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Toyota Production System

1. Introduction

The Toyota Production System (TPS) has been developed and refined over several decades. Although TPS was originally developed by Toyota Motor Corporation, it has now been adopted by many other organisations around the world, and tangible benefits in the quality and reliability of the organisation's products and services.

2. What is Toyota Production System?

The Toyota Production System has established a global reputation as a leading business philosophy that delivers measurable benefits in terms of efficiency and quality in manufacturing. TPS is an "integrated socio-technical system, developed by Toyota that comprises its management philosophy and practices".

3. What are the Objectives of Toyota Production System?

The main objectives of TPS are to phase out overburden (*muri*) and inconsistency (*mura*), and to eliminate waste (*muda*). The most significant effects on process value delivery are achieved by designing a process capable of delivering the required results smoothly; by designing out *mura*. It is also crucial to ensure that the process is as flexible as necessary without stress or *muri* since this generates *muda*.

There are seven kinds of *muda* targeted in the TPS:

- **Overproduction**
Overproduction includes producing more, sooner and faster than required by the next process. It leads to the production of unnecessary products, which are wasting material, resources and personnel. Lean organisations would need to ensure that overproduction, redundant or early production is avoided and eliminated.

- **Unnecessary stock**
Unnecessary stock is not only a waste, but also creates waste. Hence, it is necessary for lean organisation to manage their inventory well, and prevent the holding or purchasing of unnecessary raw materials, performance of unnecessary work-in-progress, or the production and storage of unnecessary products.
- **Inefficient transportation**
Inefficient transportation may add to cost but creates no value to the product and end customers. Thus, organisations should streamline their transportation of materials or products, which can result in the reduction of multiple handling of materials, delays in material handling, and avoid unnecessary handling.
- **Unnecessary motion**
Poor planning and organisational layout often cause motion waste. An example of unnecessary motion is the walk that is undertaken by the personnel to pick up store parts. Storing the parts closer to where they are actually used could eliminate such unnecessary trips and unproductive actions and motions.
- **Waiting time**
Waiting for products, personnel or parts all result in wasted time. The operator or machine idle time does not add value to the product. Hence, lean organisations should ensure that unnecessary waiting times are reduced to increase efficiency and achieve a smoother production process.
- **Rejects and defects**
Lean organisations should also strive to reduce or eliminate the production of defective units. Errors in the production process should be identified during the lean analysis and will greatly help to eliminate the production of defective units that cannot be used or sold and avoid reworking and repairing.
- **Inappropriate processing**
Lean organisations need to eliminate doing more work than necessary. Organisations should strive to reduce or stop over-processing by eliminating unnecessary steps or work elements that do not add value to the work or product.

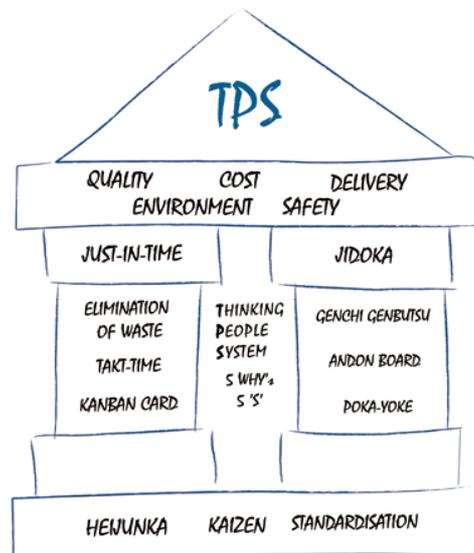
Toyota Production System has three desired outcomes:

- To provide the customer with the highest quality, at lowest possible cost, in a timely manner with the shortest possible lead times.
- To provide members with work satisfaction, job security and fair treatment.
- It gives the company flexibility to respond to the market, achieve profit through cost reduction activities and long-term prosperity.

TPS strives for the absolute elimination of waste, overburden and unevenness in all areas to allow everyone in the team to work smoothly and efficiently. The foundations of TPS are built on standardisation to ensure a safe method of operation and a consistent approach to quality.

