

MPC



READY, SET, GO!

THE RACE TOWARDS INDUSTRY

4.0

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FOREWORD

Industry 4.0 concentrates on creating intelligent products, processes and procedures. It is able to change the whole entire value chain which allows workers, machines, resources and customers to communicate easily.

Industry 4.0 offers huge new market approach and segmentation as companies are able to produce a better range of products as the process of transforming customers' requirements into actions is now has become seamless and sophisticated. All data on the latest trends and changes in customer behaviours can be captured in real time, making it possible to produce cutting-edge products which will lead to an exponential growth in every business.

In Malaysia, the Government has played crucial roles in engaging the private sector towards Industry 4.0. Initiatives are introduced to encourage industry players to embark on this new journey of industrial revolution. Malaysia Productivity Corporation (MPC) as an agency under Ministry of International Trade and Industry (MITI), promotes initiatives on improving nation's productivity, including that of Industry 4.0 implementation.

MPC organises seminars and study missions, both locally and internationally, for the purpose of educating industry players on the importance of transforming into a smart organisation or factory. MPC is proactively promoting the implementation of LEAN and 5S at the firm level as these are the fundamental elements that are required to be embraced first to reap the potential benefits and sustain Industry 4.0 implementation. MPC has also collaborated with our strategic partners such as SIRIM, PSDC and also agencies under MITI. This collaboration is essential in integrating and aligning all the initiatives and efforts to ultimately accelerate Malaysia's industrial implementation for greater productivity growth.

In assisting the implementation, MPC has decided to publish this book, aiming to provide information on the basic concept of Industry 4.0. This book also provides readers with three real case studies to illustrate the companies' involvement required for digital transformation and smart manufacturing. Readers are also invited to visit our online system which is known as Benchmarking Online Networking Database (<http://bond.mpc.gov.my>) to retrieve more e-articles that can be utilised as implementations reference. MPC hopes that all these initiatives would close the gap in bringing Malaysia's industry players to adopt a more global practice for achieving world-class performance.

In the process of completing this case study, our utmost appreciation goes to all parties namely the Productivity Nexus Champions and Governing Committee members and management of companies featured in this book for allowing us to publish their best practices.

Table of CONTENT

The Race Towards Industry 4.0 01

Welcome to the Future	• 02
Looking Back in History	• 02
The Race is On	• 04
Germany	
United States (US)	
Japan	
China	
France	
Republic of Korea	
United Kingdom	
India	

The Big, BIG, Benefits 07

Productivity	• 07
Agility	• 07
Innovation	• 07
Customer Experience	• 07
Costs	• 07
Revenues	• 08

Be A Part Of Something Bigger 09

People Matters!	• 09
Digital Trust is Key	• 10
It's All in Performance Management	• 11
The 5S to Success	• 12
'Lean'-ing it the Right Way	• 14

Being Ready for Industry 4.0 15

Technology	• 16
Process	• 16
People	• 16

The Nine Building Blocks of Industry 4.0 17

Big Data and Analytics	• 17
Autonomous Robots	• 17
Simulation	• 17
Horizontal and Vertical System Integration	• 18
The Industrial Internet of Things (IIOT)	• 18
Cybersecurity	• 18
The Cloud	• 18
Additive Manufacturing	• 18
Augmented Reality	• 18

The Game Changers 19

Capacity Development	• 19
Practitioners	• 19
Assessment	• 20
5S/Lean for Industry 4.0	• 20

Learning from the Best Practices Case Studies 21

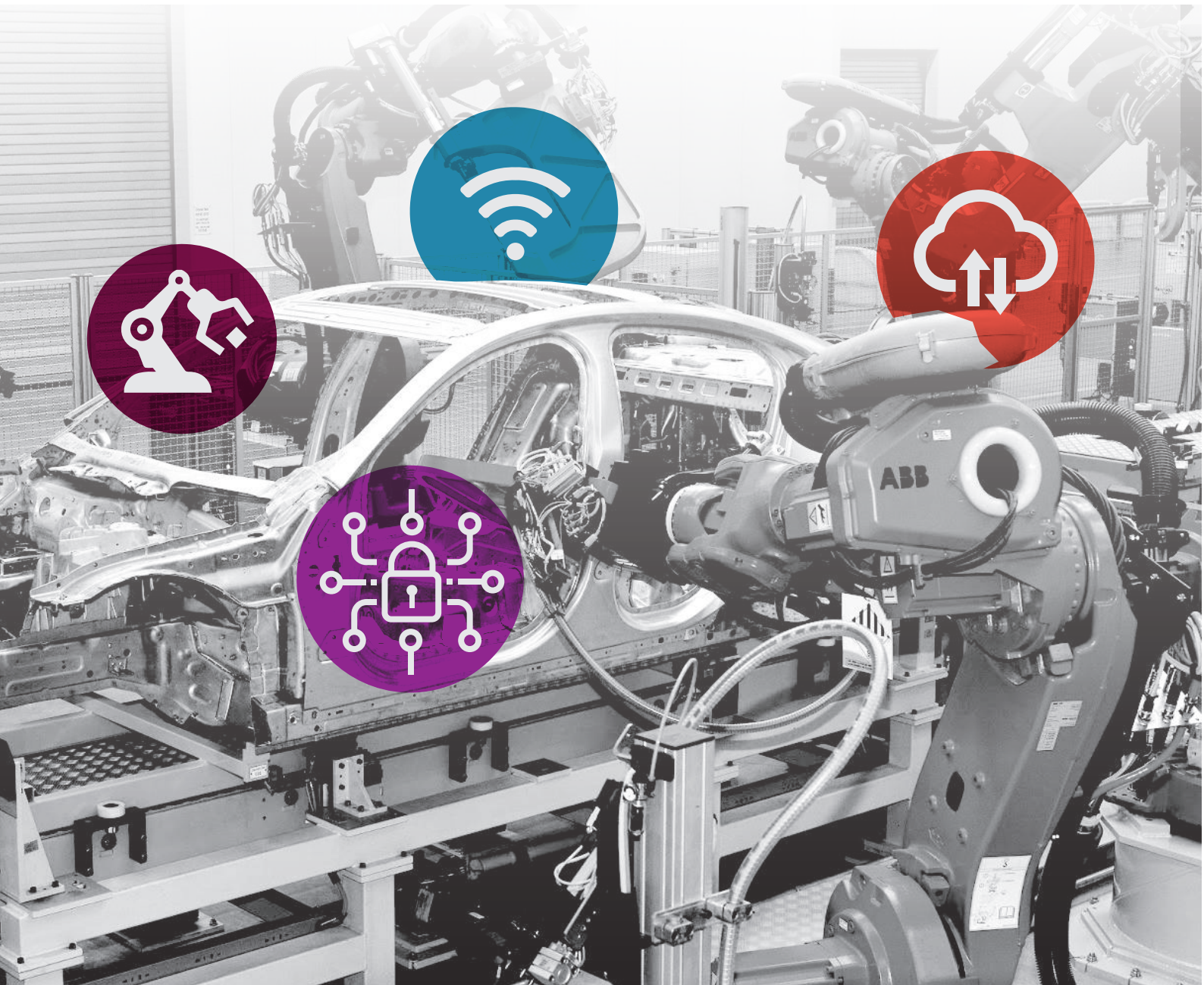
Senheng	• 21
Pentamaster	• 25
Nationgate	• 28

References 31

READY, SET, GO! THE RACE TOWARDS INDUSTRY 4.0

Life would be so different today if not for the Industrial Revolution. Everyday chores would still consist of strenuous manual work, cities would have never flourished as people would have preferred to stay closer to home as working and travelling long distance would be close to

impossible as it takes long period of time to get from one place to another. Without the Industrial Revolution, human advancement and growth would have been unfathomable, innovation and creativity become a foreign concept and all the positive change that we enjoy now, imaginary.



Welcome to the Future

Since the Germans first introduced “Industrie 4.0” in 2011, the phrase has been quickly adopted, becoming the hottest and most spoken buzzword across the manufacturing sector worldwide. But Industry 4.0 is more than just a fashionable buzzword. The term refers to the Fourth Industrial Revolution, comprising growing trends in automation, the Internet of Things (IoT),

Big Data and Cloud Computing technologies. Just like steam power, electricity and electronics of the past industrial revolutions, Industry 4.0 is revolutionising the manufacturing and production industry through digital optimisation. By integrating cyber-physical systems into manufacturing technologies, Industry 4.0 creates manufacturing of the future – the smart factory.

