scientists and engineers engaging international audiences but also engaging with each other, broadening each other's views of what it means to be working in science right now.

2015, marked as the first year FameLab arrived on Malaysian shores, jointly organised by the Malaysian Industry-Government Group for High Technology

(MIGHT) and the British Council, as part of the Newton-Ungku Omar Fund and Science to Action (S2A) initiative. Apart from outreaching and communicating science, FameLab aims to encourage the scientist, technologist, engineers and mathematicians to share their expertise and knowledge in a more 'understandable' language to the public.

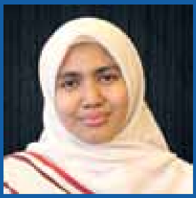
The search for Malaysia Best Science Communicator started in April this year, with a number of online application nationwide. After screening, selected applicants were then invited to pitch and compete in the regional heats. Various topics were presented, from agroforestry, genomics, to nuclear energy and ten most enlightening and interesting presentations were selected to compete in the Final round.

Contestants were evaluated based on three main criteria which are content, character and creativity – the 3C. The panel of judges who are representative from academia and also communication and media experts, shared their professional views and constructive views with the participants throughout the heats and final round. These feedbacks have been invaluable advices to the participants in their career development as well as motivation for them to continuously communicate science.

Top ten finalists were selected, and need to undergo a compulsory training

The finalists (and the pioneer of FameLab Malaysia!) and their topics during the final round.

Shawn Keng has an entrepreneurial appetite for new community projects and innovative solutions to solve emerging social problems. His research focus was on personalised human genomics and detecting virulent gene markers in bacteria.



Dr. Radhiah Shukri is a senior lecturer at Universiti Putra Malaysia. She received her Ph.D. in Carbohydrate Science and Technology at Kansas State University, USA. She currently teaches Cereal Technology and Food Processing and Preservation. She has a passion for delivering science in creative and efficient ways.

Siti Aimi Sarah bt. Zainal Abidin graduated with a BSc. in Biotechnology at the International Islamic University of Malaysia, Kuantan campus. Aimi recently finished her PhD in Halal Products Science at Universiti Putra Malaysia. She is currently working on her post-doctoral researcher at the Faculty of Veterinary Medicine, UPM.

Ivan Se Hoo Kien Weng is a science teacher specializing in Chemistry and Physics. He had some debating experience in high school and in his university days. He enjoys teaching and educating.

The second of three siblings, **Wan Shakirah Wan Abdul Kahar** has a Bachelors Degree in Computer Engineering, and worked as a power electrical engineer for six years, before getting a Masters Degree in Nuclear Power Plant Engineering. She is currently working as a nuclear engineer and she loves to hike and play the guitar.

Nor Atika Musbah is a student of Mechanical Engineering at Universiti Teknologi PETRONAS. This upcoming May will be her third year studying there. She is the first one in her family to pursue engineering although most of her family members are into technology-related fields.

session by international experts from the UK. A two-day Masterclass was conducted by Dr Emily Grossman, a science communicator, broadcaster, educator, and an expert in molecular biology and genetics. The training intended to uncover finalists' hidden strength and maximise their communication skills. This was followed with a three-day Researcher Connect Training emphasising on research and non-technical writing by Dr. João Rangel Almeida and Tara Mitchell.

Ameen Kamal was selected as the first FameLab Malaysia champion after a very close and tight battle. Continuing to compete in the Cheltenham Science Festival, he representing Malaysia in the FameLab International with the topic 'BioRefineries: A Greener Industrial Revolution'. Although Ameen did not bring the trophy home, he did an excellent job representing Malaysia (watch his action at https://www.youtube.com/watch?v=5lGHz2ABJes.)

MIGHT and British Council will continuously organising FameLab, open the opportunity and promote more active participation from the youth. FameLab is a fun science storytelling competition which allows the contestants to use their creativity in delivering the knowledge on science related matters to the public.

So, are you passionate about science?
Share it with the world!

Ameen Kamal aspires to be able to convey scientific concepts in an interesting and easily understandable manner to capture interest in the hearts of people from all walks of life. He considers science as a universal language and tool for peace and prosperity.

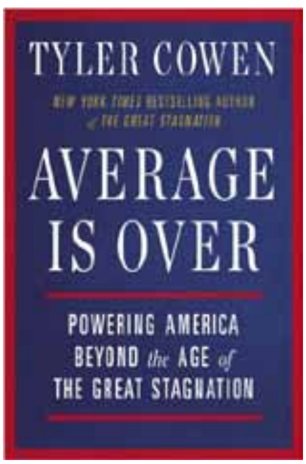
Lukman Jamaludin is a graduate of Electronic Engineering from MMU, with an interest in Optical Engineering. He likes to play with the Rubik's cube and enjoys heavy metal music as well as reading manga.

