Productivity Link

SINGAPORE PRODUCTIVITY ASSOCIATION

August 2011

Contents

Multiple Activity Charts

1. Work Measurement

Work measurement, also known as time and motion study or work study, is defined as “the application of techniques designed to establish the time for an average worker to carry out a specified manufacturing task at a defined level of performance”. It aims at examining the way an activity is being carried out, simplifying or modifying the method of operation to reduce unnecessary or excess work, or the wasteful use of resources. It also sets up a time standard for performing that activity, uncovers non-standardisation that exist in the workplace, and identifies non-value adding activities and waste.

A work has to be measured for the following reasons:

- To discover and eliminate lost or ineffective time
- To establish standard times for performance measurement
- To measure performance against realistic expectations
- To set operating goals and objectives

Hence, the relation between productivity and work measurement is obvious. If work measurement results in cutting down the time of performing a certain activity by 20 percent, merely as a result of re-arranging the sequence or simplifying the method of operation and without additional expenditure, then productivity will also go up by a corresponding value, that is by 20 percent.

2. Why is Work Measurement Valuable?

Work measurement is a mean of raising productivity of a plant or operating unit by the re-organisation of work, a method which normally involves little or no capital expenditure on facilities and equipment. It is systematic and ensures that no factor affecting the efficiency of an operation is overlooked. Work measurement can also contribute to the improvement of safety and working conditions at the workplace by exposing hazardous operations and developing safer methods of performing operations.

There are a variety of ways in which work can be measured and a variety of techniques and tools have been established. One of the measurement tools that can be used is the multiple activity chart.

Work measurement benefits a wide range of applications which include:

- Planning the appropriate staffing levels to satisfy operational demands, while minimising labour cost
- Creating individual and/or department performance baselines (useful in implementing performance-based incentive programs)
- Quantifying the cost (and feasibility) of producing a new product or delivering a new service to customers
- Identifying opportunities to reduce the cycle time of processes and improve productivity
- Finding and addressing process bottlenecks

3. What is Multiple Activity Chart?

A multiple activity chart is a chart on which the activities of more than one subject (worker, machine or item of equipment) are recorded on a common time scale to show their interrelationship.

The chart deals with the criteria of work elements and their time for both the worker and the machine. The activities of each subject (worker or equipment) are recorded, normally as blocks in columnar form, against a time scale. It is not usual, or necessary, to include a high level of detail, but it is necessary to distinguish between components of work where subjects are working in an independent way (such as worker carrying out a manual task while a machine carries out an automatic process) or in an interconnected way (such as a worker setting up or operating a machine). The resulting chart clearly shows both interdependence and interference between subjects, and their effects in terms of creating delays and unoccupied time periods. They serve as useful devices to assist in the redistribution and balancing of workloads.

Multiple activity charts comprise a variety of charts with different names (but essentially doing the same thing) such as worker-machine process chart and gang process chart.

4. Benefits of Multiple Activity Charts

The multiple activity chart is extremely useful in organising teams of operatives on mass-production work, as well as on maintenance work when expensive plant cannot be allowed to remain idle longer than is absolutely necessary. It can also be used to determine the number of machines which an operative (or operatives) should be able to look after and assist in identifying bottlenecks.

The chart is a useful tool for understanding the flow of work in a cyclical process and as a consequence understanding which resource is controlling the overall progress of the work. It can also be used to describe any repetitive worker-machine system, as well as to investigate potential process improvements apart from illustrating delays and redundancy, hence ensuring process improvement efforts can be made to eliminate inefficiencies and identify the activities that can be combined. The multiple activity chart can also be used to model different scenarios to determine the optimum mix of resources for the work.

5. Using Multiple Activity Chart

Multiple activity chart uses separate vertical columns, or bars, to represent the activities of different operatives or machines against a common time scale. The chart shows very clearly periods of idleness on the part of any of the subjects during the process.

