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Productivity and Internet of Things

1. Introduction

What is the 'Internet of Things' (IoT) and how does it affect productivity?

In an article published by the Straits Times on 30 December 2013, 'Internet of Things is the next big thing', IoT is seen as the next big step in the online world's development that will have a big impact on industries from food security to transport and agriculture. Mr Leong Mun Yuen, Chief Technology Officer of the Infocomm Development Authority, was cited as saying "Companies must jump on to these, if they have not already, as they will be key areas in boosting productivity and giving them the edge they need to survive". Networking giant Cisco said there will be 25 billion devices connected to the Internet by 2015 and the IoT itself will be a US\$14 trillion (S\$18 trillion) industry in the next decade. VTT Technical Research Centre of Finland sees IoT as a platform for sophisticated services and an ICT enabler that could bring about 40% of productivity improvement and an additional \$15 trillion in global GDP by 2030 IoT is certainly something you may not want to ignore.

2. IoT Demystified

We found that there are different ways of defining IoT. To many, it may be conceptual. To VTT Technical Research Centre of Finland, IoT is "a set of enabling technologies that can be used by almost all areas of business and society to improve productivity. The core enabling technologies are sensing, processing, communication, refining and managing information."

Figure 1 in the next page illustrates this definition.

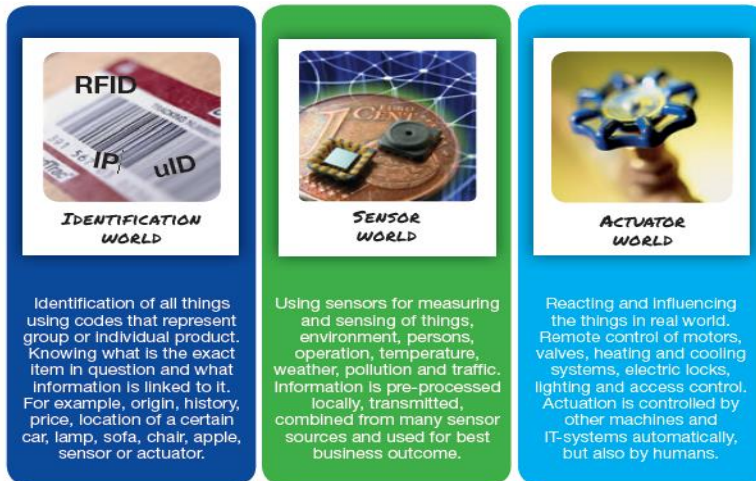


Figure 1: Definition of IoT by VTT Technical Research Centre of Finland,
Source: Productivity Leap with IoT_VTT <http://www.vtt.fi/inf/pdf/visions/2013/V3.pdf>

McKinsey & Company's expanded definition is described in the diagram below.

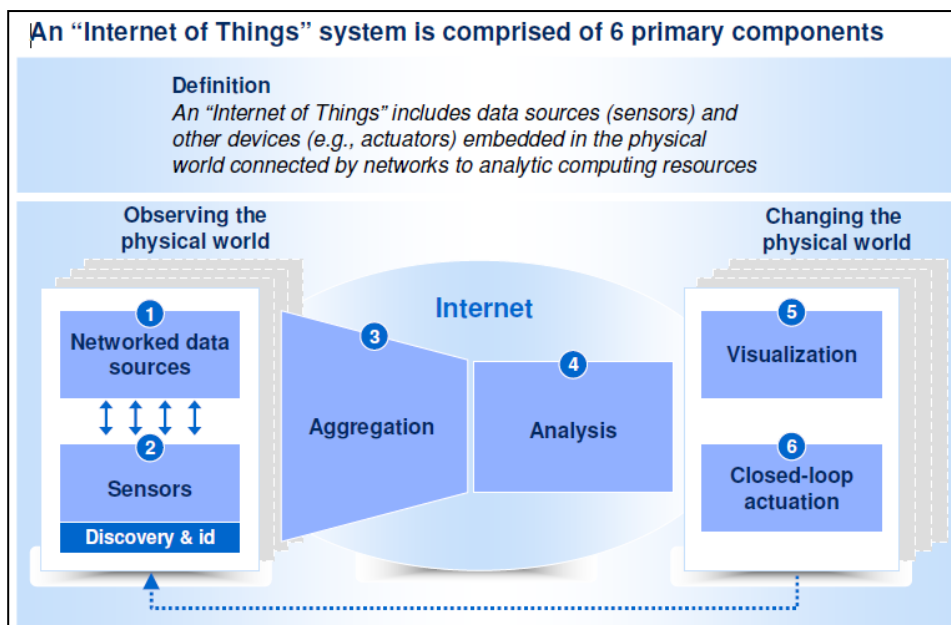


Figure 2: Definition of IoT by McKinsey & Company

Source:

http://www.cityinnovationgroup.com/uploads/6/1/1/7/6117894/20100310_iot_alumni_webcast_fin_al_exploring_the_potential_of_2.pdf