Looking Back in History

The First Industrial Revolution which took place in the 18th century was an important period for human development as it shaped the world we live in today. The invention of the steam engine was crucial to industrialisation as it paved the way for the development of more sophisticated heat engines for the generation of electricity. Taking place during the time where societies were predominantly agrarian and rural, it became a stalwart juggernaut, kick-starting the replacement of manual labour with machinery and shifting the population towards urbanisation and industrialisation. Beginning in Great Britain and eventually spreading to Europe and America, this transformation is referred to as the industrialisation of the world.

Over a century later after the First Industrialisation Revolution, the second wave of industrialisation began. Popularly known as the Technological Revolution, the Second Industrial Revolution, which was prompted by technological advancement, saw the emergence of new sources of energy such as electricity, gas and oil. By this time, transportation had already made a major breakthrough connecting cities and communities through the railroads. Many major inventions came about during this period such as Alexander Graham Bell’s telephone and Thomas Edison’s light bulb. These inventions made life much easier and also allowed work to continue through the night resulting in increased production output. Coupled with Henry Ford’s

invention of the moving assembly line, the age of mass production and economy of scale was established.

The Third Industrial Revolution started around the middle of the 20th century and it witnessed the rise of electronics and use of information technology to automate production. Newfound technologies such as microprocessors, telecommunication systems as well as computers led to the production of miniaturised devices which would open doors, most notably to space research and biotechnology. For industry, this revolution gave rise to the era of high-level automation in production, thanks to two major inventions – automation and robots.

While the First Industrial Revolution was characterised by the use of steam and shift to machinery, the second is distinguished by the use of electricity for mass production. The Third Industrial Revolution was set apart by the use of computers and electronics to automate production leading to the basis of Industry 4.0. This revolution is epitomised by the exponential expansion of emerging technologies–cyber-physical systems (CPS) as well as dynamic data processing that blurs the lines between the physical, digital and biological realms to completely transforming industries across the globe.

The Revolution

The First **1st** INDUSTRIAL REVOLUTION

for the **development** of hot engines
 for the **generation of electricity**

Kick-starting the **replacement** of manual **Labour** with **machinery** and **shifting** the **population** towards **urbanisation**

The Second **2nd** INDUSTRIALISATION known as the **Technological Revolution.**

the emergence of new sources of energy such as :



Transportation a MAJOR breakthrough connecting cities & communities through the **railroads**



The Third **3rd** INDUSTRIALISATION REVOLUTION

the rise of **electronics** and use of **information** to automate production

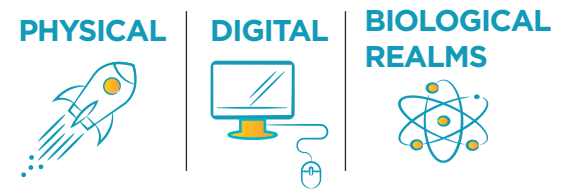
High Level automation in production
Automation & Robots

The Fourth **4th** Industry 4.0

Industry 4.0 is epitomised by the exponential expansion of **emerging technologies**

cyber - physical systems (CPS)

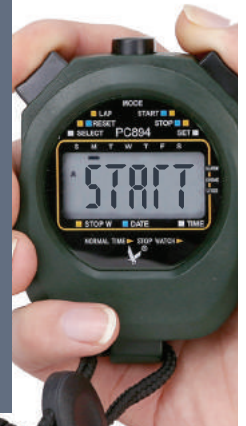
as well as dynamic data **processing** that blurs the lines between the



The Race is On

Industry 4.0 is taking economies by storm, ultimately changing the competitiveness of companies and regions. To support the manufacturing industry to transition into this rapidly changing industrial landscape, industry leaders and policy makers in several countries have established various programs on smart manufacturing, to enable industries to adopt Industry 4.0 principles which enhancing global competitiveness and also sustain countries' economies.

While adoption is different for every organisation, one fact that remains unchanged is that inaction will result in the obsolete. Technology, competition and shifting consumer expectations have changed the game, and industry leaders need to get on board to stay ahead and even stay in the game. Across the board, speed of adoption varies resulting in some nations moving even further along the adoption curve.



Germany

In Germany, the Industry 4.0 platform was established as a public-private central coordination model and a focal point for all I4.0 activities. In 2006, the German government launched a policy as one of its national strategic

initiatives that presently positions Germany as one of the most stable national economies in Europe. This feat is made possible due to the country's success of modernising its manufacturing industry.

United States (US)

In line with Industry 4.0, a concept of Industrial Internet has been brought up in North America by the General Electric (GE) company in late 2012. It is seen as a tight integration of physical and digital worlds that combines big data analytics with the Internet of Things. The concept assumes a much broader application area as the Industry 4.0 and covers power generation and distribution, healthcare, manufacturing, public sector, transportation,

and mining. Given the importance of manufacturing to the United States and the interest it has generated, many initiatives are currently being supported by the federal government in advancing the concepts in Industry 4.0. Some of the initiatives are 2nd Advanced Manufacturing Partnership (AMP2.0), National Network for Manufacturing Innovation (NNMI) and Manufacturing Extension Partnership (MEP).

Japan

Japan is still lagging behind Germany and the US in terms of smart manufacturing implementation, but Japanese companies still have a firm belief that connected manufacturing will strengthen their competitiveness. In April 2016, the Japanese government enacted the 5th Science and Technology Basic Plan. It covers many aspects, including innovation promotion and internationalisation. A focus point, however, is the development of the society towards a Smart Society, the "Society 5.0", through the full

utilisation of technological innovation including Internet of Things (IoT), Artificial Intelligence (AI) and Big Data, that derived from Industry 4.0. Considering this, the Japanese government has announced "Connected Industries," as a new concept framework in which industries will create new added value and the solutions to various problems in society through connectedness of various facets of modern life, including humans (including the roles as consumers and suppliers), machines, systems, companies.

China

China is currently in the lead and benefitting from long-standing government support for high-tech manufacturing. While its government supports high-tech manufacturing via incentives/designated high-tech zones as well as specific Industry 4.0 efforts, the adoption remains industry-led seeing larger enterprises bringing in tech on their own. Furthering its

effort in bolstering the country's hi-tech industries, policy makers devised the "Made in China 2025" initiative which was drawn from Germany's Industrie 4.0 plan. Since its inception in 2015, China has been experiencing exponential growth through the initiative, growing to become even more self-sufficient in a range of technologies and activities.

France

In France, the concept 'Industrie du futur' was introduced as a core of the future French industrial policy. It is based on cooperation of industry and science and built on five pillars: (1) cutting edge technologies including additive manufacturing, virtual plant, IoT, and augmented

reality, (2) supporting the French companies, especially small to middle ones, to adapt to new technologies, (3) extensive employees' training, (4) strengthening international cooperation around industrial standards and (5) promotion of French industry of the future.

Republic of Korea

The Korean government has been driving smart factories since 2015 via the Innovation in Manufacturing 3.0 Initiative. Undergoing plans to invest and build 10,000 smart factories by 2020, the government established centres in a collaborative

effort between the government and large organisations such as Samsung and Hyundai to assess SMEs in addition to providing them the funding and support to promote and nurture smart factories.

United Kingdom

The United Kingdom is at the early stages of deploying collaborative model, between government, industry and academia for the adoption of Industry 4.0. The government plays a key role in fund deployment alongside the private

sector as an act to drive the way forward toward Industry 4.0 through various initiatives such as the establishment of 'Digital Academy' and the development of an industry roadmap.

India

India has demonstrated efforts toward adopting Industry 4.0 with initiatives such as the setting up of Industry 4.0 'Experience Centres' which is likely a government-led. These centres serve the purpose of eventual knowledge and technology transfer. The

Indian government has allocated seed investments for these centres to source the technology as well as hire global expertise with the intention of eventually acquiring new innovations and technology assemblies for India.

Industry 4.0 Initiatives across selected Countries

France



France introduces "Industrie du futur" as the core of Future French Industry Policy based on cooperation of industry and science and built on five pillars.

Japan



Japanese government enacted the 5th Science and Technology Basic Plan to focus on the development of smart society, the "Society 5.0".

United States (US)



United State Federal Government supported various manufacturing initiatives such as 2nd Advanced Manufacturing Partnership (AMP2.0), (NNMI) (MEP).