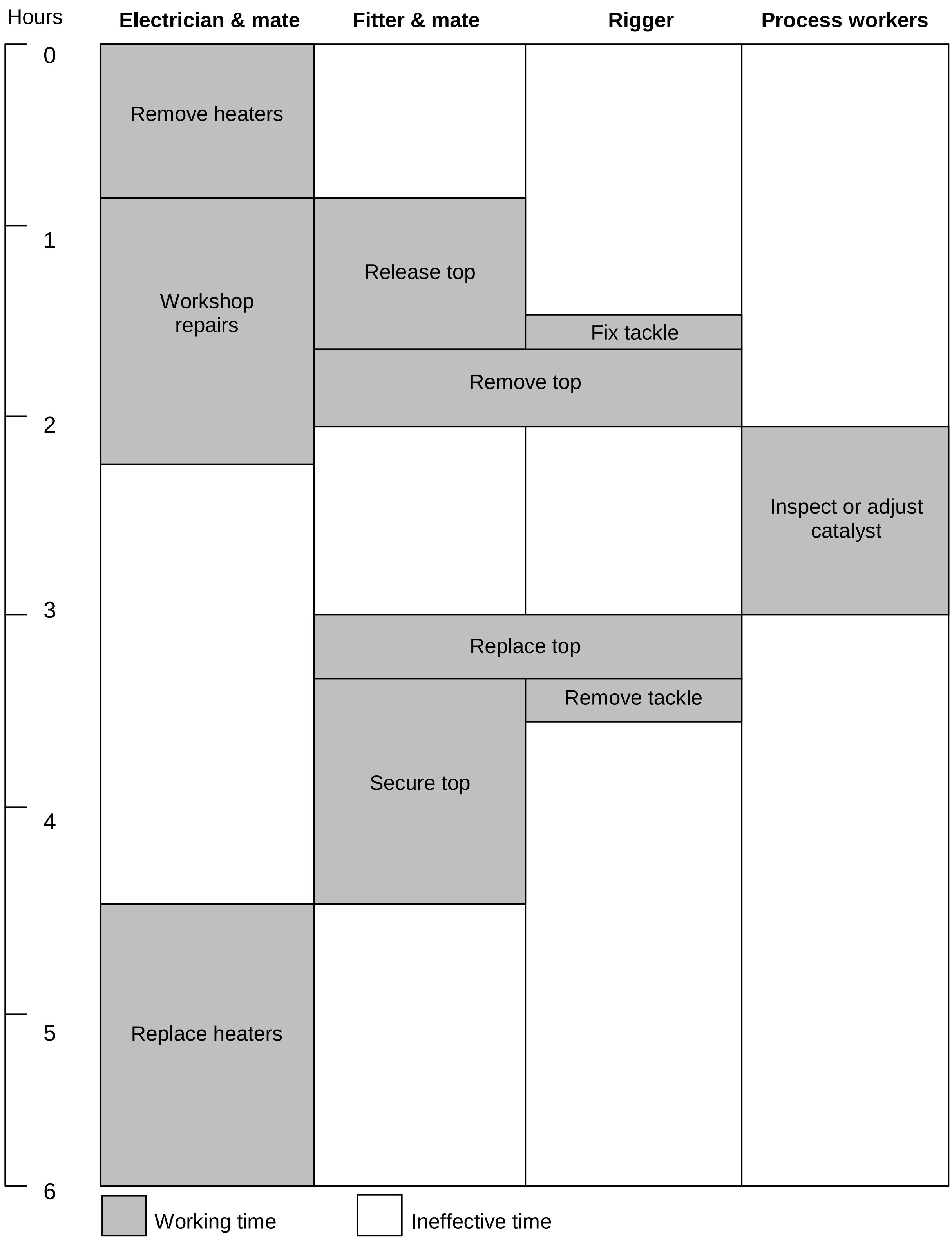
Multiple activity chart brings out the comparative utilisation of men and machines very clearly and helps to synchronise the various activities and improve the situation. It is a useful tool for planning team work and determining the staffing pattern. A study of the chart often makes it possible to rearrange these activities so that such ineffective time is minimised.

5.1. Example: Inspection of Catalyst in a Converter

In the multiple activity chart, the activities of the different operatives or of the different operatives and machines are recorded in terms of working time and idle time. These times may be recorded by an ordinary wristwatch, stop-watch or by electronic timing, according to the duration of the various periods of work and idleness. While extreme accuracy is not required, the timing must be accurate enough for the chart to be effective. The times are then plotted in their respective columns.

The charts below depict an application in the field of plant maintenance. During the “running-in period” of a new catalytic converter in an organic chemical plant, it was necessary to make frequent checks on the condition of the catalyst. In ensuring that that the converter would not be out of service for any longer than was strictly necessary during these inspections, the job was studied. The original operation, with the relationships between the working times of the various workers, is shown in chart 1.

Chart 1: Inspection of catalyst in a converter (original method)



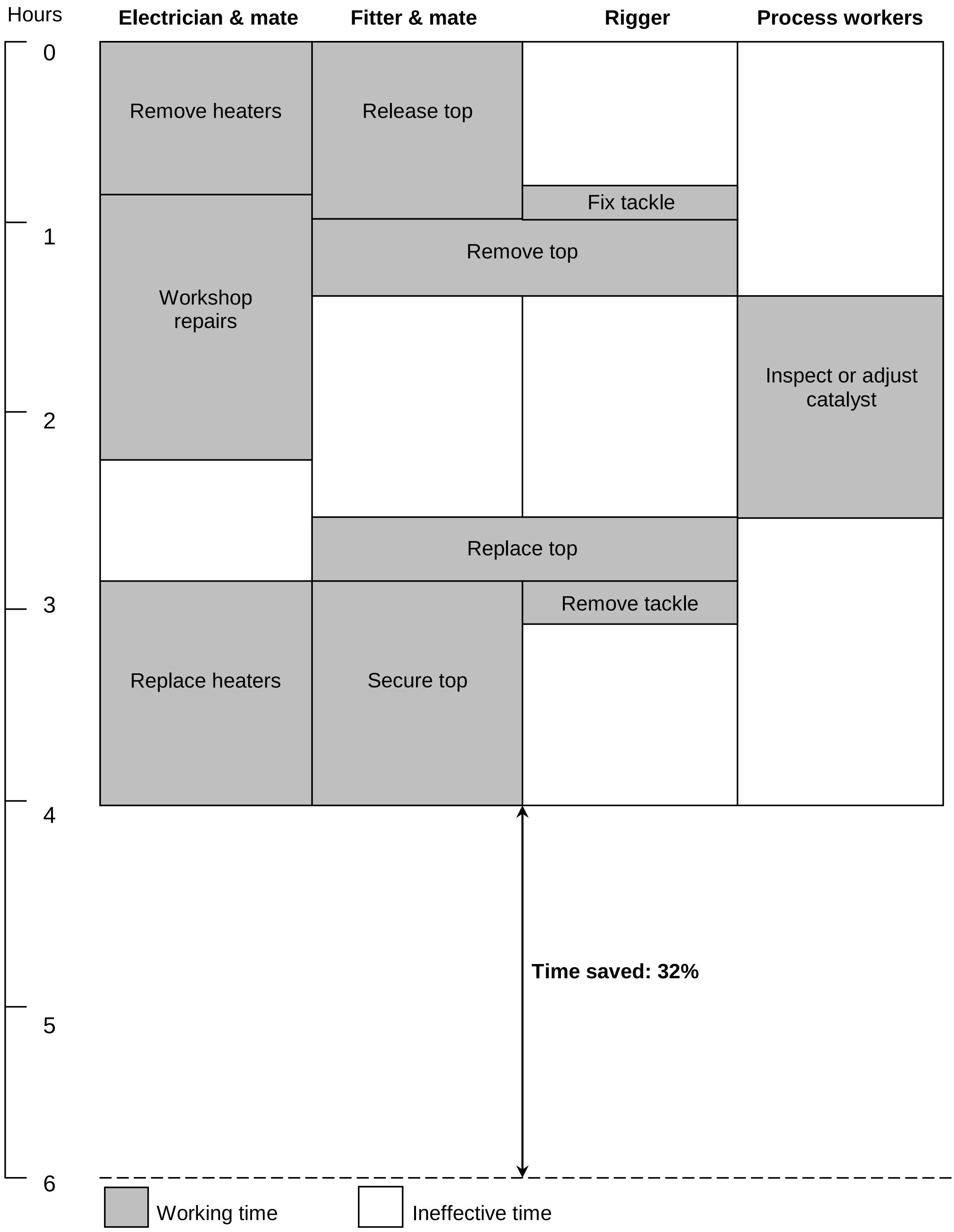
In the original method (chart 1), the removal of the top of the vessel was not started until the heaters had been removed, and the replacement of the heaters was not started until the top had been completely fixed. This meant that fitters had to wait until the electricians had completed their work. Similarly, at the end of the operation, the heaters were not replaced until the top had been replaced, and the electricians had to wait in their turn.