Far from being conceptual, many manufacturers and designers feel that the 'Internet of Things' will provide a great deal of benefit, boosting productivity when everyday objects are able to do more than they were originally able to through ambient intelligence. They envision people living comfortably in digital environments in which the electronics are sensitive to people's needs, personalised to their requirements, anticipatory of their behaviours and responsive to their presence. With the pathways of information in our physical world changing, this allows the surrounding world to become an information system that we can use. Roadways can provide

data that help determine traffic condition, pacemakers can connect to provide information to a cardiologist about a patient, without the patient making a hospital visit.

Data sources, such as sensors and actuators are embedded into real world items and then connected through networks to analytic resources. This allows better tracking and monitoring of behaviors of people, observation of places or things. It enables a better understanding of the physical environment leading to improved situational awareness. Through better data visualisation and deeper analysis, sensors are then used to help humans make better decisions, optimise processes and resource consumption which then lead to better automated control, even in situations where there is great uncertainty.

3. The Potential Benefits of IoT for Businesses

Through IoT, most industries will find there is an evolution that improves the quality of life for all of us. It will boost how we live, how we work and how we communicate with others. Of course, companies in each industry will need to rework their infrastructures to meet the changing face of things and help to protect information. But once systems are in place, data management will be easier and statistics will be more accurate.

With IoT, time will be saved and productivity will increase. Business processes can be reduced due to a more streamlined approach. This will offer improved products and services, better customised to fit the evolving needs of customers.

Industries will be able to merge effective business models with products to make them work more effectively. New technology will be blended into everyday items so that you can accomplish more. A person would wear a watch that calculates steps for them and transmits this information to their computer so they can monitor peak walking times, varying heart rates during the day and even oxygen levels. These could be achieved using a WIFI connection. A decade ago, that was not possible, but in today's world, it can be achieved with the 'Internet of Things'.

For example, in a warehouse setting, you can collect data directly from the factory floor and logistics network. This can help you determine inventory needs, slow down or speed up production as needed, monitor maintenance and how long it is taking to get your products to market. You can explore ways to simplify your operations and improve effectiveness.

The IoT can also help boost security and safety. Sensors and video cameras can monitor equipment better, ensuring that automatic protection devices act to prevent dangerous situations from happening. If an accident does occur, you can reduce investigation time by having this information readily available.

Decision-making can happen in a fraction of time. Automatic decisions can be made based on logical programming, while important decisions that need input from workers will be prioritised so businesses can operate more effectively. This can lead to new business opportunities and better revenue streams with fewer people being bogged down with trivial.

Perhaps most importantly, software upgrades and enhancements can be done automatically or at a push of the button, no matter where a device is. This will allow for a universal upgrade to take place in seconds, ensuring all systems are operating on the same level.

With IoT, there will be millions of new ways that data from objects, sensors and devices can mine data for you and your companies. Since data is money, it is imperative that businesses be proactive to create methods for obtaining this information.

The table below provides a useful summary on the potential of IoT to different industries.

Internet of Things: A Transformational Force		
Industry	Key Change	Potential Benefits
Automotive and Transportation	Real-time driving behavior, traffic and vehicle diagnostics.	Improved customer experience, reduced pollution, increased safety and additional revenue streams.
Healthcare	Remote monitoring of staff and patients ability to locate and identify status of equipment.	Improved employee productivity, resource usage and outcomes that result in efficiency gains and cost savings.
Manufacturing	Quick response to fluctuations in demand; maximized operational efficiency, safety and reliability, using smart sensors and digital control systems.	Enhanced agility and flexibility, reduced energy consumption and carbon footprint.
Retail	Stock-out prevention through connected and intelligent supply chains.	Ability to predict consumer behavior and trends, using data from video surveillance cameras, social media, Internet and mobile device usage.
Supply Chain	Real-time tracking of parts and raw materials, which helps organizations preempt problems, address demand fluctuations and efficiently manage all stages of manufacturing.	Reduced working capital requirements, improved efficiencies and avoidance of disruptions in manufacturing.
Infrastructure	Smart lighting, water, power, fire, cooling, alarms and structural health systems.	Environmental benefits and significant cost savings with better utilization of resources and preventive maintenance of critical systems.
Oil and Gas	Smart components.	Reduced operating costs and fuel consumption.
Insurance	Innovative services such as pay-as-you-go insurance.	Significant cost savings for both insurers and consumers.
Utilities	Smart grids and meters.	More responsive and reliable services; significant cost savings for both utilities and consumers resulting from demand-based and dynamic pricing features.