TPS also urges the organisation to continually improve their standard processes and procedures, in order to ensure maximum quality, improve efficiency and eliminate waste. This is known as *kaizen*, which is applied to every sphere of the organisation's activities.

4. The Toyota Production System



Source: Toyota production system and what it means for business. (n.d.). Retrieved June 1, 2012, from <http://www.toyota-forklifts.eu/SiteCollectionDocuments/PDF%20files/Toyota%20Production%20System%20Brochure.pdf>

TPS empowers team members to optimise quality by constantly improving processes and eliminating unnecessary waste in natural, human and corporate resources. It influences every aspect of Toyota's organisation and includes a common set of values, knowledge and procedures. It entrusts employees with well-defined responsibilities in each production step and encourages every team member to strive for overall improvement.

Hence, TPS delivers the following key benefits:

- Quality
- Cost
- Delivery
- Environment
- Safety

4.1. Just-in-Time

The Toyota Production System fulfils customer demand efficiently and promptly by linking all production activity to real marketplace demand. Just-in-time production relies on "finely tuned processed in the assembly sequence using only the quantities of items required, only when they are needed". While it poses a planning challenge, it is also a typical scenario in many types of business in which the process (manufacturing or otherwise) has to continuously respond to demand.

Toyota Production System has responded to this reality of life by developing an approach that can meet the challenge in an efficient, cost-effective way. Just-in-time offers a smooth, continuous and optimised workflow, with carefully planned and measured work-cycle times and on-demand movement of goods, reduces the cost of wasted time, materials and capacity. Team members can concentrate on their tasks without interruption, which leads to better quality, timely delivery, and peace-of-mind for Toyota's customers.

Just-in-time is itself, based on four key principles that work together to support this unique concept at every level: *heijunka*, elimination of waste, *takt* time and *Kanban*.

Heijunka

Heijunka, a key part of the just-in-time process, is the elimination of unevenness in workload (*mura*) by levelling volumes to produce a smooth, continuous and efficient flow. With *heijunka*, processes are designed to enable products to be switched easily, producing what is needed, when it is needed.

Heijunka also eliminates *muri* – overburden or strenuous work that can lead to safety and quality problems. Both *mura* and *muri* are thought of as types of *muda*, or waste, which should be eradicated.

Elimination of Waste

Waste, or *muda*, is defined as anything that does not add value. This includes areas that might not normally be considered as waste, such as overproduction, holding too great an inventory, and all unnecessary movement, processing and waiting.

Takt Time

Time management is the core of TPS. *Takt* is the rate of customer demand. *Takt* time is the term referring to a work-cycle that fulfils each customer's demand.

The key is that work-cycle should be synchronised with demand to avoid underproduction or overproduction. *Takt* time determines the flow rate and enables the calculation of how much work can be done. Optimisation of *takt* time reduces waste and inefficiency through the elimination of risk of time delays, or excess production.

Both *takt* time and *heijunka* give in the ability to be flexible according to demand and ensure the production is smooth, continuous and proportionate.

Kanban

In order to have flexible, efficient and smooth workflows, it is necessary to have the right things at the right place at the right time. In TPS it means having just the right components to build the product.

Kanban is not an inventory control system, but a scheduling system that helps determine what to produce, when to produce it, and how much to produce. *Kanban* became an effective tool to support the running of the production system as a whole.

The *kanban* card is a key component of *Kanban* that is used to signal the need to move materials within a manufacturing or production facility or move materials from an outside supplier to the production facility. It is a simple, highly-visible device that “calls up” components as they are required. This means only a minimum stock of components is held in the assembly area. Before stocks need replenishing, a *kanban* card instruction from the operator ensures a just-in-time delivery. The process is based on a ‘pull’ principle – with items called only as they are required, as opposed to a ‘push’ principle that may not take account of actual need.

4.2. Jidoka

When it comes to quality, there is no room for compromise in the Toyota Production System. The TPS principle of *jidoka* builds quality checks into each step of the production process. By ensuring that all processes are visible, *jidoka* helps ensure that abnormalities are made visible and addressed immediately.

Jidoka translates as “autonomation” and can be described as “automation with a human touch”. Quality is monitored throughout, with each team member being responsible for performing quality checks before delivering the goods-in-process to the next point in the production line. If a defect or error is identified it is addressed immediately – even if this means temporarily stopping production.