A critical examination of the operation and questioning of the existing procedure revealed that in fact, it was not necessary to wait for the heaters to be removed before removing the top. Hence, once this had been determined, it was possible to arrange for the top to be unfastened while the heaters were being removed and for the heaters to be replaced while the top was being secured in place. The result is shown in chart 2.

It will be seen that the idle time of the electrician and fitter and their respective mates has also been substantially reduced, although that of the rigger remains the same. Obviously, the rigger and the process workers will be otherwise occupied before and after performing their sections of the job and are not, in fact, idle while the heaters and cover are being removed or replaced. The saving effected by this simple change was 32 percent of the total time of the operation.

Hence, the multiple activity charts shows up clearly the periods of ineffective time and by rearrangement of work it becomes possible to eliminate or reduce the ineffective time. This makes the chart useful for maintenance work in order to reduce the down time of equipment, as well as helping to determine the number of workers for a group job and the number of machines that can be looked after by an operator. The chart is thus useful in analysing and obtaining optimum utilisation of men and machines.

Chart 2: Inspection of catalyst in a converter (improved method)



6. Worker-Machine Process Chart

When the activities of machines are recorded in relation to that of the operator, the chart is sometimes called as the worker-machine process chart. This is only a special variant of the multiple activity chart.

A worker-machine process chart, also known as man-machine chart, seeks the most effective relationship between operator and machine(s), i.e. minimum total idle time. It graphically represents the relationship between the manual work performed by the operator and machine(s). Given the different work steps required in a production process to load, operate and unload machines in conjunction with the process times of the machines themselves, the worker-machine chart is used to determine the highest production level that can be achieved given the resources available. This process usually involves performing as much manual work as possible internal to the machine cycles i.e. when the machine is running so that when a the machine cycle is complete the production generating machine cycle can be restarted again with as little downtime as possible.

6.1. Example: Finish Mill Casting

Chart 3 represents a common form of worker-machine chart, recording the operation of a vertical milling machine. The chart represents the method by which the operative was doing the job before the study was made, where the machine remains idle during almost three-quarters of the operation cycle. This is due to the fact that the operative is carrying out all his activities with the machine stopped, but remains idle while the machine is running on an automatic feed.

An examination of the chart reveals that the work carried out by the operative can be divided into two parts: one which must be done with the machine is stopped, such as removing and locating the work piece, and the other which can be done while the machine is running, such as gauging. It is an advantage to do as much as possible while the machine is running as this will reduce the overall operation cycle time.

Chart 3: Finish mill casting (original method)