Abhi Veerakumarasivam is a geneticist and an educator. Upon completing his PhD at the University of Cambridge, he was employed as a lecturer at Universiti Putra Malaysia. He is currently seconded to Perdana University as the Director of Research and Innovation. His research group dissects the genetics of cancer recurrence and invasion by using bladder cancer as a model.

Dr Zaid Omar received his PhD in Image Processing from Imperial College London in 2012 and is currently a senior lecturer at Universiti Teknologi Malaysia. His research interests include image fusion, medical imaging and agent-based modelling (ABM). He also enjoys football and films.

myForesight

Book Club



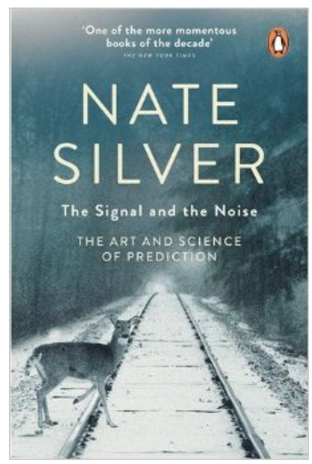
Average Is Over:
Powering America Beyond the Age of the Great Stagnation

ISBN-10: 0142181110
ISBN-13: 978-0142181119
Author: Tyler Cowen
Publisher: Plume`

The United States continues to mint more millionaires and billionaires than any country ever. Yet, since the great recession, three quarters of the jobs created here pay only marginally more than minimum wage. Why is there growth only at the top and the bottom?

Renowned economist and bestselling author Tyler Cowen explains that high earners are taking ever more advantage of machine intelligence and achieving ever-better results. Meanwhile, nearly every business sector relies less and less on manual labor, and that means a steady, secure life somewhere in the middle—average—is over.

In **Average is Over**, Cowen lays out how the new economy works and identifies what workers and entrepreneurs young and old must do to thrive in this radically new economic landscape.

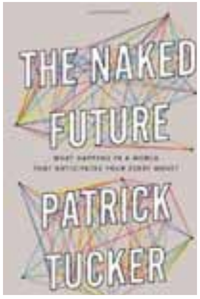


The Signal and the Noise:
The Art and Science of Prediction

ISBN-10: 0141975652
ISBN-13: 978-0141975658
Author: Nate Silver
Publisher: Penguin

Every time we choose a route to work, decide whether to go on a second date, or set aside money for a rainy day, we are making a prediction about the future. Yet from the financial crisis to ecological disasters, we routinely fail to foresee hugely significant events, often at great cost to society.

In **The Signal and the Noise**, the New York Times political forecaster Nate Silver, who accurately predicted the results of every single state in the 2012 US election, reveals how we can all develop better foresight in an uncertain world. From the stock market to the poker table, from earthquakes to the economy, he takes us on an enthralling insider's tour of the high-stakes world of forecasting, showing how we can use information in a smarter way amid a noise of data - and make better predictions in our own lives.



The Naked Future: What Happens in a World That Anticipates Your Every Move?

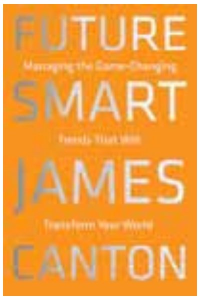
ISBN-10: 1591845866
ISBN-13: 978-1591845867
Author: Patrick Tucker
Publisher: Current

An in-depth look at the future of the future

An app on your phone knows you're getting married before you do. Your friends' tweets can help data scientists predict your location with astounding accuracy, even if you don't use Twitter. Soon, we'll be able to know how many kids in a kindergarten class will catch a cold once the first one gets sick.

We are on the threshold of a historic transition in our ability to predict aspects of the future with ever-increasing precision. Computer-aided forecasting is poised for rapid growth over the next ten years. The rise of big data will enable us to predict not only events like earthquakes or epidemics, but also individual behaviour.

Patrick Tucker explores the potential for abuse of predictive analytics as well as the benefits. Will we be able to predict guilt before a person commits a crime? Is it legal to quarantine someone 99 percent likely to have the superflu while they're still healthy? These questions matter, because the naked future will be upon us sooner than we realize.