Germany



Industry 4.0 platform is a centralised Industry 4.0 activities and a public private coordination model.

Republic of Korea



As part of collaborative effort between the government and large organisations, centres were established to provide funding and to nurture and promote smart factories.

United Kingdom



Government plays key role fund deployment as well as the establishment of 'Digital Academy' and the development of industry roadmap.

China



Enterprises prefer bringing in tech on their own despite government supports of high tech manufacturing via incentives and designated high-tech zone as well as specific Industry 4.0 efforts. "Made in China 2025" is drawn from Germany's Industry 4.0 Plan.

India



Industry 4.0 Experience Centres serve the purpose of eventual knowledge and teach transfer and allocating seed investments to source the technology hire global expertise.

THE BIG, BIG, BENEFITS

The one common element that all industrialisation revolutions share is the need to increase productivity and quality. Industry 4.0 is all about doing things differently. By leveraging on Industry 4.0 technologies, businesses are able to attain growth without compromising quality, cost or time. There are numerous benefits that come with the adoption of Industry 4.0 but the benefits identified to change the fundamental equation of manufacturing can be classified into six categories.

1 Productivity

People and machines can establish a smart working relationship thus allowing businesses to double up production capacity, reduce human errors and offer mass customisation to meet diversified needs within a short notice. Automation also tends to keep quality high therefore boosting productivity further.

2 Agility

Focusing on High Mix Low Volume (HMLV) and even one-off manufacturing, Industry 4.0 takes agility to the next level. Improved agility helps in which an organisation is able to offer an improved version of existing products to a more varied customer base and speeds up product innovation.

3 Innovation

Since Industry 4.0 production lines are made to accommodate HMLV, they are appropriate to new product introduction and experimentation in design. The extreme visibility from IoT feeds at intelligent products and equipment to enable better understanding on what works for both product as well as process design.

4 Customer Experience

Awareness and thorough information availability that comes with Industry 4.0 mean manufacturers are able to deliver better services to their customers. For instance, self-service views which allow access to customers into the operation may be possible. Detailed, yet in context, data from Manufacturing Execution System (MES) can be a basis to immediately resolve issues between customers and manufacturer.

5 Costs

While Industry 4.0 will require initial investments, once the intelligence is built into products and processes, the costs will plummet. Fewer quality problems lead to less material waste, lower personnel and operating costs. The speed and ability to handle such a high mix seamlessly will also lower costs.

6

Revenues

With better quality, lower costs, higher mix and the ability to serve customers well, Industry 4.0 puts manufacturers on a path to be a preferred supplier to current customers while also opening up to larger markets. Adding new technologies can steer benefits to the next level. Businesses that are able to have a cyber-physical system of their operations will benefit from the extra monitoring, control and optimisation. The ones that can truly leverage big data/machine learning will be able to identify patterns that may help to predict and avoid impending issues. Manufacturers who undergo the decentralised intelligent production approach of Industry 4.0 are the ones that will be able to compete profitably in the most demanding global markets.



BE A PART OF SOMETHING BIGGER

Industry 4.0 is here for the long term and companies that fail to adopt will inevitably elude growth. With more businesses realising the significant opportunities and benefits that come with Industry 4.0, many are attempting to reform themselves in order to be able to adopt better. Yet studies conducted by Pricewater Cooper (PwC) and Deloitte show that many companies struggle to plan a transformation programmes that captures the benefits and creates value thus losing out on competitiveness. The reason is because these companies are mostly daunted by

the implementation of digital industrial technologies into their business model as they are mostly inadequately equipped for the transformation.

But what exactly does a company need in order to transform? Industry 4.0 is all about technology and although a commitment to invest in emerging technologies is a necessary criterion, it is only one part of the requirement. The “Building the Digital Enterprise” study by PwC identified other criteria needed.



People Matters!

Despite technology becoming an increasingly important tool of trade in Industry 4.0, focusing on the technological aspect alone doesn't amount to seamless digital transformation of a business. Business leaders must be able to recognise that digital transformation goes beyond adopting advanced technologies and for a company to digitally transform successfully, it is the people that matter most.

In planning for a company's digital transformation, it is essential for businesses to focus on the people who will be the driving force of this change. Adoption of Industry 4.0 necessitates a considerable transition in terms of recruitment and employee skills, and most of all training.

According to Boston Consulting Group “Man and Machine in Industry 4.0” report, in addition to the new jobs created superseding many traditional roles, Industry 4.0 will also require employees to be better problem solvers and display greater flexibility. Companies must look at new approaches to recruit people and focus more on capabilities rather than qualifications to find workers with the relevant skills for specific roles. Companies should

collaborate with government agencies to be able to develop a set of requirements to fill these newly created roles as well as revise their skill sets to work effectively within this new environment.

Although the crux of Industry 4.0 is about doing more with less, that doesn't necessarily entail to job loss. Complete automation still requires people to operate it. In this changing landscape, it's essential for businesses to ensure that employees understand how the business is changing and how they can assume a role in this transformation.

By creating a digital culture and the right kind of training, businesses can help employees across the board - from top management right down to the warehouse worker understand how the technology that underlies Industry 4.0 works as an enabler that helps create a sustainable competitive value for the company. Overcoming employees concerns and anxieties about Industry 4.0 through the provision of essential training will not only equip staff with the necessary digital skills needed but also enable them to continuously adapt to the ever changing work environment that comes with Industry 4.0.

It is important for businesses to zoom in on those who will be the driving force of these changes. It is necessary for big changes to take place once Industry 4.0 is adopted. This shift has to take place the area of recruitment, workers' skills and training.

Industry 4.0 will need workers to be more flexible and be better at solving problems.

Doing away with workers' concerns and anxieties on Industry 4.0 by giving them necessary training so they have the required digital skills and can constantly adapt to the ever changing work environment which comes with Industry 4.0.

Engaging the workers

Companies need to work with government agencies to develop a set of requirement for these newly created roles for the workers as well as upgrade their skills so that they can work effectively within the new environment.

Making sure that workers know how business is changing and understand how they can play a part in this transformation.

Digital Trust Is The Key

The digitalisation aspect of Industry 4.0 can be compared to a huge wave sweeping the Earth. People need to learn the basics to be able to have the trust to ride on it confidently. Adopting Industry 4.0 means businesses can expect massively growing information flow which requires the right analytics technique and infrastructure to support it. Therefore, companies must prepare themselves by rethinking their entire business model.

Inside a company's operations and processes, the connected network and devices across the horizontal and vertical value chain is resulting in an upsurge of data from multiple sources that help work to create value for the business. However, with the massive data flow from various point of entry, businesses must take a rigorous, pro-active approach to data security and related issues to work on building digital trust.

Digital trust addresses three major challenges of the digital era – cybersecurity, which involves making sure that data transferred across the network cannot be hacked; transparency, which means making clear how data is processed, sent and stored; and personal data protection; so that sensitive information such as bank account details and personal records stay out of malevolent hands.

Businesses must work with the relevant expertise in the industry. They need to develop digital competencies to overcome these challenges, and they also need to create the digital trust necessary to support data analytics that plays a major role in creating value to the customers. This, in turn will give businesses the competitive edge needed to thrive in changing business world.

Digital trust deals with three central issues affecting the virtual realm. They are cyber security, transparency and personal data protection. Cyber security involves making sure everything shared across telecommunication networks and cyberspace is hack proof. Transparency means spelling it out on how data is crunched (processed), sent and stored and personal data protection is a key concern to prevent sensitive information such as bank account details and personal records from falling into the wrong hands.

Businesses must work with the relevant experts in the industry to develop digital know-how and combat these issues and threats. This would build digital trust to support computational analysis of data that plays a major part in showing customers the value of engaging with a company with a high level of confidence in the area. This would give a firm a good reputation and the edge to prevail over their competition and prosper in the ever changing business environment.



It's All in Performance Management

Lean Management is a proven management practice used by service providers, manufacturers, and public agencies all over the world to enhance their products and service delivery. It eliminates wastages and improve business process flow to offer customers cost effective products and superior services.

Lean creates a strong foundation for the implementation of Industry 4.0 by eliminating work processes that hinder efficiency and optimise the production capacity to meet business and

customers challenging demands. While there is a tremendous opportunity to improve productivity through the implementation of Industry 4.0, organisations must put in place a robust and effective Lean Management practices to bring the desired impact of accelerating higher productivity.