Multiple activity chart

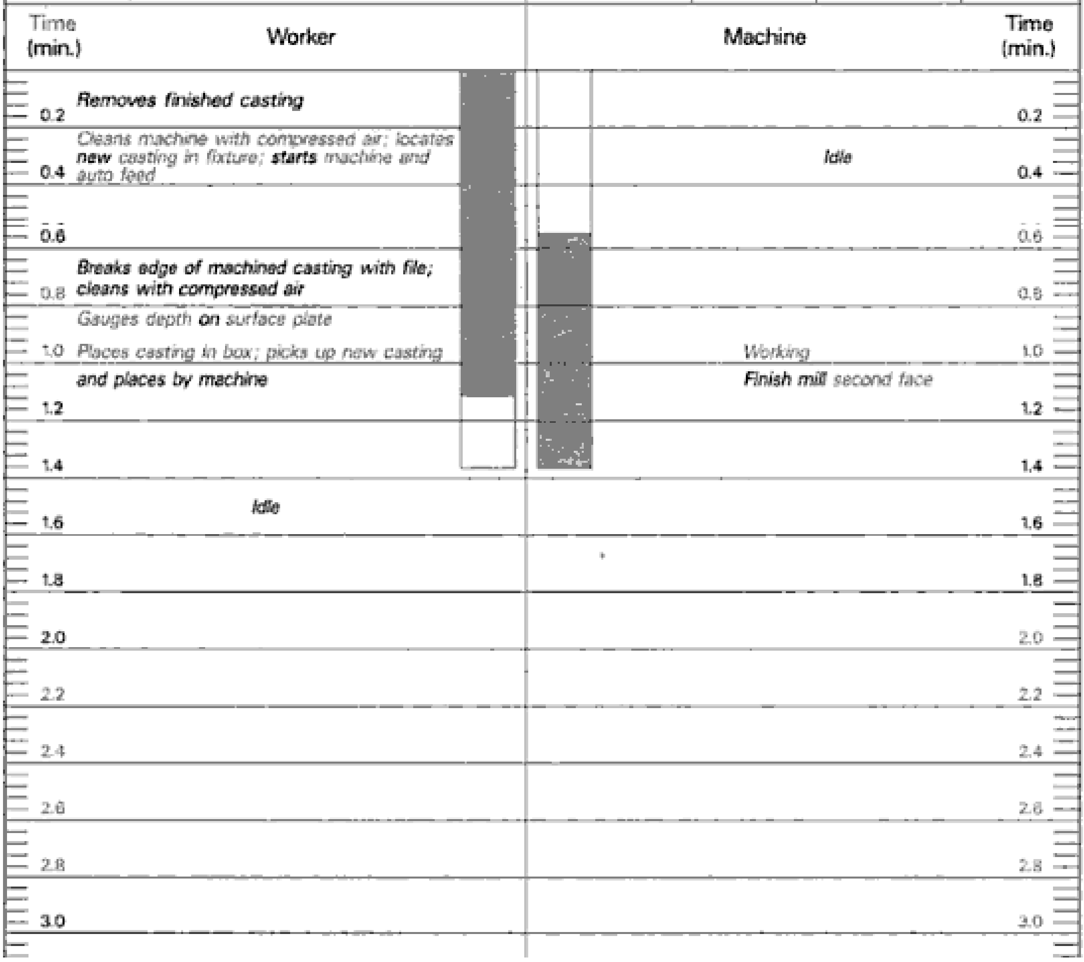
Chart No. *8*	Sheet No. *1*	Of *1*	Summary			
Product *B. 239 casting*				Present	Proposed	Saving
			Cycle time	(min.)		
	Drawing No. *B. 239/1*		Worker	*2.0*		
Process: *Finish mill second face*			Machine	*2.0*		
			Working			
			Worker	*1.2*		
			Machine	*0.8*		
Machine(s): *Cincinnati No. 4 vertical miller*	Speed *80 r.p.m.*	Feed *15 in./min.*	Idle			
			Worker	*0.8*		
			Machine	*1.2*		
			Utilization			
Operative:	Clock No. *1234*		Worker	*60%*		
Charted by:	Date:		Machine	*40%*		

Time (min.)	Worker	Machine	Time (min.)
0.2	*Removes finished casting; cleans with compressed air*	*Idle*	0.2
0.4	*Gauges depth on surface plate*	*Idle*	0.4
0.6	*Breaks sharp edge with file; cleans with compressed air*	*Idle*	0.6
0.8	*Places in box; obtains new casting*	*Idle*	0.8
1.0	*Cleans machine with compressed air*	*Idle*	1.0
1.2	*Locates casting in fixture; starts machine and auto feed*	*Idle*	1.2
1.4	*Idle*	*Working Finish mill second face*	1.4
1.6	*Idle*	*Working Finish mill second face*	1.6
1.8	*Idle*	*Working Finish mill second face*	1.8
2.0	*Idle*	*Working Finish mill second face*	2.0
2.2			2.2
2.4			2.4
2.6			2.6
2.8			2.8
3.0			3.0

Chart 4: Finish mill casting (improved method)

Multiple activity chart

Chart No. *9*	Sheet No. *1*	Of *1*	Summary			
Product *B. 239 casting*				Present	Proposed	Saving
			Cycle time	(min.)		
	Drawing No. *B. 239/1*		Worker	*2.0*	*1.36*	*0.64*
Process: *Finish mill second face*			Machine	*2.0*	*1.36*	*0.64*
			Working			
			Worker	*1.2*	*1.12*	*0.08*
			Machine	*0.8*	*0.8*	—
Machine(s): *Cincinnati No. 4 vertical miller*	Speed *80 r.p.m.*	Feed *15 in./min.*	Idle			
			Worker	*0.8*	*0.24*	*0.56*
			Machine	*1.2*	*0.56*	*0.64*
			Utilization			*Gain*
Operative:	Clock No. *1234*		Worker	*60%*	*83%*	*23%*
Charted by:	Date:		Machine	*40%*	*59%*	*19%*



Improved Method

Hence, chart 4 above shows the improved method of operation. Gauging, breaking the edges of the machined face with a file, placing the casting in the box of finished work, picking up an un-machined casting and placing it on a work table ready to locate in the fixture are now all done while the machine is running. A slight gain in time has been made by placing the boxes with the finished work and the work to be done next to one another, thus casting can be put away at the same time as the new one is lifted from its box. The cleaning of the machined casting with compressed air has been deferred until after the sharp edges have been broken down, thus saving an extra operation.

The result of this re-arrangement is a saving of 0.64 of a minute, a gain of 32 percent in the productivity of the milling machine and operative.

7. Gang Process Chart

While the worker and machine chart plots the activity of one worker when servicing one or more machines, a gang process chart plots the activity of a group of workers servicing one facility or machine. Also known as multi-man chart, it is applied to a group of workers, seeking the most effective relationship between several workers. The chart shows the exact relationship between the idle and operating cycle of the machine and the idle and operating times per cycle of the workers who service the machine. It reveals the possibilities for improvement to reduce both idle operator time and idle machine time.

7.1. Example: Crushing Bones

The following chart presents an example of a combined teamwork and machine chart applied to the feeding of sorted bones from a storage dump to a crushing machine in a glue factory. The original layout of the working area is shown in figure 6.

Workers sorted the bones into “soft” and “hard” types. The selected bones were carried to a heap, ready for loading by two workers into the trolley by hand. These two workers were idle during the time that the trolley was being pushed to the crusher, emptied into it and brought back. Two other workers, who pushed the trolley, were idle while it was being loaded.

The following figures relate to the activities of the loaders, the trolley and the crushing machine during eight cycles, which lasted 117.5 minutes.