Jidoka is supported by four important elements that help to ensure that quality is maintained at every stage: *genchi genbutsu*, the *andon* board, standardisation and *poka-yoke* (mistake-proofing).

Genchi Genbutsu

Improvements are often made as a result of discovering problems. Therefore, problems need to be properly understood through *genchi genbutsu*, which means “go and see”. It suggests that in order to truly understand a situation, one needs to go to *gemba* or, the “real place” – where work is done, rather than relying on information supplied by others,

in order to gain a complete and accurate understanding.

Andon Board

The *andon* board is a simple, yet highly visible electronic sign, which displays the status of every production line. It notifies management immediately if a worker has identified a fault, together with its precise location.

Workers take individual responsibility for production quality and have the power to stop the production line when required. The production line will not be restarted until the reason for the fault has been resolved.

Standardisation

Another key element for quality assurance is a focus on standardisation. Developing and relying on standardised work tasks not only ensures consistently high levels of quality, but also maintains production pace and provides a benchmark for implementing continuous improvement.

Poka-Yoke

In Toyota production lines it is a common sight to see devices that make it difficult or impossible for a worker to make common errors. Known as *poka-yoke*, this principle is a simple, yet creative and reliable way to reduce errors and maintain quality. All commonly used items are clearly labelled so that they can be found and used by everyone just as easily.

4.3. Kaizen

Kaizen is said to be the heart of TPS. While the process of change can be challenging in many organisations, change is a way of life in Toyota, thanks to the company's fundamental philosophy of continuous improvement known as *kaizen*. *Kaizen* means that everyone throughout the organisation is continuously looking for ways to improve operations, and people at all level in the company support this process of improvement.

Kaizen also requires clarity in terms of what is to be achieved – setting clear objectives and targets for improvement. It also requires a positive attitude, with the focus on what should be done rather than what can be done.

Kaizen is supported by three key principles: Thinking People System (TPS), 5 Whys and 5S.

Thinking People System

In TPS, team members are invited to think about the process and make timely decisions in order to keep it running smoothly, rather than merely operating like machines. This involvement creates responsibility for the success of the process, increasing both morale and quality. This is also essential for the success of *kaizen*.

Every morning, an *asa-ichi* meeting is held in Toyota plants to discuss quality deviations and eliminate their causes. *Kaizen* is not just based on improvements being developed and implemented by experts or management only. Instead, it involves everybody, relying on the extensive knowledge, skills and experiences of the people working directly in the process.

5 Whys

Kaizen requires that the logic and benefit of all improvements are carefully evaluated before being implemented. This is achieved by employing the concept of the ‘5 whys?’.

Every planned improvement needs to be tested by questioning ‘why?’ at five levels to ensure that its logic and value is clear. This also reduces the risk of making changes without sufficient justification.

5S

Toyota Production System goes beyond the areas that are purely related to production processes. It also extends to the whole organisation – sales and marketing, administration, product development and management.

Every employee, regardless of position is treated equally. Toyota takes care to nurture a sense of

pride and efficiency in the workplace. This is supported by the 5S:

- *Seiri* – Sifting
- *Seiton* – Sorting
- *Seiso* – Sweeping and cleaning
- *Seiketsu* – Spick-and-span
- *Shitsuke* – Sustain

These principles ensure that every team member is actively involved in keeping processes as effective and efficient as possible.

What are the benefits of Kaizen?

Kaizen involves every employee in making change – in most cases small, incremental changes. It focuses on identifying and solving problems at their source, and changing standards to ensure the problem stays solved.

These continual small improvements add up to major benefits. They result in improved productivity, improved quality, better safety, faster delivery, lower costs, and greater customer satisfaction. On top of these benefits to the company, employees working in *Kaizen*-based companies generally find work to be easier and more enjoyable, resulting in higher employee morale and job satisfaction, and lower turn-over.