However for lean itself to be effective, organisations must embark on 5S practices to develop a productive work culture focusing on basic requirements for efficiency. Let's take a look at the foundation to lean culture – the 5S.

The 5S to Success

5S is one of the first tools that can be applied to a company seeking for continuous improvement. A 5S implementation is the first step towards eliminating waste and maintains an efficient, clean and safe working environment, that help to create Lean Manufacturing.

Although 5S was initially for manufacturing processes, the principles have proven to be applicable and also successful when implemented in other areas within an organisation. 5S is a method implemented into an organisation for the purpose of laying a foundation towards future lean methods. As the most basic lean methods to implement, it is also the foundation of all improvements and the key component of establishing a Visual Workplace. The

Visual Workplace is a concept that emphasises on sharing of critical information about business process performance at strategic locations for effective communication to members of the team.

Comprising 5 Japanese words namely Seiri, Seiton, Seiso, Seiketsu and Shitsuke, this manufacturing methodology begun by leaders at the Toyota Motor Company in the early and mid-20th century. A 5S programme focuses on having visual order, well-organised, cleanliness and standardisation. The results promised by a well-implemented 5S method include improvements in profitability, efficiency, service as well as safety. The 5s methodology is explained as below;

Seiri (Sort)

When in doubt, move it out. This step involves removal of unwanted items or wastes using the Red Tag technique. By identifying things not needed and removing them will save time searching for things we do need, hence improving efficiency.

Seiton (Set in order)

There is a place for everything and everything is in its place. This step sees arrangement or organising of items to things appear neat and orderly. It is basically a continuation of the Sort phase. Removing items to be discarded or arranged in an alternative location will essentially create space and help facilitate an alternative layout of an area. This helps in restructuring work contents so that certain operations can be carried out within the cycle of others.

Seisu (Shine)

Seisu means clean or inspect through cleaning. This is a practical element to establish the maintenance of a clean environment as ongoing process. Regular cleaning will help identify faulty tools and equipment and is a big step in preventive maintenance.

Seiketsu (Standardise)

Seiketsu refers to determining rules and ensuring enforcement of rules that are made. These prevent from relapse and act as a check and balance to identify where standards have slipped. There is a danger of letting things slip back to the way it used to be and hinder improvement.

Shitsuke (Sustain)

Part of daily work and it becomes a habit or in simpler terms, it's all about the discipline. It is essential to ensure people maintain applying good practices, standardisation and housekeeping. In order to do so, it is necessary for good communication so people will be aware of what we are trying to achieve and why. Continuous education also helps people understand the concepts and techniques while rewards and recognition help people feel appreciated and be appreciative in return.

The ability to implement 5S effectively impacts a business by allowing it to reap its benefits which include increase of profit, improve workforce, create a safer workplace, reduce error and defects and improving communication within the organisation.



‘Lean’-ing it the Right Way

Made famous by Toyota where suppliers managed inventory and production were disciplined and organised, the Lean Management is an approach to running an organisation that supports the concept of continuous improvements. While Lean Manufacturing is applicable to production, Lean Management is pertinent to all aspects of a business.

The whole idea of lean revolves around transforming the way organisations operate. In addition to continuous improvements, the principles of lean also comprise respect for people as well as unwavering focus on delivering customer value thus making many companies to rethink their practices used in the past.

In order for lean to be truly effective, a new, transformative approach to working requires a transformation in leadership as well. Lean Management leads lean principles while also offering guidance and ensuring that lean is used to optimise the entire organisational system for value delivery.

A shift in mindset is compulsory to be able to apply lean Management principles. Instead of acting as a supervisor, it is best to approach as a teacher and coach instead. Lean leaders must lead gently, ensuring that lean principles are put into practice with the right goal in mind – to sustainably maximise the delivery of value to the customers.

Keep in mind that Lean Management is not a collection

of defined methods, tools or practices. It would be more precise to justify it as a management philosophy or a long-term approach that systematically looks to improve processes and products through progressive changes.

So how does Industry 4.0 fit into Lean Management? While lean principles are likely to become more important because efficient and effective processes are the prerequisite of Industry 4.0, Industry 4.0 can also become a lean enabler. As digital transformation compels an organisation to become more responsive to changing market and operational conditions without sacrificing efficiency, the purpose of Lean Management and the goal of lean as a whole justifies this effort. By making this shift, leaders are able to build sustainable and healthy companies, on a foundation of respect, learning and most importantly, continuous improvement.

In short, Industry 4.0 technologies may be exactly what we need in order to create lean supply chains and networks. Lean is about doing more with less – today and in the future. To continuously develop processes and preserve quality, businesses must evolve. Embracing intelligence and analytics help companies set new benchmarks, establish what works, what doesn't and what essentially could be more effective. As such, the lean mindset is invaluable when it comes to sustainability in manufacturing so it is pivotal to maintain the Lean Manufacturing perspective alongside forward-looking Industry 4.0 intelligence.

BEING READY FOR INDUSTRY 4.0

Based on the recent *Readiness for the Future of Production Report 2018*, by the World Economic Forum (WEF) and A.T. Kearney, Malaysia was positioned in the 'Leader' quadrant meaning countries with a strong current production and base in the best position to benefit from the changing nature of manufacturing. It is notable that Malaysia along with China was the only two countries that do not fall into the high-income group to make it into the "leader" list.

Despite regarded as enviable because it highlights Malaysia's strong current manufacturing position and readiness for Industry 4.0, this is also a challenging position for Malaysia as it places the country's economic value at risk should it fail to transform at haste. In order to keep up with global leaders such as

Germany, Japan, Korea and China, Malaysia is working towards an end-to-end Industry 4.0 ecosystem within the country. The formation of this ecosystem is vital in guiding the development of the new Industry 4.0 policy framework and its four goals comprising GDP contribution, national productivity, higher skilled employment and innovation capabilities.

A set of shift factors that needs to be optimised in a balance manner have been identified within the framework that would aid a concentrated and comprehensive transformation agenda for Malaysia's manufacturing sector. The readiness of businesses to make the digital transformation into Industry 4.0 largely depends on the following shift factors.



Technology



Technology has always been the underlying factor behind previous industrial revolutions. Similarly, technology still remain as a critical factor for Industry 4.0 emerging technologies such as cloud computing, automation, Artificial Intelligence (AI), and IoT are forming an interconnected industrial landscape where physical assets and equipment are integrated with systems to enable contents and dynamic exchange and data analysis. For companies to achieve their Industry 4.0 objectives, automation, ubiquitous connectivity and intelligent systems are necessary.

While investment in technology is necessary for Industry 4.0 digital transformation, many businesses fall into the trap of wasting time, effort and resources in investing in technologies that fail to address operational issues at hand. Hence, it is crucial for companies to have detailed understanding of performance and operational problems before they decide to invest in Industry 4.0 solutions to benefit operational excellence through optimal applications of digital technology.

Process



When a company is able to apply technology alongside effective, well-designed processes, only then it can maximise value. The use of technology to digitise a poorly-designed process will only result in a poorly-designed digital process. Conversely, applying technology to a well-developed process will enhance its efficiency and enable the creation of new value.

Previously, companies centred their efforts on improving the efficiency of individual processes but under Industry 4.0, the concept of process improvement has expanded to focus on the integration of processes within a company's operation, supply chain and product lifecycle. As the processes within operations, supply chain and product lifecycle become integrated, they will converge into a single unified system where data is shared, processed and integrated across the product management, production and enterprise layers of the organisation. These will then generate the next leap forward in flexibility and efficiency.

People

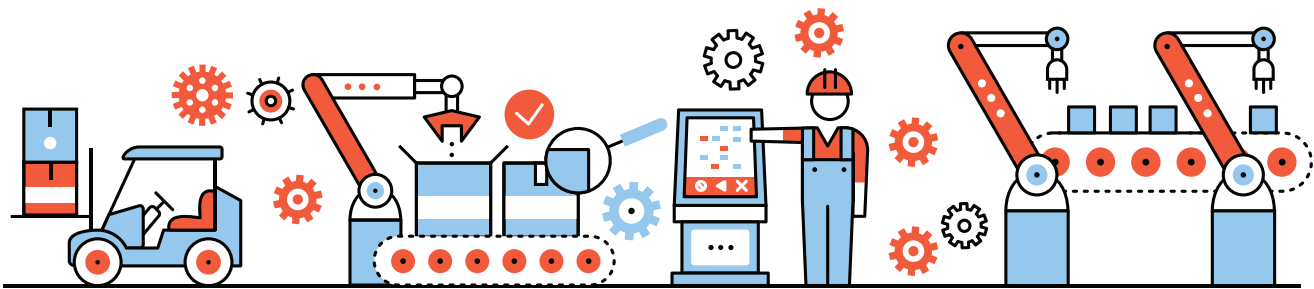


People are the third shift factor of Industry 4.0 as it plays an equally important role alongside technology and processes. To remain relevant in the face of increasing competition, companies must adapt their organisational structures and processes to allow their workforce to keep pace. Industry 4.0 highlights two key components that can effect businesses' effectiveness.