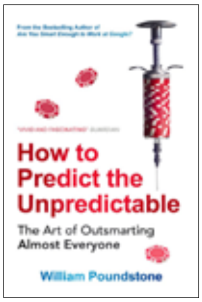


Future Smart: Managing the Game-Changing Trends that will Transform Your World

ISBN-10: 0306822865
ISBN-13: 978-0306822865
Author: James Canton, Ph.D.
Publisher: Da Capo Press

A forecast of the most important game-changing trends—and how to manage and profit from them to improve your life. We live in a time of complex and radical change. Those that are ill-prepared for the seismic shifts set to occur over the next thirty years will be in for a rough ride.

The world is moving rapidly toward ubiquitous connectivity that will further accelerate how and where people collaborate, share, gather, do business, and exchange knowledge. The most important impact on the world of the Connected Planet Trend will be universal access to all human knowledge by everyone on the planet. Connecting and enabling new innovations, discoveries, solving world challenges, creating new products, solutions, generating economic prosperity — that is what the possibilities are of the Connected Planet in the near future. The massive empowerment of individuals and societies through the power of global connectivity captures the essence of this trend. The Connected Planet will empower individuals with the mobile web, digital money, linked online markets, collaborative supply chains, and, above all, fuel a market for innovative new ideas.



How To Predict The Unpredictable - The Art Of Outsmarting Almost Everyone

ISBN: 9781780744070
Author: William Poundstone
Publisher: Oneworld

We are hard-wired to believe that the world is more predictable than it is. We chase 'winning streaks' that are often just illusions, and we are all too predictable exactly when we try hardest not to be. In the 1970s, Daniel Kahneman and Amos Tversky coined the phrase 'representativeness' to describe the psychology of this behaviour.

Since then representativeness has been used by auditors to catch people fiddling their tax returns and by hedge fund managers to reap billions from the emotions of small investors. Now Poundstone for the first time makes these techniques accessible for everyone, in the everyday situations that matter. You'll learn how to tackle multiple choice tests, what internet passwords to avoid, how to up your odds of winning the office Premier League sweepstakes, and the best ways to invest your money.

happenings

Sesi Bual Bicara: Penyelidikan Masa Hadapan

Dewan Persidangan Fakulti Sains & Teknologi, Universiti Kebangsaan Malaysia

28th April 2015

The future is near, but what kind of future are we looking into? Are we ready and bold enough to face the future? Discussing on various interest related to the future, from tourism to education - myForesight® was actively involved as a panel for a dialogue session on Futures studies. The session was opened to the professionals in Universiti Kebangsaan Malaysia (UKM) and the public.

There were overwhelming feedback from the audiences which varies from reality checks on current education system, way forward for tourism industry, to the needs to inculcate Foresight in research activities and the importance of having guidelines in reducing negative impacts of technology in our social life.

First Famelab in Malaysia to Help Build Cadreship of Articulate Young Scientists

Midvalley Bangsar, Kuala Lumpur

4th April 2015

Malaysia Industry-Government Group for High Technology (MIGHT) in collaboration with British Council has jointly organised FameLab in Malaysia with the preliminary round completed earlier today. It is modelled after the United Kingdom's FameLab started in 2005.

Malaysia launched its national agenda to mainstream science under Science to Action (S2A), which recognises that science literacy and knowledge would play a key role to help the country to strive successfully in the future global environment as well as to achieve the high income country status by 2020. With the average age of 28.2 years (UN Data) for Malaysia, young scientists must play a key role to instil interest in science, particularly STEM among the students as well as gain public support. FameLab will support the effort to develop the science communications skills needed to achieve this initiative.

MIGHT through S2A programme will convalesce this idea further with young school children through SchoolLab, another soon to be launched programme.

FameLab Malaysia – Northern Heat

SEAMEO RECSAM, Penang

11th April 2015

The 2nd pitching session for FameLab Malaysia was in Penang! The session was held at the SEAMEO RECSAM Auditorium, Gelugor. The quest for best science communicator continues in Penang to give the chance for participants in the Northern area to share their passion and interest in science.

10 participants from both Heats sessions will be selected to participate in the Fame Lab Masterclass and Researchers Connect training organised by British Council. The finalists will then compete for the National Final in Kuala Lumpur. The winner will be representing Malaysia at the Cheltenham Festivals to compete with International FameLab winners from other 25 countries.

ForesightClub @ Universiti Tun Hussein Onn

Universiti Tun Hussein Onn, Johor

24th to 26th March 2015

Welcoming the new batch of ForesightClub @ UTHM!

A two-day training course on Foresight methodology was held with the students of Department of Technology and Management, from the Faculty of Technology Management and Business.