With every employee looking for ways to make improvements, one can expect results such as:

- Reduced waste in areas such as inventory, waiting times, transportation, worker motion, employee skills, over production, excess quality and in processes.
- Improved space utilisation, product quality, use of capital, communications, production capacity and employee retention.
- *Kaizen* also provides immediate results. Instead of focusing on large, capital intensive improvements, *Kaizen* focuses on creative investments that continually solve large numbers of small problems. Large,

capital projects and major changes will still be needed, and *Kaizen* will also improve the capital projects process, but the real power of *Kaizen* is in the on-going process of continually making small improvements that improve processes and reduce waste.

5. What are the Benefits of the Toyota Production System?

Companies around the world that pursue and emulate TPS best practices have seen much success. Among the benefits include: decreased waste and costs in the manufacturing process; improved product quality and on-time delivery; and the development of a competitive world class manufacturing operation.

Enhances quality

TPS aims to get rid of variation. While other production system like Six Sigma only focuses on variation elimination and product quality in various processes, TPS is all inclusive for managing every factor of the business.

Reduces wastes

A core factor of the Toyota Production System is waste reduction. Here, waste refers to any process that does not bring value to an organisation. By eliminating waste from production processes, many firms have lessened the time they take to deliver their services or products to consumers. TPS helps to identify waste items and processes in a company, which might range from defects to time wasted during production.

Benefits consumers

The TPS is more value-driven and customer-driven. A key aspect of this production system is reduction in production times. The time a customer places their order as well as the time of service or product delivery is thereby reduced. TPS delivers great value to consumers and this may boost consumer retention. The producer also benefits from lessened defects as well as the manufacture of products at lower costs.

6. Seven Principles of Toyota Production System

In order to reduce or eliminate the waste, seven principles were developed by Toyota known as the seven principles of Toyota Production System.

- (i) **Reduce setup times**
All setup processes that are implemented are a waste as they tie up to labour and equipment. By organising procedures, using carts and highly skill workers to do their own setup (self management), Toyota managed to reduce setup times.
- (ii) **Small lot production**
Producing products in a big lots result in a high setup cost, high capital cost of high speed machinery, larger inventories, long lead time, and of course large defect cost.
- (iii) **Employee involvement**
Toyota organised their workers by forming teams and gave them the responsibility and training to do many specialised tasks. Teams are also given responsibility for housekeeping and minor equipment repair. Each team has a leader who also works as one of them on the line.
- (iv) **Top quality control**
Quality is well controlled at each station of production line. The concept is not to pass the defective product to the next process and this has helped a lot in the Toyota production line. Any defective product found must be discovered and corrected as soon as possible. Hence, to achieve this objective, responsibility is given to the owner of that process. If the defect cannot be fixed, he can stop the line by pulling stop cord called *jidoka*.
- (v) **Equipment maintenance**
Toyota operators are assigned primary responsibility for basic maintenance, as they are in the best position to detect signs of malfunctions. Maintenance specialists are tasked to diagnose and fix only complex problems, improve the performance of equipment and train workers in maintenance.

- (vi) Pull production
To reduce inventory holding costs and lead times, Toyota developed the pull production method, where the quantity of work performed at each stage of the process is dictated solely by demand for materials from the immediate next stage. The *Kanban* plan coordinates the flow of small containers of materials between stages. This can be generally referred to as Just-in-Time.

- (vii) Supplier involvement
Toyota treats its suppliers as partners, and an integral element of TPS. Suppliers are trained in ways to reduce setup times, inventories, defects, machine breakdowns etc., and take responsibility to deliver their best possible parts.

Case Study

Kaizen at Fleetwood

Fleetwood RV's plant 77 in Chico, California, was experiencing growing pains. It had a slow start as the oil embargo kept the plant from opening until 1984, five years after it was built. However, by 1997, its annual gross sales had reached US\$110 million a year. Nevertheless, the plant had hit a manufacturing plateau and production had levelled off. Plant 77 had introduced a quality improvement process in 1992 that involved a five-step problem-resolution process, corrective action teams and process model work sheets, but progress was slow. In order to grow, the plant needed more room and higher production numbers, but it needed to attain them without the expense of added labour or new construction.

The recreational vehicle (RV) market can be a difficult one in which to succeed. Primarily products for the affluent, RVs have a more limited market than do other vehicles. Recording US\$1.73 billion in sales in 1999, Fleetwood's RV division flourished because it offered a wide variety of RVs and was known for quality – according to its customer satisfaction surveys.