The first is the workforce which include both employees and top management and the second is the organisational system that governs how the company function. Both components are essential in order to reap the full benefits of Industry 4.0. For instance, an experienced leadership team and workforce will be discouraged by inflexible structures, inconsistent practices, and siloed processes. On the other hand, open channels for cooperation and innovation will not be effective unless employees are informed and incentivised to use them. As such, the necessary enhancements must be made to people, before a company can implement Industry 4.0 strategies effectively.

THE NINE BUILDING BLOCKS OF INDUSTRY 4.0

Although technology has always been present in manufacturing, Industry 4.0 is all about advanced digital technology. There are nine modern technologies regarded as a game-changer and are paving the way toward greater efficiencies as well as changing traditional production relationships between suppliers, producers, customers as well as human and machine interaction. These technologies are the driving force behind manufacturing's operational transformation. Also known as the nine pillars of technological advancement, these technologies form the building blocks of Industry 4.0.



1. Big Data and Analytics



Companies collect data to improve their operational processes. Big Data and Analytics is the collection of data comprising equipment and systems and customer managements system

help assist companies to identify trends, patterns and relationships between inputs, processes and outputs, enabling real-time decision making.

2. Autonomous Robots



The use of robotics arms gifted to us in the Third Industrial Revolution has enabled the industry to leapfrog. Industry 4.0 will see the further rise of autonomous system namely robotics working

side by side with humans (Collaborative Robot – COBOT) but with a greater range of capabilities all helping to contribute to a company's competitiveness, productivity and profitability.

3. Simulation



Vast range of industries are applying simulation into their operational processes, enabling operators to test and optimise machines and systems. This is especially relevant for those working within a dangerous physical environment because it allows

them to test the processes before they embark into the real situation. This would help in avoiding and improving machine downtime as well as increasing overall product and work quality.

4. Horizontal and Vertical System Integration



Through this technology; companies, departments, functions and capabilities are linked together allowing seamless communication, coordination

and exchange of data across the business as a whole.

5. The Industrial Internet of Things (IIOT)



This technology connects the Internet to everyday items, tasks, equipment and components enabling real-time responses.

Saving businesses valuable resource such as time and money, this also help in reducing production time as well as aid risk management.

6. Cybersecurity



Many businesses are wary about the whole leap into Industry 4.0 due to concern over security threats. Sophisticated and reliable security management system is essential to safeguard systems against cyber-attacks, networking to

support the systems' distributed operations, game techniques to advance their user interaction and visualisation, as well as software engineering and AI to build autonomic capability into the systems for intelligent operations.

7. The Cloud



Cloud Computing involves a network of remote servers to store, manage and process data which helps especially in production-related sharing across sites and company boundaries. This is

advantageous for businesses as it permits the company to bring forward their savviness in all sales situations.

8. Additive Manufacturing



Additive manufacturing such as 3D design printing is highly useful especially in the making of prototype and production of individual components. This technology enables

manufacturers to focus on producing small batches of customised products which offer construction advantages such as complex, lightweight designs.

9. Augmented Reality



Made popular via the gaming community such as Pokemon Go, augmented reality allows augmented imagery to be placed in front of the real-world. This presents businesses the opportunities to

showcase their products to the market without having to bear the expense of creating a physical copy.

THE GAME CHANGERS

In accelerating Malaysia's transformation into Industry 4.0, a number of initiatives have been formulated and several organisations have been established with the purpose of facilitating the industry's digital transformation. It is important for the industry to have a strong platform and support system so they may transform smoothly into Industry 4.0.

Creating the future workforce is not only about attracting and developing new talent needed, but also preparing existing employees through training

programmes as well as re-designing work processes to reduce skill mismatch between jobs and employees.

There are ample of resources made available by the Malaysian government to assist businesses transition into the new era of Industry 4.0. Businesses can seek these organisations to get the essential help needed especially in term of capacity development, assessments, organisation management as well as learning from the actual practitioners themselves.

Capacity Development

When the word manufacturing comes up, the thought of a labour-intensive workplace springs to mind. Industry 4.0 changes all that by shifting the manufacturing sector from being labour-intensive to skill-intensive. Industry 4.0 has brought with it a new perspective to understand the importance of investing in the right people for specific skills and the development of employees.

Human Resource plays an important role to not only ensure that only qualified people are employed for specific roles but also to help the existing workforce

to upgrade their knowledge and the necessary skills so they do not get left behind and a company will stay aligned with its business goals.

Organisations such as Penang Skills Development Centre (PSDC) and the German-Malaysia Institute (GMI) provide the necessary skills training and self-directed learning and development institution that offering assistance for businesses to strengthen their workforce to prepare them for Industry 4.0.

Practitioners

Malaysia's economy has flourished by leaps and bounds over the past 20 years, thanks to its thriving manufacturing base that embarks on robotic assembly lines, precision engineering and computer controlled processes. Leveraging upon Malaysia's strong manufacturing base, Malaysia is aligning itself with Industry 4.0 by advocating companies to be open to emerging technologies and incorporating them into their business strategy in order to remain competitive.

Many Malaysian companies have jumped onto the bandwagon through their R&D, engineering design, innovation and system integration and also developing propriety machinery and equipment for global exports. It has been reported that currently there are 165 projects across the country focusing

on the manufacturing of robotics and automation equipment for numerous industries undertaken by companies that specialises in machinery and equipment for the semiconductor industry and material handling.

Other businesses that have also adopted Industry 4.0 practices include local system integrators (SI) that provide integrated high-tech solutions for high-tech industries. Among local practitioners in the country include companies such as NationGate Solution (M) Sdn Bhd, Sanmina-SCO System (M) Sdn Bhd, Pentamaster, Inari Technology Sdn Bhd, Robert Bosch (M) Sdn Bhd, ViTrox Technology Sdn Bhd, First Solar Malaysia Sdn Bhd and Infineon Technologies (M) Sdn Bhd.

Assessment

The only way for industries to compete in the future is through embracing the technologies of Industry 4.0. Businesses which fail to measure up to the standards set in Industry 4.0 will lose out. By applying new technologies, digital transformation occurs and companies will benefit from the competitive advantages that Industry 4.0 provides.

Assessments works well to measure a company's digitisation transformation and readiness for Industry 4.0. It helps businesses understand the company's standing in Industry 4.0 and gives

valuable insights on how the company is positioned against their competitors. Only through evaluation can a company identify relevant technology and market trends to be able to make strategic decision on technological investments befitting for their organisation.

Two organisations established for research and industry standards developments that are spearheading Industry 4.0 assessments within the nation are Standard and Industrial Research Institute of Malaysia (SIRIM) and iPlast.

5S/Lean for Industry 4.0

Technological advancements such as cloud computing, IoT, Big Data, AI and many more are revolutionising production in a impactful way, however, instead of making 5S/Lean principles irrelevant, the changing nature of business in Industry 4.0 has actually reinforced the important role of Lean.

With Industry 4.0 comes 5S/Lean. The changing business landscape offers a much richer understanding of customer demand and allows sharing of data throughout complex supply chains and networks. Smart factories can produce faster with less waste.

However, given the increasing technology complexity that Industry 4.0 brings forth, many companies are perplexed on how to approach this new era using the traditional approach.

The Malaysia Productivity Council (MPC) in support of the Malaysian government's efforts in ushering businesses into Industry 4.0 champions the lean approach. Through the introduction of MPC's Lean Roadmap, this is a systematic approach to promote Lean Management that complements the existing quality and productivity initiatives, incorporating all efforts in promoting process efficiency to heighten competitiveness of the nation.