Figure 3: Internet of Things: A Transformational Force by McKinsey & Company

Source: <http://www.cognizant.com/InsightsWhitepapers/Reaping-the-Benefits-of-the-Internet-of-Things.pdf>

4. How to Leverage the Internet of Things?

Let us explore some of the possibilities to leverage IoT for productivity gain.

Supply chains will experience dynamic management tools. These tools will allow information to be obtained faster and expand the reach of the data. This includes data that was once difficult to obtain through traditional means.

In a retail setting, the IoT will create shopping assistants that will help customers in a store. This can include having a device on the cart that will notify shoppers of unique deals when they are in an area and help to improve customers' shopping experience.

Government will find that these applications allow them to better help with crowd control during emergencies and streamline evacuations. There is also the ability to use items to locate accidents when individuals do not know precisely the location of the incidents.

The healthcare sector will experience continuous patient monitoring, even when the patient is at home. When a problem is spotted, the patient can be brought to hospital. Family members can better monitor their loved ones in nursing homes, without the need to get there daily.

Transportation can be improved as technology help to avoid accidents, detect them and provide better traffic control systems. The elderly and those with special needs can experience better transportation care with assistant systems.

5. Risks and Concerns of IoT

While IoT could potentially bring about productivity leap, it does bring about some concerns as well. Companies need to consider the technology and organisational challenges. Technology challenges would include costs, reliability, technical standards and maturity. Organisational challenges would cover polices governing data privacy, data security, legal liability and role of IT function.

With this form of technology, there will be an increase in threats to security. Sensors can become easy targets for hostile attacks. Defense measures are needed to enhance security protocols and reduce some of the risks the systems will face.

Data privacy will be another concern. Reliable data will need to be kept confidential at all times. Users will be wary of data mining operation where their personal information can be divulged. When developing and releasing a system that mine data, companies need to ensure that they are protecting their customers' data effectively. This will need to include preventing the unauthorised use of data that extends beyond what customers have agreed to.

To leverage IoT and overcome technology challenges, it may be wise for organisations to work closely with mature vendors to overcome key hurdles such as a lack of standards and interoperable technologies, data and information management issues, privacy and security concerns and organisational inability to manage IoT complexities.

6. Factors to Consider For Successful Use of the IoT

Several factors should be taken into consideration when you want to successfully use the 'Internet of Things'. This begins with the understanding that the IoT is highly complex and you will need to identify the areas where it can provide you with the benefits of your investment.

You will need to develop robust data management capabilities as these improved statistics will help you to achieve better performance from the data you obtain. A good way to do this is to recruit talent specifically for the IoT and ensure that you give them in-depth training and at the same time, seek assistance from existing industry specialists to ensure you are maximising your

efforts. You can start by integrating data from machines with your enterprise systems to better optimise your business practices. These investments will result in stronger data analytic capabilities for your business.

Case Study

Cases on the use of IoT

a. IoT and Smart Manufacturing

According to a December 2013 survey by the American Society for Quality (ASQ), only 13 percent of the manufacturers surveyed said they use smart manufacturing within their organization. Of those organisations that claim to have implemented smart manufacturing, 82 percent say they have experienced increased efficiency, 49 percent experienced fewer product defects and 45 percent experienced increased customer satisfaction.

For example, General Electric (GE) enhanced its factory visibility with mobile technology to improve the monitoring of machine efficiency and shorten decision making time, such as prompt action to shut down a faulty production line to stop the creation of defective products. It also uses IoT-enabled HVAC systems to optimise energy consumption and says that efficiency improvements of 5% in a small industrial power plant generating 15MW can save over USD200,000 on average per year.

b. IoT and the Service Sector

Service use cases have also been done with the Internet of Things. An example was in the Heathrow's Terminal 2. In this use case, Heathrow airport Terminal 2 was fitted with several smart toilets that had been created by EuroTech using technology from Intel. The airport features 643 toilets and is expected to serve 20m people yearly. The smart toilets brought about the following benefits:

- Decision making and customer service was improved.
- Usage count was monitored and cleaning staff was alerted to specific toilets that were used at a certain point.
- Cleaning time was tracked for improvement.
- Areas and toilets that were used more often were also noted.
- People were directed to toilets that were not in use.
- When a blockage or valve failure occurred, maintenance was automatically notified. This technology allows the staff to reduce downtime of toilets and to ensure that the overall user experience is improved.