The Kaizen Discovery

Plant 77 found a way to re-energise production when its Operations Director, Steve Hulft, discovered *Kaizen*. Plant 77 ultimately adopted TBM's Global Production System (GPS), essentially a tailored amalgam of the Toyota Production System and lean manufacturing principles driven by *Kaizen* methodology. In contrast to the Toyota Production System, which was tailored for the automotive industry, the GPS was designed to apply to virtually any industry. It also helps companies to establish the change culture necessary for the successful application of *Kaizen*. This is an area not addressed in Toyota as they already had such a culture in place. Hence, its system did not address problems other companies would likely face when attempting to effect change. GPS's primary purpose is to help the company produce more with less while adding value constantly.

Its potential for growth and its management's support of the process and determination to improve made plant 77 an ideal candidate for implementing GPS. Anand Sharma, President and CEO of TBM Consulting Group notes that "change affects every part of an organisation. If management is not ready, it will kill the enthusiasm required for success."

Once its consultants determined that the company was a good candidate, it was time for the two-day launch process. During the launch, plant 77's management team learned where they were to begin work. How to prepare, and also selected a team leader. Additionally, the team and the consultants scheduled monthly interventions, which average four days per month, present an opportunity for progress reviews and on-the-spot advances. During interventions, visiting consultants actually work in the plant to identify problem areas, such as having to leave the work station to obtain tools or materials, and improve them.

Near the end of the launch, senior management set new policy and worked to align their objectives with their newly developed skills. Among the objectives they identified were reducing work-in-progress, increasing workers' daily piece production, solving specific safety and ergonomics issues, and fixing specific quality problems.

The next big step was the in-house *Kaizen* "event," which had to involve at least one manager who would demonstrate by his or her presence on the shop floor that management supported the process. A week-long *Kaizen* event, which can be either public or private (in-house), are designed to involve and empower everyone, helping to break down inertia and the resistance to change. During each event, the *Kaizen* team is assigned an improvement project with specific goals. Following four to eight hours of classroom training, the team and consultants examine the existing manufacturing process, identify areas of waste and non value-added operations, and begin generating improvement ideas. The team then applies the ideas directly to the factory floor, keeping those that eliminate waste and contribute to building a one-piece-flow manufacturing process.

Plant 77 held its first in-house *Kaizen* event in July 1998, which proved very effective – reducing cycle times by 28 percent, work-in-progress by 73 percent, labour hours by 19 percent and floor space waste by 59 percent. This drove all of Fleetwood's other motor-home plants to begin working with TBM. Eventually, managers at plant 77 decided to stage a public *Kaizen* event.

During public *Kaizens*, representatives from other companies, as well as other industries, visit the host company both to learn and to contribute by offering suggestions for process improvements. To understand the process more thoroughly, plant 77's production manager, John Fedele, and general manager, Al LaBelle, had attended public events at Maytag and Black & Decker before setting out to build Fleetwood's own GPS.

In December 1999, plant 77 became the first Fleetwood plant to hold a public *Kaizen* event, hosting 48 participants in five

teams and working in five areas. Among the visitors were consultants from Japanese and Brazilian firms and representatives from Safari Motor Coach, Kaiser Aluminum and Perkins Diesel Engine. Notably, plant 77's was the first public *Kaizen* ever held on the west coast of the United States and the first in the RV industry.

The public *Kaizen* was a five-day workshop. During the first day and a half, participants attended basic training, where they learn about *Kaizen* methodology and developed new tools and skills they'll be using in the following week and beyond. After training, team members watched and assessed the one-piece-flow production as it takes place. They timed and recorded work practices, making note of areas in which waste occurs. On the third day, the participants implemented their suggestions for change, and maintenance crews worked through the night moving equipment and materials. After the shop floor was reorganised, teams spend the fourth day refining changes, generating more ideas and re-timing production cycles to provide evidence of improvement. On the last day, participants gather to discuss the changes they had made, which usually included productivity gains and significant reductions in work-in-progress inventories, defects, lead time and wasted floor space.