Trolley loading time	7 minutes (2 workers)
Trolley to crusher, empty and return	7 minutes (2 workers)
Trolley load	250 kg
Weight transported in 117.5 minutes	8 x 250 = 2,000 kg
Crusher waiting time	37.75 minutes

Chart 5 shows the activities of the crusher, trolley, trolley operatives and loaders. The chart shows that ten minutes of the crusher waiting time was taken up in replacing a broken belt, however, after the belt was repaired, the crusher ran continuously for 16.5 minutes instead of the usual ten, as a fresh trolley load was ready for it. If a normal four minutes of idleness is allowed, the net idleness due to the broken belt becomes only six minutes.

A critical examination of the chart shows that the crusher was normally idle for 31.75 out of 111.5 minutes (exclusive of breakdown time), or 28.5 percent of the possible working time. Each of the two groups of workers (loaders and trolley operatives) was idle for 50 percent of its available time. One question that might arise is why the trolley operatives cannot load the trolley. The answer to this is if they did so, they would not get any rest and would have to work continuously just to keep the crusher. Hence, there would be a saving in manpower, but no improvement in the productivity of the plant.

A study of the layout of the working area, on the other hand, shows that the workers sorting the bones at the dumps labelled "Bones" have to carry the sorted bones from the points where they are working to the "Heap of selected bones", so that they can be loaded into the trolley. This raises the question as to why the bone sorters cannot load the sorted bones straight into the trolley. The answer is that they could do so if the rails were extended another 20 metres to the bone dumps. This will eliminate the loaders, but still leaves the problems of the four minutes of idle time of the crusher, while it is waiting for the trolley to return with a load. There are more bone sorters than loaders and they can load the trolley more quickly. If each trolley load were reduced, it would take less time to load and would require less effort to push. In this way, it might be possible to keep up with the cycle of the crusher. The load was therefore reduced to 175 kilograms, and waiting time was eliminated.

Improved Method

The line of crosses in figure 6 shows the extension of the rails to the bone dumps. The loaders who were eliminated were transferred to do other work in the factory. This was made possible by the fact that the crusher output rose substantially as a result of the change of the method.

Chart 7 shows the multiple activity chart with the improved method, with a considerably improved percentage of the running time of the crusher.

The performance figures are now:

Trolley loading time	1 minute
Trolley to crusher, empty and return	6 minutes
Trolley load	175 kg
Weight transported in 117.5 minutes	15x175 = 2,625 kg
Crusher waiting time	6 minutes

The crusher waiting time as seen in the chart is inclusive of three minutes for clearing of hard bones – an abnormal occurrence. If this time is excluded to enable the original and improved performances to be compared, the overall time during which the crusher is available for action is

112.5 minutes. The increase in output from the crusher over almost identical periods is 625 kilograms, an increase in productivity of the crusher of almost 30 percent. Also, two labourers out of eight have been released for other work, hence increasing the labour productivity by 75 percent.

Chart 5: Crushing bones (original method)