LEARNING FROM THE BEST PRACTICES CASE STUDIES

Senheng

Introduction



Senheng Electric (KL) Sdn Bhd was established in 1989 by the Lim brothers. The company has its humble beginning as a small mom and pop consumer electronics shop in Pandan Jaya with an initial stock

worth RM30,000. Prudent in managing his finances, Lim was able to open up a new shop every year using internally generated fund.

In 1993, Lim went to Taiwan to observe and learn firsthand how a chain store operates. The exposure in Taiwan taught him how to standardise

his business processes and procedures to make it easier to run his stores.

Upon his return, he adopted the business model employed at renowned chain stores like Poh Kong, 7 Eleven, Bonia and 99Speedmart. The company went on to become the leading consumer electronics chain store with 121 stores nationwide.

However, starting from 2014 to 2016, Lim saw his business declining by about 6 to 7 percent annually. He discovered that customer traffic had migrated from offline to online. Senheng had already gone online by then, but its online and instore businesses were operated separately, each in its own silo with distinct activities.

From Chain Store To Seamless

This transformation, along with customers' desire for integrating the advantages of both traditional and online shopping, has prompted Senheng to re-assess how to best attract and serve their customers.

On its 28th anniversary Senheng launched its seamless business model called 'SEAMLESS 2.0' in September 2017 by streamlining its 121 retail stores nationwide with an effective online channel to offer more value-added O2O shopping experience.

Senheng's SEAMLESS 2.0 platform uses Big Data to deliver a loop of continuous, relevant connections to shoppers before, during and after purchases.



"We are seeing an online-to-offline (O2O) revolution that changes the way people shop. Ultimately, consumers expect a seamless shopping experience across various channels that can be accessed whenever and however they choose."

Mr. Lim Kim Heng
Managing Director (MD)
Senheng Electric (KL) Sdn Bhd

Senheng Seamless Business Model

In its effort to implement the seamless retail concept, Senheng has enhanced the nine essential elements comprising product, pricing,

inventory, logistics, payment mode, repairs & services, loyalty programs, promotions, and sales partner benefit.

1. Product

Senheng has standardised its product offerings across channels and aims to provide the largest assortment of stock keeping unit (SKU) in the country.

Prior to this, the company's e-catalogue had to be updated manually every day by the staff.

Digitalising the product uploading process has resulted in a 50% increase in efficiency, and the availability of such international brands has increased traffic on its website, which further strengthens Senheng's reputation as an online store.

2. Pricing

Unlike most retailers who have different pricing structures for Peninsula Malaysia and Sabah and Sarawak, Senheng's prices are fixed nationwide, whether through online or offline channels.

The company's merchandising team uses an

Online Market Survey Solution to conduct a daily price competitiveness ranking across the market and negotiate with suppliers to ensure the best price for its customers.

3. Inventory

In managing the inventory of its online and offline stores, Senheng adapts to a centralised system for optimum order fulfilment.

It applies the 80-20 long-tail concept for its stock

inventory whereby 80% of the inventory comprises popular, high-demand products while the less popular online models make up the 20% balance.

4. Logistics

In SEAMLESS business model, another key milestone would be the launch of Centralise Delivery Management (CDM). CDM is a Supply Chain Management (SCM) solution where all the supplies are centralised and operated based on a single window for business partner to replenish order on a daily basis.

Senheng aspires to attain three goals by unlocking the CDM. By using CDM, it will reduce extra inventory floating at each logistics center and at the same time maximising the stock at the Central Distribution Centre (CDC). Replenishment from CDC to every warehouse will be done daily, enabling online and offline orders to be fulfill within 48 hours.



5. Payment Mode

Senheng ensures that its online buyers enjoy the same varied mode of payment as in-store buyers. Online buyers also have the privileges to pay for their items with installment financing plans, credit

card payment options, redemption facility etc. It also plans to introduce the mobile point of sale (mPOS) payment to both cash-on-delivery (COD) and credit- card-delivery (CCD) buyers.

6. Repair & Service

After-sales service is a critical element in the successful marketing of any products. Senheng has developed an application called the Senheng App where customers can use the App to track the progress of their service request. They can

also use the QuickChat module modeled after the Uber concept that comes with the Senheng App, to make any inquiry anywhere, anytime, and the nearest store manager will respond within 15 minutes.

7. Loyalty Program for PlusOne member

The Senheng PlusOne Loyalty Program is now cardless. The membership is programmed into the customer's mobile phone via the Senheng App. PlusOne members who purchase products online or offline enjoy an extra one-year Senheng

warranty on top of the manufacturer's warranty. Such standardisation has not only streamlined the PlusOne membership benefits across channels, it also helps boost customer loyalty and return rate.

8. Promotion

Senheng has streamlined its branding and promotion by offering the same benefits and entitlements to offline and online customers. Such streamlining has eliminated any confusion and ambiguity arising from human error which inevitably occurs where a company runs different promotion programs online and in-store.

Senheng is also collaborating with Google and Facebook to track its online and offline customer history, including to monetise its Big Data. By doing this, the company is able to analyse its customers' behaviour. The collaboration will enable the company to track offline conversion through their various online promotion activities.

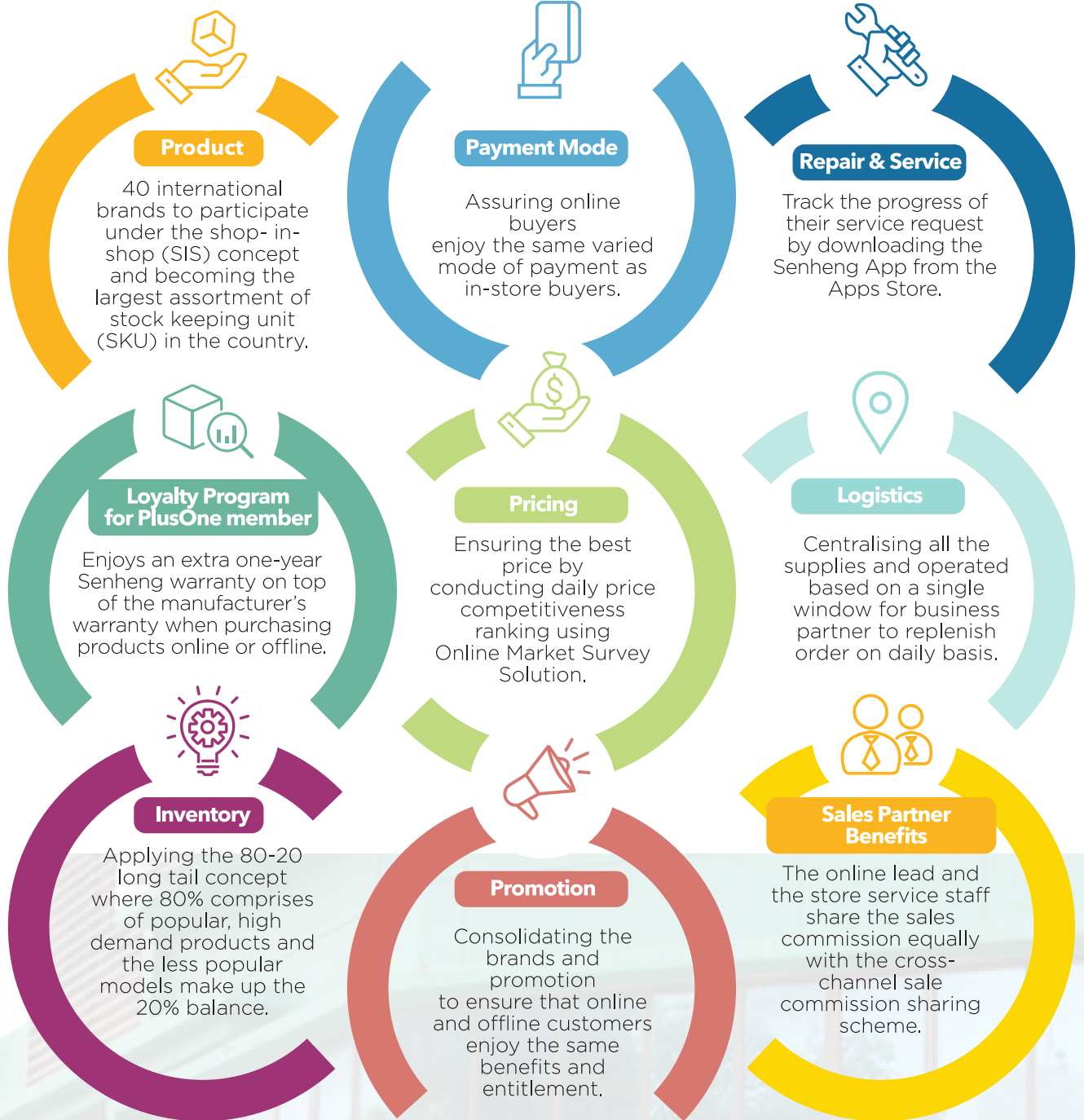
9. Sales Partner Benefits

Senheng has a cross-channel sale commission sharing scheme whereby when a sale is transacted online and the customer chooses to collect the product at the nearest store, both the online lead and the store service staff gets to share the sales commission equally.