Less is More

Kaizen events are designed to be a learning process for everyone involved. One skill particularly important for Fleetwood employees is being able to identify waste.

Among the first waste issues the teams addressed was lumber. At the time of the public *Kaizen*, the plant used eight-foot lengths of lumber, which the supplier cut from 16-foot lengths. However, the teams discovered that, in most cases, seven-foot lengths were all that were necessary. The supplier now cuts from 14-foot lengths, which are more easily available and less wasteful – and saved Fleetwood money.

Lumber also played a role in one of the primary problems that team members wanted to solve: a lack of floor space. They now bring in the lumber into the shop in much smaller quantities, as compared to having whole bunks of lumber stacked at each cut station. This way, the available floor space at Fleetwood increased by 29 percent.

Grow Ahead

As Fleetwood worked to increase production efficiency by building more with less, plant 77 had been able to reduce labour usage by about 14 percent. This might have led to layoffs in many companies, but it was not the case at the

Chico site. For employees to truly cooperate in making the GPS implementation successful, they needed to feel that they were not going to improve themselves right out of jobs.

A successful change culture requires a commitment from management that improvements would not result in layoffs. The solution is a proactive growth strategy. As the company grows, present workers whose jobs have been eliminated due to efficiency increases are assigned new duties. This accomplishes two objectives: current employees have the job security they need so they would continue to contribute to improvement efforts, and the necessity to hire and train new employees vanishes. Fleetwood had already begun a growth strategy, so it could also use attrition to its advantage: as workers leave, the plant would not replace them. Moreover, the company was starting to place an emphasis on in-sourcing. As the people, machines and materials were already paid for, there is no need to send materials out to cut costs.

Envisioning the Future

Thus far, 19 of plant 77's departments have been "kaizenized," resulting in a 65 percent overall reduction in work-in-progress and a 22 percent overall reduction in cycle times. The Chico site has also jumped from being last to first in customer satisfaction among Fleetwood's five RV plants. Despite these tremendous advances, the plant has no plans to slow down, as *Kaizen* is, after all, about continuous improvement. Without adding any additional buildings to the plant, their next goal is to increase production from the current average rate of 55 units per week to 150 units per week, eventually working up to 200 units per week. The plant currently produces two classes of RVs on one line, but managers would like to be able to produce each class on its own line to increase efficiency and boost production numbers. To do so, space within the plant would be reassigned for new activities, and two parallel production lines, one for each class, would replace the single U-shaped line now in use.

Recommended Readings

Articles can be retrieved from
NLB's e-Resources –
<http://eresources.nlb.gov.sg>

Books are available at the Lee
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The Singapore Productivity Association (SPA) was set up in 1973 as an affiliated body of the then National Productivity Board, now SPRING Singapore. Its objective is to promote the active involvement of organisations and individuals in the Productivity Movement and to expedite the spread of productivity and its techniques.



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Module 2: Productivity Tools, Techniques & Management Systems (Duration: 3 days) <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 	Module 2: Productivity Tools, Techniques & Management Systems (Duration: 3 days) <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
Module 3: Innovation & Service Excellence (Duration: 3 days) <ul style="list-style-type: none"> • Knowledge Economy & Innovation • Service Excellence • Team Excellence 	Module 3: Innovation & Service Excellence (Duration: 3 days) <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
Module 4: Critical Success Factors (Duration: 1 day) <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.

Funding & Payment

The course is supported by the Singapore Workforce Development Agency (WDA). Funding is available at 70% and 50% of the course fees respectively for SMEs and MNCs/LLEs/Statutory Boards. Please find the prices payable in the net fee table below:

For SMEs:	Net Fee	Nett Fee with GST
SPA Member (S\$3,700)	S\$1,110	S\$1,187.70
Non-Member (S\$3,950)	S\$1,185	S\$1,267.95
For MNCs/LLEs/Statutory Boards	Net Fee	Nett Fee with GST
SPA Member (S\$3,700)	S\$1850	S\$1979.50
Non-Member (S\$3,950)	S\$1975	S\$2113.25

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.

For registration or more information, write to us at CPP@spa.org.sg.

Alternatively, you could also contact our secretariat:

Ms. Leanne Hwee

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