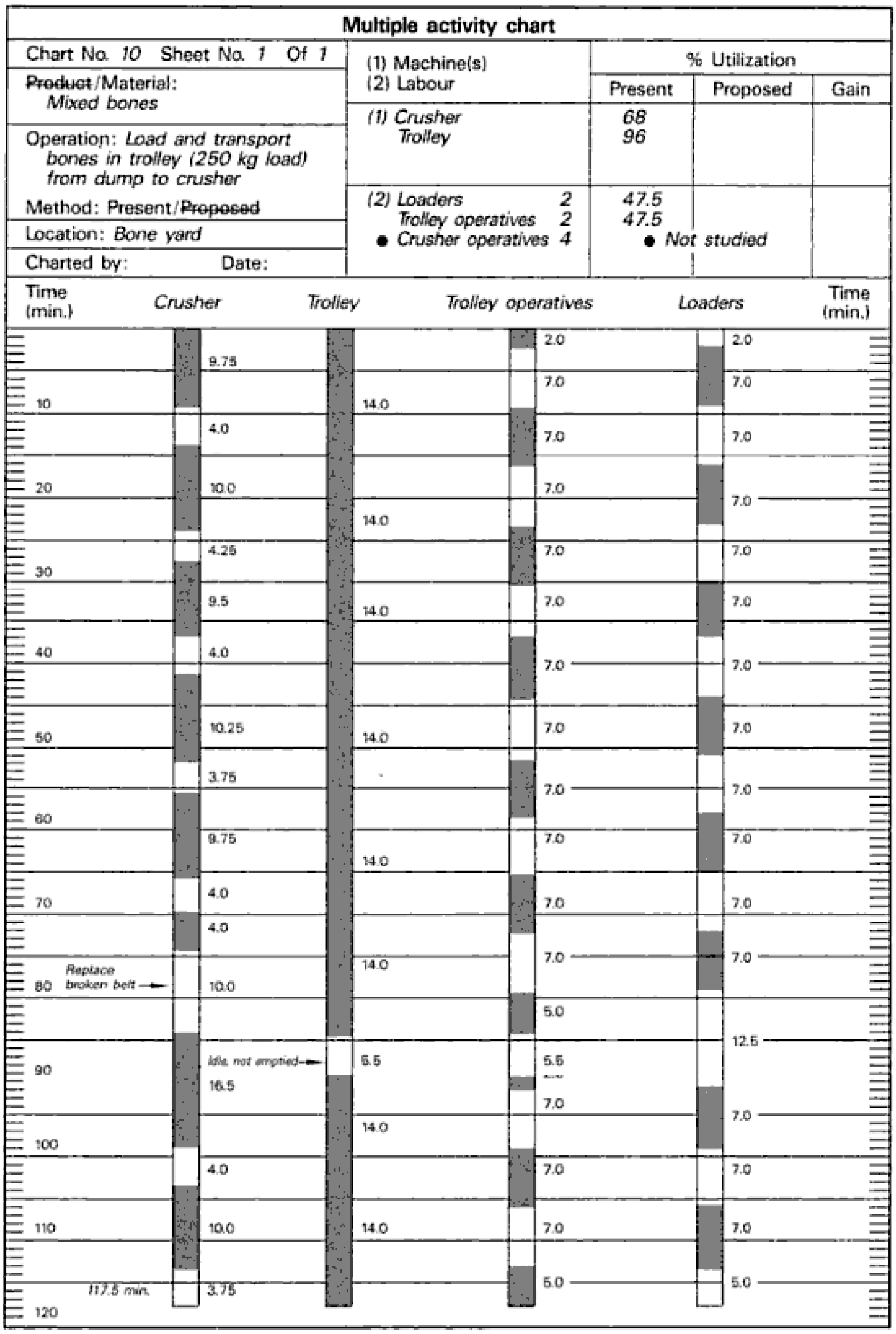


Figure 6: Layout of working area

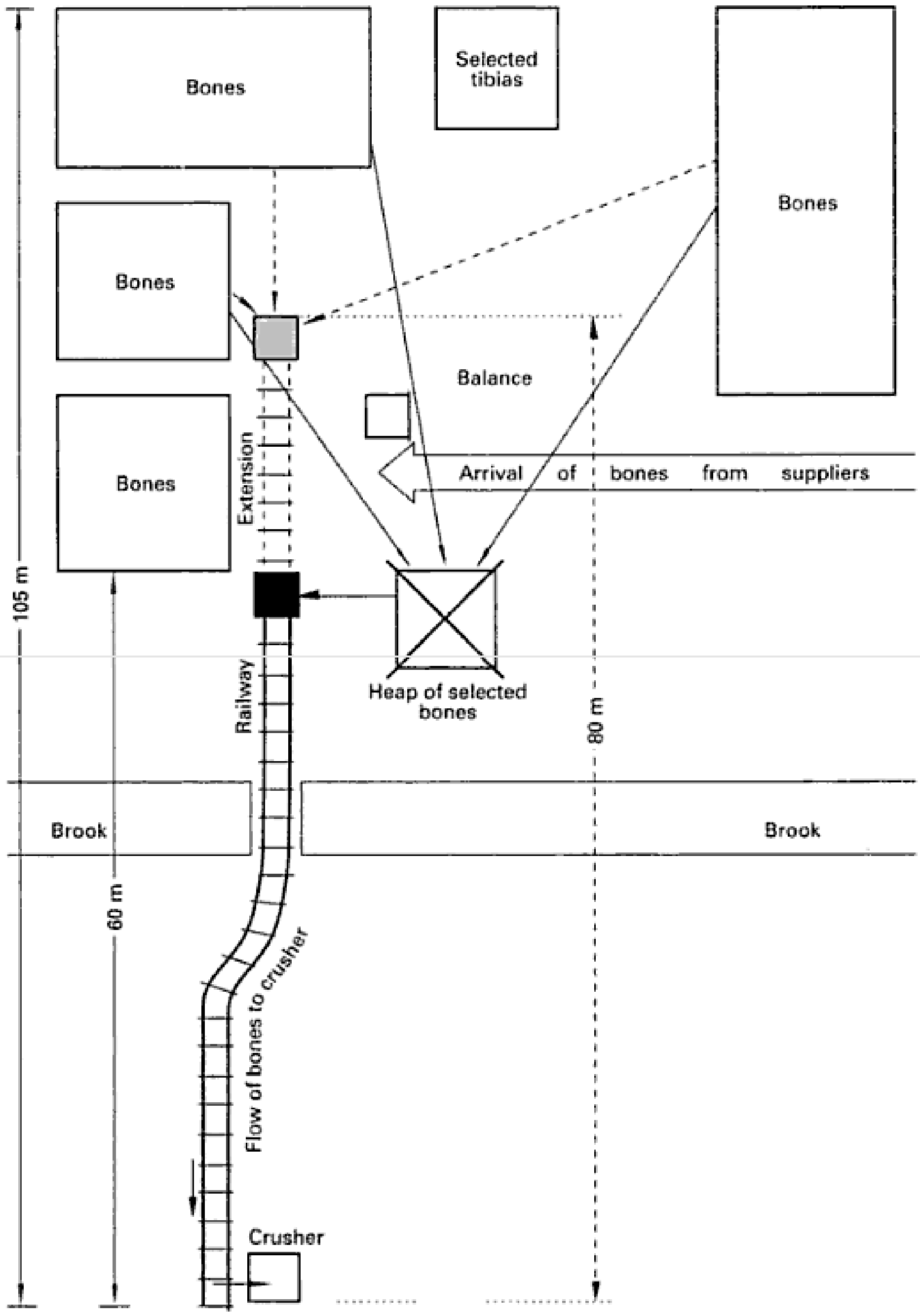
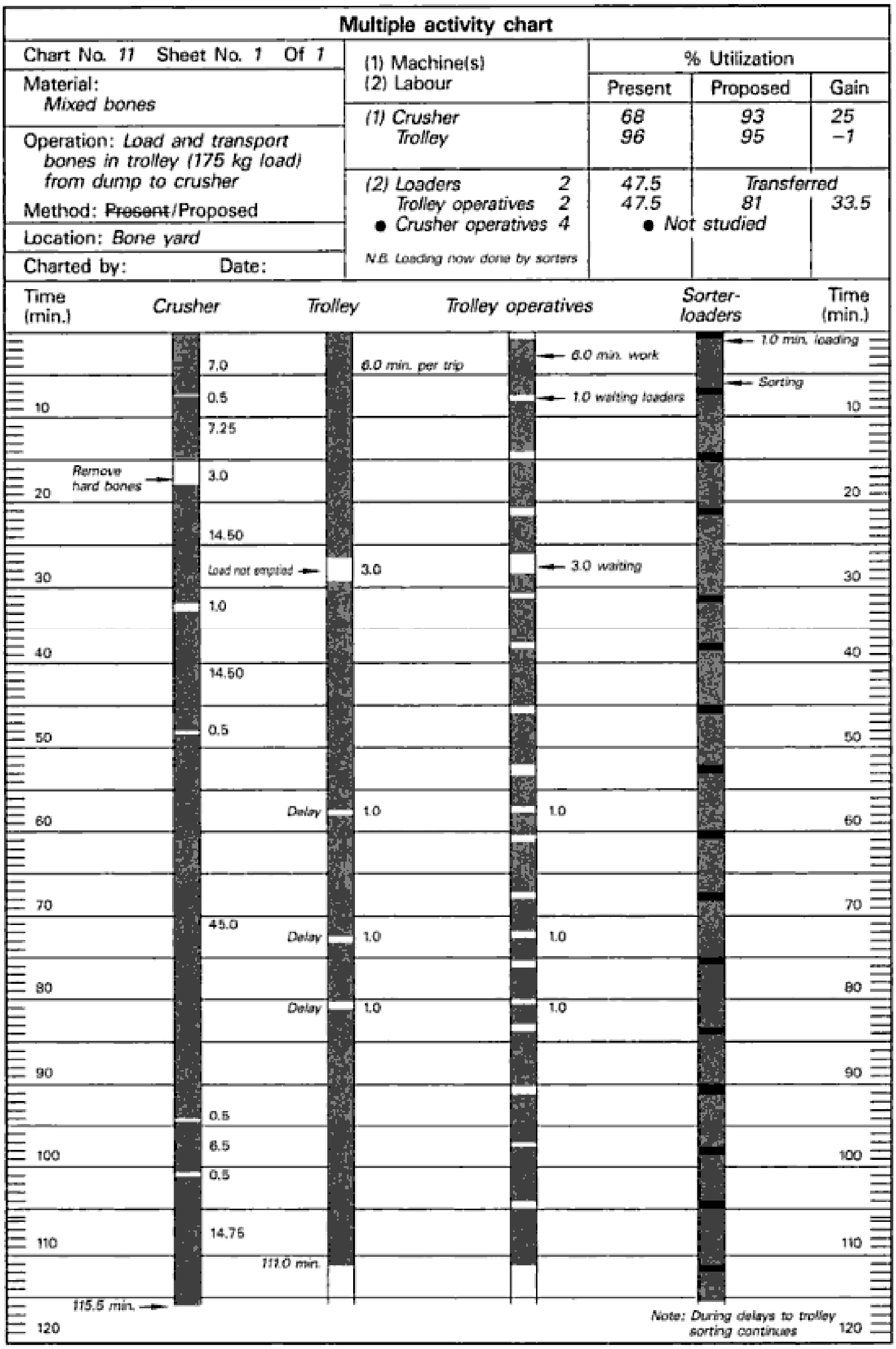