This programme is a continuation of the collaboration between myForesight® and UTHM in promoting and mainstreaming Foresight among the youth and in preparing a future-minded students. These students will adopt the Foresight methodology and tools in doing their PSM, as part of the requirement in their bachelor degree final dissertation.

At the end of the session, the students shared their future perspective in the "letters from the future" activity. Some of the letters read, really amazed the audience as they were creatively and (mostly) optimistically describing the future they live in about ten years' time. Fascinated and currently associated with technology lifestyle, they can relate past present and future outcomes.

This shows that Malaysian youth is ready to venture into another level as they will be the next constituency to shape and determine the nation's future!

Scenario Building Series and Stakeholder's Engagement Session

23rd to 27th March 2015

Domestic governance in public service has a crucial role to play in determining the future of public service transformation plan. In line with the Malaysian Public Service Transformation programme, the engagements series with the state of Sabah and Sarawak were carried out from 23rd to 27th March 2015. The half-day scenario building sessions with each state stakeholders was hosted by INTAN Wilayah of the respective state. Participation includes representatives from state secretary offices, government agencies and youth groups.

The scenario building workshops was part of myForesight® mainstreaming foresight initiatives. The purpose of the sessions is to identify the current issues, trends and challenges of Malaysia's public service in both states. The outcome of this engagement will be included into the Strategic Outlook and Policy Directions of the Malaysian Public Service Post 2020 report.

Interviews with prominent leaders of the state were also conducted which include amongst other Y.B Datuk Amar Abang Haji Abdul Rahman Zohari bin Tun Abang Haji Openg, Minister of Housing & Tourism, Sarawak who is also the President of SABERKAS (Pertubuhan Belia Kebangsaan Bersatu Sarawak), Y.Bhg. Datu Aloysius J. Dris the Chief Executive Officer Sarawak Development Institute (SDI) who is also the President of Angkatan Zaman Mansang (AZAM), and Y.Bhg. Tan Sri Wilson Baya Dandot the Chief Executive Officer Regional Corridor Development Authority (RECODA). Interviews with the Chief Executive and President of Sabah Economic Development and Investment Authority (SEDIA) Y.Bhg. Datuk Dr. Mohd. Yaakub Haji Johari and Sabah Youth Council President and the Exco Members were also conducted to seek local perspectives that will drive the public service landscape.

Foresight: Concept, Tools & Methodologies

Johor Bahru, Johor

10th to 12th March 2015

Strategic Thinking and Whole-of-Government Decision Making: "Cognostics" Training Workshop took place from 9th to 11th March 2015 in MIGHT, Cyberjaya

myForesight® and the UNDP Global Centre for Public Service Excellence (GCPSE) has organized a two and a half day training workshop to introduce the emerging field of cognostics and a potentially useful tool that facilitates decision making and strategy development in a complex public service environment. The workshop was made possible with collaboration from the Parmenides Foundation and UNDP Malaysia.

This workshop was conducted by Professor Albrecht von Müller (Director, Parmenides Center for the Study of Thinking, Germany); a leading academic in the field and experienced Government advisor. The hands-on workshop exposed the participants to new ways of dealing with complexity and pervasive structural change. The workshop is also designed to introduce participants to the EIDOS software, which allows a representation of both the overall reasoning architecture, and the individual thinking steps that contribute to it, in a maximally condensed and transparent form.

The by-invitation workshop was attended by local senior government officials and international UNDP regional officers.

Creating the Asia-Pacific Futures Network

Tamkang University, Taiwan

19th to 20th March 2015

APFN was conducted for the purpose of recognizing foresight/future studies as an idea whose time has come in parts of the Asia-Pacific region.

Among the objectives of APFN are:

i. Share stories of what works in Asia
ii. Spread foresight from its current government focus to civil society and the small business and corporate sector
iii. Strengthen current informal networks
iv. Explore how Asian traditions, when critically understood, will have the ability inform future studies
v. Link with other informal networks of international organizations throughout the world
vi. Explore emerging issues likely to challenge the current trajectories of the Asia-Pacific

Among topics discussed are practice of Futures Studies in Asia including Philippines, Singapore, Taiwan, and Iran, and also a moderated discussion on the next steps in creating an Asia-Pacific Futures Network. The two days symposium was held at Tamkang University,Taiwan.

myForesight® was represented by Mr Rushdi bin Abdul Rahim has the opportunity to share the activities and experience on foresight done in Malaysia at the Asia-Pacific Future Network (APFN) International Symposium.

happenings

Strategic Thinking and Whole-of-Government Decision Making: “Cognostics” Training Workshop

MIGHT, Cyberjaya
9th to 11th March 2015

Strategic Thinking and Whole-of-Government Decision Making: “Cognostics” Training Workshop took place from 9th to 11th March 2015 in MIGHT, Cyberjaya.

myForesight® and the UNDP Global Centre for Public Service Excellence (GCPSE) has organized a two and a half day training workshop to introduce the emerging field of cognostics and a potentially useful tool that facilitates decision making and strategy development in a complex public service environment. The workshop was made possible with collaboration from the Parmenides Foundation and UNDP Malaysia.