7. Conclusion

So what are the next steps for companies?

The NCS' SURF Emerging Technologies Maturity Index 2014 reported that 50% of those who responded indicated that they proactively assign resources to emerging technologies. 50.4% claimed to have investments that focused on the Internet of Things, while 17.5% actually invested in the Internet of Things. Another 16.3% stated that there were unsure of these

investments, citing major concerns such as price (according to 23%) and the complexity of things (according to 27%).

McKinsey & Company in its alumni webcast in March 2010, outlined the possible next steps for companies as summarised in the diagram below:

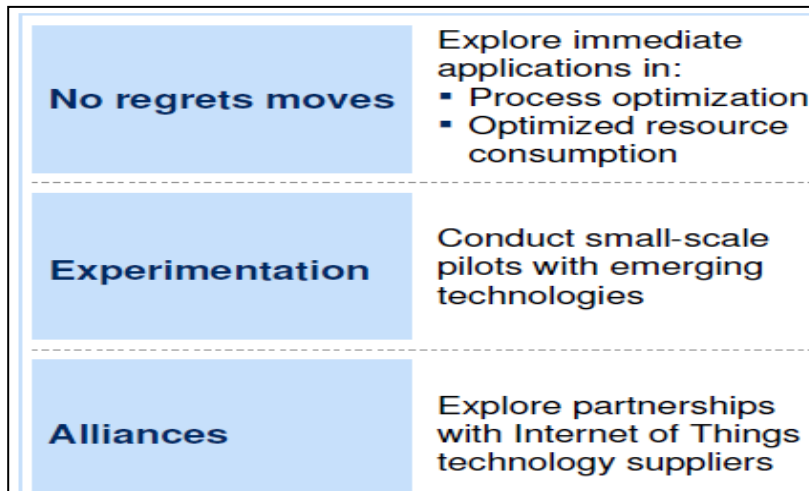


Figure 4: Next Steps for Companies

Source:

http://www.cityinnovationgroup.com/uploads/6/1/1/7/6117894/20100310_iot_alumni_webcast_final_exploring_the_potential_of_2.pdf

Companies with the ability can explore immediate applications to optimise processes and resource consumption. Through experimentation, companies can conduct small scale pilots with emerging technologies before scaling them. Companies can also explore partnerships with Internet of Things technology suppliers who can help to take their operations and productivity to the next level.

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<p>Module 2: Productivity Tools, Techniques & Management Systems (Duration: 3 days)</p> <ul style="list-style-type: none"> • Business Excellence • Productivity Measurement & Analysis • Process management: <ul style="list-style-type: none"> ▪ Cost of Quality ▪ Lean Six Sigma ▪ Process Mapping & Analysis • Integrated Management Systems 	<p>Module 2: Productivity Tools, Techniques & Management Systems (Duration: 3 days)</p> <ul style="list-style-type: none"> • Delivering Service Excellence • Productivity Measurement & Analysis • Process management: <ul style="list-style-type: none"> ▪ Cost of Quality ▪ Lean Six Sigma ▪ Process Mapping & Analysis
<p>Module 3: Innovation & Service Excellence (Duration: 3 days)</p> <ul style="list-style-type: none"> • Knowledge Economy & Innovation • Service Excellence • Team Excellence 	<p>Module 3: Innovation & Service Excellence (Duration: 3 days)</p> <ul style="list-style-type: none"> • Introduction to Service Excellence & Sales Productivity • Store Management & the Roles of a Store Manager • Minimising Operational Constraints & Focusing on Sales • Setting Goals & Analysing Statistics • Coaching & Motivating Sales Staff • Service Behaviours that Encourage Business
<p>Module 4: Critical Success Factors (Duration: 1 day)</p> <ul style="list-style-type: none"> • Management Commitment • Managing & Sustaining Change • Overcoming Resistance to Change • Training and Education • Planning for Implementation and Control of Productivity Improvement Programme • Briefing on project assignment & Role of Productivity Practitioner 	

As part of the CPP curriculum, participants are required to start a productivity improvement project upon completion of the in-class component. Project guidance will be provided by a professional consultant assigned for this purpose and is for a total of 2 man-days.