Chart 7: Crushing bones (improved method)



Case Study

The Singapore Productivity Association Presents: Certified Productivity Practitioner Course

Asian Steel Company Ltd offers steel processing, trading and investment holding to customers in the region. One of the core businesses in the company is steel processing. Production of steel includes 2 big slitter lines which involve four key operations such as warehousing and metal forming. The slitter lines help the company to process different types of steel in the shortest possible time and develop a wide range of steel products.

Slitter Line

For the Project Guidance component of the course which all participants have to fulfil, they chose to embark on the project "Productivity Improvement Through Reduction of Setting Time (for Slitter Machine)". The objective of the project was to reduce the production cycle time for one of their production lines, Slitter Line 4. The Line cuts steel in various specifications as required by the final products. By reducing the cycle time, Mr. Masaru hopes to increase efficiency by enabling more time to be made available for production.

With guidance from Mr. Low Choo Tuck, an SPA consultant, Mr. Masaru and Ms. Capina did a cause-and-effect analysis and found that inefficiencies in work allocation among the production line operators resulted in longer set-up times for the various units which contributed to delays in the production process.

Uncoiler Unit

Using the Multiple Activity technique, both of them were able to reconfigure some of the work processes such that activities in some units can proceed concurrently. This resulted in an impressive 40% reduction in the set-up time for Slitter Line 4.

Seeing the successful results that were generated from the above project, the company plans to roll out the project across all its production lines, and targets to increase output by 15% in the long term.

Recoiler Unit

Mr. Masaru Oide, Deputy General Manager and his assistant, Ms. Lyneth Ticzon Capina from Asian Steel Company Ltd were among the graduates from the course. Both of them took up the Certified Productivity Practitioner course in August 2010 with the objective of achieving higher productivity in order to generate better business results for their company, which engages in steel processing.

Said Ms. Ticzon, "[The course taught] helpful tools and techniques in our operation, especially for production and QA section. It also taught us how to do a detailed analysis for each operation and how to eliminate unnecessary operations."

About Certified Productivity Practitioner (CPP)

According to the report released by the Economic Strategies Committee in 2010, Singapore's productivity growth in her key sectors are less than satisfactory compared to top performers in the world – In the service industry, productivity growth was 58% that of the United States and growth in manufacturing was 63% of the United States'. Productivity growth in the construction industry was lowest, at only 34% that of Japan's.

As a small country lacking in natural resources, productivity growth is pertinent to Singapore's economic development. With only human capital as our main resource, it is imperative for all the key sectors to achieve sustained high productivity growth in order to remain competitive in the increasingly globalized market.

The Singapore Productivity Association's (SPA) Certified Productivity Practitioner Course supports the government's call to increase productivity growth by 2 to 3% in the next 10 years by training productivity practitioners who can help steer their companies towards world class business excellence.