This cross-channel commission sharing initiative is one of the contributory factors that has resulted in better customer experience and helped the company achieve a target of 30% store pick-up for on-line purchases.



The 9 Elements



source: Full article entitled "Going Seamless Boosts Customer Traffic" available in <http://bond.mpc.gov.my>



Pentamaster

Introduction



Established in 1991, Pentamaster Corporation Bhd provides world class automated equipment and automated manufacturing solutions to the semiconductor and manufacturing industries across the globe through its three solutions namely an Automated Test Equipment, Automated Manufacturing Solution, and a Smart Control Solution System. The company has a staff force more than 400 people, half of whom are engineers whose core competencies include mechanical engineering design, software programming, control engineering, vision imaging, optic design, electronic instrumentation design, and project management. Apart from Malaysian companies, Pentamaster's customers include multi-national corporations (MNC) in the ASEAN and Asia Pacific regions, China, Japan, Africa, Europe and the United States.

Offering an Array of Digitised Production Equipment and Solutions towards Industry 4.0

Pentamaster produces more than 150 automated equipment annually. The company's ability to produce a combination of production equipment and the right solutions has boosts its reputation with growing demand from the industry. These solutions facilitate to improve, monitor, and respond to changes in production demand which consequently increase efficiencies, decrease downtime, and reduce wastage at the production lines.

With the diversified product line-up, Pentamaster has the ability to meet the market demand by offering digitisation of products, including the expansion of existing product line up, e.g. by adding smart sensors or communication devices that can be used with data analytics tools, as well as the creation of new digitised products which focus on completely integrated solutions.

These customised products usually generate significantly higher margins than mass-manufactured offerings. Pentamaster managed to record an increment in profit of 30% annually as a result of the products innovation.



"For a company to successfully migrate to Industry 4.0, it is crucial to have a top-down mind set change in terms of commitment, focus, direction and value add. Hiring the right people and training them is very important."

Mr. Chuah Choon Bin
Non-Executive Chairman
Pentamaster Corporation Berhad

Teamwork Aspires Great Success in Industry 4.0

Pentamaster produces high-tech products wherein real time data must be available at anytime, anywhere. Data collection encompasses the whole spectrum in the creation process from the conceptualisation phase, design and manufacturing stage, up to completion and after-sale service.

The company's engineers have developed the software to retrieve the data required at each business workflow. The data collected by every piece of machinery in the production process is integrated in real time into the Pentamaster server using cloud computing technology.

In-house data analytics technology and skill levels are the two important elements to boost data analytics capabilities. Pentamaster has developed significant analytic software which speed up the process of sorts-out and analyses the big data, to produce a real time report specific to the work order. As the company's products and solutions are tailor-made and not mass produced, data collection and analytics is of the utmost importance in enabling Pentamaster to optimise overall business planning and controlling functions.

With the available data, management can gain the insights needed to optimise operational, tactical, and strategic planning and execution across the supply chain. Pentamaster's in-house solution can optimise asset utilisation through operational efficiency while minimising transport and logistic costs. It also enables early detection of defects or abnormalities in the production process through a high speed and accurate quality inspection.

The company is able to ensure on-time delivery of goods and rapid response to unexpected disruptions and changes to customer orders. It can evaluate different scenarios and choose the best transportation routes, modes, and carrier combinations.

Pentamaster employs autonomous robotics in the quality inspection process. The decision made to automate the work process is the right move in making sure that the product quality is the best in its class other than achieving the target of zero defect. At the same time, the worker's skill can be enhanced where workers manoeuvre the robots instead of manual inspection which is time consuming and high possibilities of human errors.

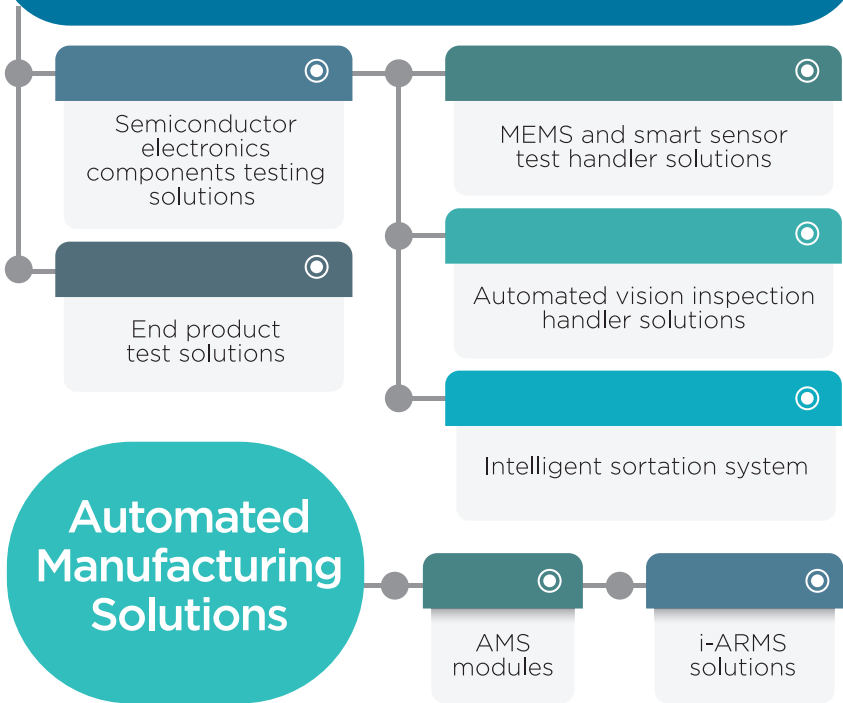
Apart from enhancing efficiency, the data from the automation process is forwarded to the customer for their reference. Real time data enables Pentamaster to update the customer in real time on the order status and product quality status, thereby instilling customer-confidence and promoting return sales.

The impact of cloud computing in Pentamaster has resulted a productivity increment of 5%, whereby the total machine downtime reduction by 40%. Technical professional skills also recorded a rise by 35%. The cost for inventory holding registered a deduction by 20% and maintenance costs and cost for quality also show reduction by 10% and 15% respectively.



Digitised Products Offered by Pentamaster

Automated Test Equipment



SUPPORTED BY Industry 4.0 Implementation Leads to Greater Success

- Pentamaster successfully developed a software that can expedite the process to produce real-time data.
- Optimises business planning by understanding the importance of data collection and analytics.
- Elevating asset utilisation with effective in-house solution.
- Autonomous robotic to carry out quality-checking.
- Pentamaster updates order and product quality status in real-time to customer

Impact of Industry 4.0

1. Productivity escalated by 5%
2. Machine disruption reduced by 40%
3. Technical professional skills rose by 35%
4. Cost for inventory lessen by 20%
5. Maintenance cost dropped by 10%
6. Cost for quality decreased by 15%

Conclusion of achievement

Numerous positive attributes especially productivity and efficiency after implementation of Industry 4.0

1

Customised products generate higher margins compared to mass-manufactured products

2

Profit increment of 30% annually from products innovation

Achievement

Accomplishment's Groundwork

- Top down mindset change
- Bring the right people
- High investment in Industry 4.0
- Inculcate a quality-centric culture

source: Full article entitled " Embracing Industry 4.0 Automation Solutions for Better Outcomes" available in <http://bond.mpc.gov.my>

NationGate

Introduction

NationGate Solution endeavors to serve the industrial sector by facilitating them an alternative to those prospects. The services that they offer to them include all kinds of high speed Surface Mount Technology (SMT), Chip On Flex/Board (COB), Final Assembly (Box Build), precision Plastic Molding and Final Testing service.