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Dec-14		
Date	Module	Time
Monday, 24 November 2014	Module 1	9-5 pm
Tuesday, 25 November 2014	Module 1 & 2	9-5 pm
Monday, 1 December 2014	Module 2	9-5 pm
Wednesday, 3 December 2014		9-5 pm
Monday, 8 December 2014	Module 3	9-5 pm
Tuesday, 9 December 2014		9-5 pm
Monday, 15 December 2014		9-5 pm
Tuesday, 16 December 2014	Module 4	9-5 pm

Jan-15		
Date	Module	Time
Monday, 22 December 2014	Module 1	9-5 pm
Tuesday, 23 December 2014	Module 1 & 2	9-5 pm
Monday, 29 December 2014	Module 2	9-5 pm
Tuesday, 30 December 2014		9-5 pm
Monday, 5 January 2015	Module 3	9-5 pm
Wednesday, 7 January 2015		9-5 pm
Tuesday, 13 January 2015		9-5 pm
Wednesday, 14 January 2015	Module 4	9-5 pm

Jan-15 (Mandarin)		
Date	Module	Time
Monday, 12 January 2015	Module 1	9-5 pm
Thursday, 15 January 2015	Module 1 & 2	9-5 pm
Monday, 19 January 2015	Module 2	9-5 pm
Thursday, 22 January 2015		9-5 pm
Monday, 26 January 2015	Module 3	9-5 pm
Thursday, 29 January 2015		9-5 pm
Monday, 2 February 2015		9-5 pm
Thursday, 5 February 2015	Module 4	9-5 pm

Feb-15		
Date	Module	Time
Tuesday, 20 January 2015	Module 1	9-5 pm
Friday, 23 January 2015	Module 1 & 2	9-5 pm
Tuesday, 27 January 2015	Module 2	9-5 pm
Friday, 30 January 2015		9-5 pm
Tuesday, 3 February 2015	Module 3	9-5 pm
Friday, 6 February 2015		9-5 pm
Tuesday, 10 February 2015		9-5 pm
Wednesday, 11 February 2015	Module 4	9-5 pm

Mar-15		
Date	Module	Time
Tuesday, 24 February 2015	Module 1	9-5 pm
Wednesday, 25 February 2015	Module 1 & 2	9-5 pm
Monday, 2 March 2015	Module 2	9-5 pm
Wednesday, 4 March 2015		9-5 pm
Monday, 9 March 2015	Module 3	9-5 pm
Wednesday, 11 March 2015		9-5 pm
Monday, 16 March 2015		9-5 pm
Tuesday, 17 March 2015	Module 4	9-5 pm

Apr-15		
Date	Module	Time
Tuesday, 24 March 2015	Module 1	9-5 pm
Thursday, 26 March 2015	Module 1 & 2	9-5 pm
Tuesday, 31 March 2015	Module 2	9-5 pm
Thursday, 2 April 2015		9-5 pm
Tuesday, 7 April 2015	Module 3	9-5 pm
Thursday, 9 April 2015		9-5 pm
Tuesday, 14 April 2015		9-5 pm
Wednesday, 15 April 2015	Module 4	9-5 pm

Core Faculty Members

MR. LAM CHUN SEE

B. ENG IN INDUSTRIAL & SYSTEMS ENGINEERING (UNIVERSITY OF SINGAPORE)

Chun see manages his own consultancy practice, Hoshin Consulting and is also an associate consultant/trainer to the PSB Corporation and Singapore Productivity Association. Prior to running his own practice, he has had years of experience as an industrial engineer with Philips, and trainer and consultant with the then National Productivity Board, APG Consulting and Teian Consulting, He was conferred the Triple-A Award in 1989 for helping to transfer Japanese know-how, particularly in the area of 5S, into local programmes and packages. Throughout his years of consultancy experience, Chun See has assisted many businesses in analyzing their productivity and quality objectives and performance; primarily through the application of the PDCA technique and basic QC tools.