This workshop was conducted by Professor Albrecht von Müller (Director, Parmenides Center for the Study of Thinking, Germany); a leading academic in the field and experienced Government advisor. The hands-on workshop exposed the participants to new ways of dealing with complexity and pervasive structural change. The workshop is also designed to introduce participants to the EIDOS software, which allows a representation of both the overall reasoning architecture, and the individual thinking steps that contribute to it, in a maximally condensed and transparent form.

The by-invitation workshop was attended by local senior government officials and international UNDP regional officers.

The 6th International Conference on Foresight

National Institute of Science and Technology Policy (NISTEP), Japan
2nd to 5th March 2015

Since 2000, National Institute of Science and Technology Policy (NISTEP), Ministry of Education, Culture, Sports, Science and Technology (MEXT) have been organising international foresight conference. This year, the Conference and Workshop on Foresight is held at the National Graduate Institute for Policy Studies (GRIPS).

Several countries such as China, Egypt, Singapore, Korea, Thailand, Turkey, USA and Vietnam, just to name a few, participate in the event. The participants also share their foresight activities and provide inputs through discussion about possible contribution of foresight to evidence-based STI policy making.

myForesight® was represented by Mr. Mohd Nurul Azammi Mohd Nudri, and he shared the updates on local Foresight activities and the perspectives on Foresight and S&T policy through Malaysian lenses.

O.T.E.C
OCEAN THERMAL ENERGY CENTRE
UNIVERSITI TEKNOLOGI MALAYSIA

KERANA TUHAN UNTUK MANUSIA
UNIVERSITI TEKNOLOGI MALAYSIA

" OCEAN THERMAL ENERGY-DRIVEN DEVELOPMENT FOR SUSTAINABILITY WITH OTEC TECHNOLOGY "

3rd INTERNATIONAL OTEC Symposium

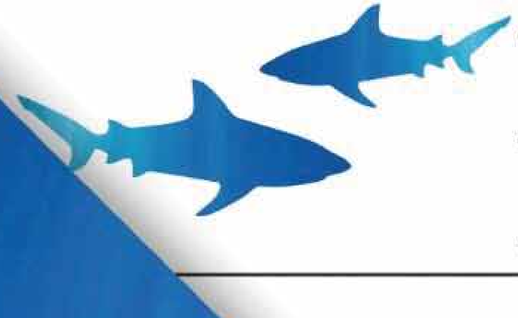
1 - 2 SEPTEMBER 2015 . KUALA LUMPUR

W*e, at the Universiti Teknologi Malaysia (www.utm.my) as the main convener, together with co-conveners: Hawaii National Marine Renewable Energy Center and Korea Research Institute of Ships and Ocean engineering, of the 3rd International OTEC Symposium 2015 (3-OTEC 2015) in Kuala Lumpur, would like to invite one and all concerned for* ***energy security, the environment, and sustainability*** *to attend this international event and meet* ***world leaders*** *and* ***experts*** *in the field of* ***ocean thermal energy conversion*** *to electricity or its energy equivalent such as hydrogen fuel.*

VISIT US @
otec2015.utm.my

5 Parallel Tracks to Lead You into the New Dynamic of OTEC Industry

- *Track 1: OTEC Policy and Advocacy*
- *Track 2: Technology Solutions*
- *Track 3: Environmental Baseline Studies*
- *Track 4: New Project Initiatives & Opportunities*
- *Track 5: Socio-economic Impacts*



Who Should Attend ?

- *Academicians and students who would like to gain broader knowledge on OTEC*
- *Planners from business fraternity*
- *Policy makers interested in developing OTEC policies in Malaysia and other tropical countries*
- *OTEC Technology entrepreneurs/developers who want to seek practical experience from experts in OTEC*
- *All professionals especially engineers, accountants and venture capitalist, who seek knowledge in OTEC technologies*
- *Any interested member of public including the media*

Tel: +(6)03-26154882
H/p : +6017-3757807
Fax: +(6)03-26154283
email: 2015otecsymposium@gmail.com

Scan me!

MAP THE FUTURE

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

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

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

We look foward to hearing from you.

myForesight® team