It is NationGate's culture to emphasise and put priority in a conducive workplace for the well-being of their employees which eventually leads to an increased productivity and efficiency

Employee Engagement Strategy towards Industry 4.0

As a leadership commitment and an effort to move forward towards Industry 4.0, the company started implementing this trend commencing from June 2017. NationGate began this initiative by getting the endorsement from the top management of the company, and acquire approval from all the directors. All activities are closely monitored through a list of KPIs in the Industry 4.0 achievement. A weekly Industrial 4.0 management review meeting is carried out to monitor the progress and status of each of the initiatives. This is to ensure that the implementation is on track.

An introduction was provided to all NationGate's employees by giving them appropriate briefing and skill training regarding Industry 4.0. This initiative succeeded in eliminating non-value added activities and increase the skills of their employees. Before Industry 4.0, workers are only able to conduct one task. After Industry 4.0, they were able to upskill their employees. Conversely, to ensure that every staff participate in this action, NationGate offers them extra benefits for every additional skill obtained whereby they are rewarded with monthly meal coupons ranging from RM20 to RM50 for every qualified skill they have obtained. Whereas for employees who achieved the complete total of five skills, their basic salary is raised by 30%.



NationGate

of their operation. The company places high level of safety awareness and good practices to build their current world class workplace for the employees. This drives them for a continuous improvement that highlight on their main concern, which is to reduce waste.



"It is highly possible for all industry players to implement Industry 4.0 into their operation. The collection of data for every process is pertinent to ensure fast and accurate results."

Mr. David KB Lim
Resource Planning Director
NationGate Solution (M) Sdn Bhd

NationGate established a designated team consisting a total of 15 members to turn their factories into Industry 4.0 oriented. For this purpose, existing and future investment of RM19 million in IT, infrastructure, computer servers, IoT, system integration and software development. To ensure that the adoption of Industry 4.0 is done immediately, NationGate has budgeted over RM100 million to be invested for new plant & machinery, advanced automation and new equipment.

Making Vertical and Horizontal Value-chain Data Integration Possible at NationGate

As the preliminary stage of the implementation of Industry 4.0, NationGate has developed an inhouse software platform with the required infrastructure to cater for the needs of this implementation. This system was built to accommodate Big Data for every process in the vertical and horizontal value chain of the company. Moreover, they also utilised this system to analyse the gathered data and to produce real-time reports. This is part of Industrial 4.0 covering simulation, IoT, Big Data, system integration and cybersecurity.

NationGate has more than 100 machines of different languages and IPs that come from multiple vendors ; homegrown as well as the

foreign vendors. Each machine is required to transmit data that involves the work process run by the machine. The challenge for NationGate would be getting these vendors to disclose the necessary internal software codes of their machine.

NationGate has also engaged external support to speed up the MIS activities. This collaboration has created a win-win situation whereby the vendor is able to understand customers' requirement in effort to digitalise and add value to their machine. NationGate sees that they have come to 25% of this effort, and aims to reach another 25% for the year 2018.

Capturing Data for Multiple Utilisation

The efforts in capturing data from the machines have driven the company towards real-time analysis and establish preventive measurement, whereby they are able to predict circumstances simply based on collected data and statistics.

Through Manufacturing Execution System (MES), all reports are displayed on the screen which facilitates employees to access the information and data easily. Engineers and technicians are able to identify the mean time between failure for an equipment when they are about to face a disruption. The employees that are assigned to handle a specific machine for routine maintenance activity can also refer to the manual displayed on the screen.

MES is also linked with Enterprise Resource Planning (ERP) which could assist the Procurement Unit to plan the purchasing of raw materials accurately. With the existence of

real-time data integrator, the Production Unit could estimate and advise the amount of raw materials needed to the Procurement Unit through MES without submitting an order form manually. The data also enable the Procurement Unit to monitor the current stocks contained in their warehouse effectively, since the stocks are stored only for a short period of time because every part has different duration of shelf-life.

NationGate recognises that the data available could benefit them in supplying data to customers efficiently upon request. The data that is given includes the profile of the equipment, process type and series number of the products. This is done to portray good image to their customer and ultimately creates good repertoire to the company. The said data is also very important to them in order to trace production history during the work process in the event that a feedback is reported by a customer.



Vertical And Horizontal Value Chain

Manufacturing Execution System (MES)

Real-time data analysis facilitate NationGate to take prevention step.

Report and routine maintenance displayed on the screen to ease the workers to detect potential predicament.

MES linked with ERP to assist in supervising current stock and purchasing raw materials.

The data benefits NationGate by tracking faulty reported by customers and resulting in good impression to NationGate.

Developing Software to Move Forward

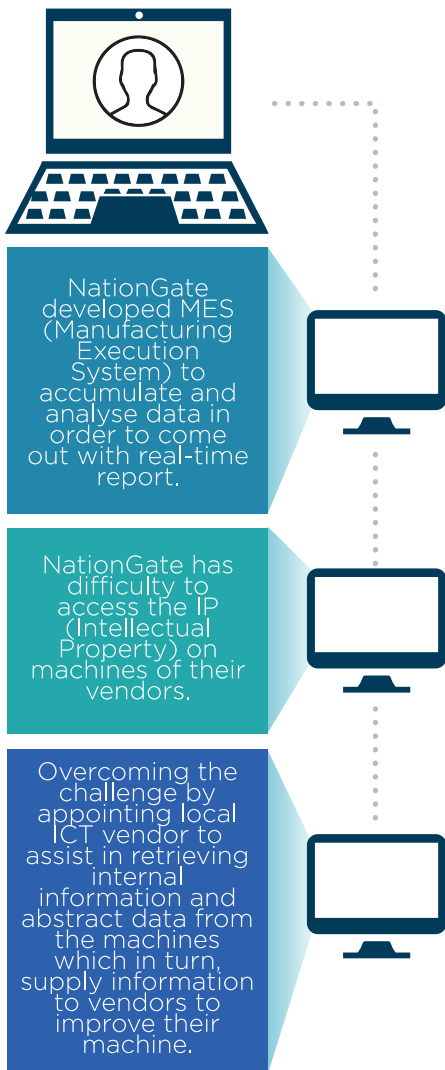
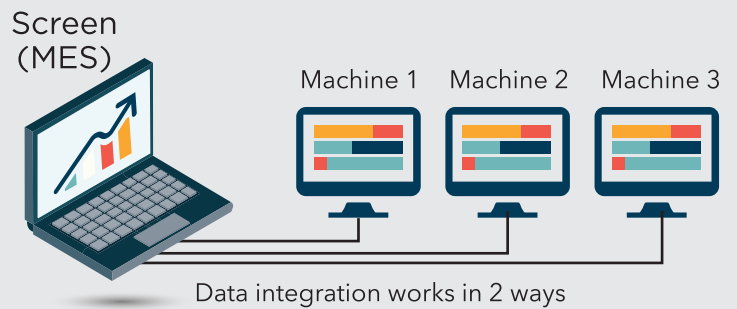
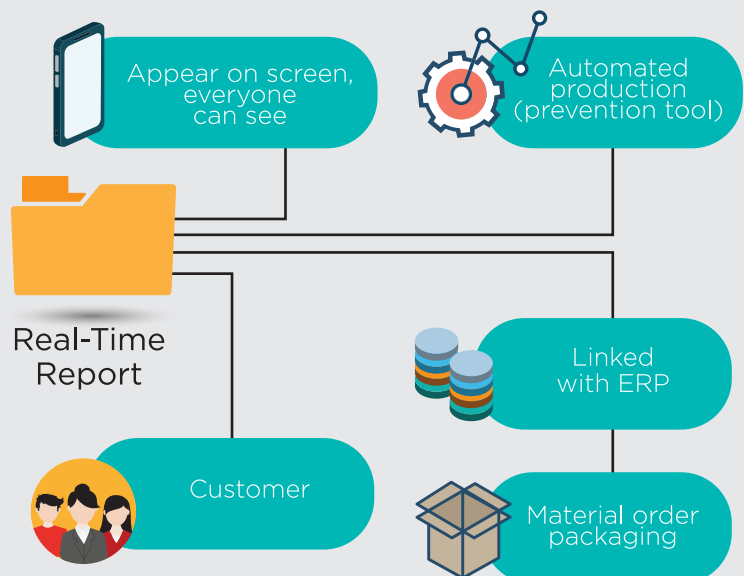


Diagram: MES Workflow Diagram



Data Processing and Analysing



source: Full article entitled "Digital System Integration and Machine Automation towards Industry 4.0" available in <http://bond.mpc.gov.my>

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