MR. LEE KOK SEONG

M.SC. IN CHEMICAL ENGINEERING (IMPERIAL COLLEGE, LONDON UNIVERSITY), B.SC. IN CHEMICAL ENGINEERING (NATIONAL TAIWAN UNIVERSITY)

Kok Seong has accumulated vast experience in the areas of productivity training and management consultancy throughout his 30 years of experience with the Standards, Productivity and Innovation Board (SPRING). He has provided consultancy assistance and training for numerous organisations both within and outside of Singapore in the areas of Productivity Management, Operation and Production Management, total Quality Management, Total Productive Maintenance, Shopfloor Management, Occupational Safety Management, Industrial Engineering Applications and Supervisory Management. He has also been greatly involved in the pinnacle Singapore Quality Award (SQA) initiative since its inception in 1993. his track records include the assessments and site visits of award recipients like Micron Semiconductor (formerly Texas Instruments), Motorola, Baxter Healthcare, Philips Tuner Factory and Teck Wah Industrial Corporation Ltd. Mr. Lee is currently a certified SQA Senior Assessor, as well as a resource person for Basic and Advanced Training Courses for Productivity Practitioners, a position he has taken on since 2007.

MR. LOW CHOO TUCK

M.SC. IN INDUSTRIAL ADMINISTRATION (UNIVERSITY OF ASTON, UK); B.SC. IN PHYSICS (NUS); DIP IN QUALITY CONTROL INSTRUCTORS (INTERNATIONAL QUALITY CENTRE, NETHERLANDS); CERTIFICATE IN PRODUCTIVITY DEVELOPMENT (JAPAN PRODUCTIVITY CENTRE); CERTIFICATE IN ADVANCED MANAGEMENT DEVELOPMENT (INSEASD)

Choo Tuck currently provides training and advisory services in productivity and quality management to businesses and government in the Asean region and Middle East. He was previously the Executive Director of the Restaurant Association of Singapore as well as the Singapore Productivity Association, and was also the Director for Strategic Planning in SPRING Singapore. During his many years of service with SPRING Singapore, he gained wide experience in productivity training, management consultancy and productivity promotion, and has helped more than a 100 businesses in improving productivity, quality control and business excellence, including organisations such as Cycle & Carriage, Motorola, PUB and DBS. On top of that, he has also served as an Asian Productivity Organisation (APO) expert on Productivity for several APO member countries, and was part of a team of experts engaged by the Singapore cooperation Enterprise to provide productivity expertise to the Government of Bahrain in 2007 and 2008.

MR. QUEK AIK TENG

B.ENG (HON.) IN MECHANICAL ENGINEERING (UNIVERSITY OF SHEFFIELD); DIP. IN BUSINESS EFFICIENCY (INDUSTRIAL ENGINEERING_ (PSB-ACADEMY); CERTIFIED MANAGEMENT CONSULTANT (CMC); PRACTISING MANAGEMENT CONSULTANT (PMC); MEMBER, INSTITUTE OF MANAGEMENT CONSULTANTS (IMC) SINGAPORE

Aik Teng currently manages his own consultancy, AT Consulting Services. One of his most recent projects includes being the LEAD Project Manager for the Singapore Logistics Association. Prior to running his own consultancy, he has been with SPRING Singapore for 20 years, and was the Head of the Organisation Excellence Department from 2004-05. He was also SQA Lead Assessor and Team Leader up till 2008 and has been involved in the SQA initiative since its inception in 1993. tasked to start up the consultancy unit within the then Productivity & Standards Board (PSB) to provide training and consultancy services to

organisations, his consulting team assisted close to 30 organisations during that period. He was also involved in a project coordinated by the Singapore Cooperation Enterprise (SCE) to assist the Bahrain Labour Fund in their Labour Reform strategy, which included helping the Bahrain government to initiate a Productivity Movement as well as develop the productivity of the local enterprises. In addition, he was appointed as Project Manager to assist the Government of Botswana to implement a national Productivity Movement, from 1994 to 2003. Botswana is currently held as a model of Productivity in the Pan-Africa region.

MR. WONG KAI HONG

MBA IN STRATEGIC MARKETING (HULL), BSC (NUS)

Kai Hong is a business consultant, management trainer and company director. He has spent almost 2 decades in the consumer products industry, having worked with retailers like Isetan, Metro, Royal Sporting House, The Athlete's Foot and Sunglass Hut; brands like Reebok and Doc Martens; and technology group Wearnes Technology. He has been involved with various functions including operations, business development, project management, human resource, training, marketing, logistics, budgeting and general management. He has developed businesses in Singapore and many Asian cities such as Seoul and Beijing.

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Alternatively, you could also contact our secretariat:

Ms. Angela Poh

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