For companies to improve productivity capabilities have to be developed to do what is necessary to improve incumbent systems and processes, and training and education is required to develop those credentials and keep the cycles of improvement rolling.

The first of its kind in Singapore, the CPP course enables participants to comprehensively understand how the various productivity tools and techniques can be implemented.

Through interactive discussions and practical projects, the CPP course aims to teach productivity champions to resolve productivity issues using the **Learn • Innovate • Apply**© approach. Relating to case studies drawn from different industries, they learn how to apply the productivity tools, techniques and methodologies learnt, to **analyse** productivity issues in their companies, and subsequently to **develop** solutions, and **implement** improvements that bring productivity and business results to a higher level.

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

Books are available at the Lee Kong Chian Reference Library.

Recommended Readings

Aft, L. S. (2000). *Work measurement and methods improvement*. New York: John Wiley & Sons.
[RBUS 658.54 AFT]

Groover, M. (2007). *Work systems and the methods, measurement, and management of work*. New Jersey: Pearson Prentice Hall.
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We can Help.

CERTIFIED PRODUCTIVITY PRACTITIONER COURSE

Learn • Innovate • Apply

Next Intake – (Broadbased/Retail) Commencing July 2011

WHY CPP?

- **Enterprise Focused** Targeted at the enterprise with focus on productivity issues and challenges at the enterprise level
- **Diagnostic Approach** Identify strengths and areas of improvement so that actions can be decided easily
- **Technique-based** Teach productivity techniques, tools and methodologies applicable to the enterprise that can be adjusted to suit specific sectors through contextualisation
- **Project Guidance** Participants to undertake productivity project for their own company on a previously identified productivity issue for which project guidance is provided. This ensures that supporting companies benefit from sending staff for the course.

CALL US TODAY AT 6375 0938 / 6375 0940 TO EITHER:

- Register for next intake; or
- Attend our information session; or
- Arrange for us to visit you

WDA FUNDING AVAILABLE!*
SMEs: **70%** of Course Fees
All other entities: **50%** of Course Fees

Up to 400% of course fees can be claimed under Productivity Innovation Tax Credit!*

*Terms & conditions apply.

1. Analyse productivity issue.
2. Develop solutions.
3. Implement improvements.

FOR FULL 2011 SCHEDULE OR MORE INFORMATION, PLEASE CALL 6375 0938 (LEANNE) OR 6375 0940 (ASHTON). ALTERNATIVELY, EMAIL TO: cpp@spa.org.sg

SINGAPORE PRODUCTIVITY ASSOCIATION
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.

SINGAPORE PRODUCTIVITY ASSOCIATION

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<tr><th>CPP Course Syllabus</th><th></th></tr>
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• Introduction to Productivity and Quality Concepts
• Factors Affecting Enterprise Productivity
• Productivity Movement in Singapore
• Productivity Promotion in Businesses
• Productivity Challenges</td></tr>
<tr><td>Module 2: Productivity Tools, Techniques & Management Systems
(Duration: 3 days)
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• Productivity Measurement & Analysis
• Process management:
▪ Cost of Quality
▪ Lean Six Sigma
▪ Process Mapping & Analysis
• Integrated Management Systems</td><td>Module 2: Productivity Tools, Techniques & Management Systems
(Duration: 3 days)
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• Productivity Measurement & Analysis
• Process management:
▪ Cost of Quality
▪ Lean Six Sigma
▪ Process Mapping & Analysis</td></tr>
<tr><td>Module 3: Innovation & Service Excellence
(Duration: 3 days)
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• Service Excellence
• Team Excellence</td><td>Module 3: Innovation & Service Excellence
(Duration: 3 days)
• 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</td></tr>
<tr><td colspan="2">Module 4: Critical Success Factors
(Duration: 1 day)
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• 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</td></tr>
</table>

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

The schedule of our next runs is as follows:

June - July 2011		
Date	**Module**	**Time**
Wednesday, 15 June 2011	Module 1	9-5 pm
Friday, 17 June 2011	Module 2	9-5 pm
Wednesday, 22 June 2011		9-5 pm
Friday, 24 June 2011		9-5 pm
Wednesday, 29 June 2011	Module 3	9-5 pm
Friday, 1 July 2011		9-5 pm
Wednesday, 6 July 2011		9-5 pm
Thursday, 14 July 2011	Module 4	9-5 pm

July - August 2011		
Date	**Module**	**Time**
Wednesday, 20 July 2011	Module 1	9-5 pm
Friday, 22 July 2011	Module 2	9-5 pm
Wednesday, 27 July 2011		9-5 pm
Friday, 29 July 2011		9-5 pm
Wednesday, 3 August 2011	Module 3	9-5 pm
Friday, 5 August 2011		9-5 pm
Wednesday, 10 August 2011		9-5 pm
Tuesday 16 August 2011	Module 4	9-5 pm

September - October 2011		
Date	**Module**	**Time**
Wednesday, 28 September 2011	Module 1	9-5 pm
Friday, 29 September 2011	Module 2	9-5 pm
Wednesday, 5 October 2011		9-5 pm
Friday, 7 October 2011		9-5 pm
Wednesday, 12 October 2011	Module 3	9-5 pm
Friday, 14 October 2011		9-5 pm
Wednesday, 19 October 2011		9-5 pm
Thursday 20 October 2011	Module 4	9-5 pm

Core Faculty Members

MR. LAM CHUN SEE
B. ENG IN INDUSTRIAL & SYSTEMS ENGINEERING (UNIVERSITY OF SINGAPORE)

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

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

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

MR. LOW CHOO TUCK
M.SC. IN INDUSTRIAL ADMINSITRATION (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. Ne 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   Mr. Ashton Chionh
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