TOYOTA

Advanced Manufacturing Technician

Manufacturing Core Exercises

MCE 3: TPS-M

STAFF GUIDE

TPS-M Process

PROCESS

1. Set a date with NAPSC and conduct TPS-M training.

2. Meet with the school faculty and plan the semester action plan for accomplishing the MCE. Organize resources and responsibilities.

3. Meet with the AMTs, distribute materials, and give direction on what is to be done and how to go about accomplishing the MCE.

4. Advise AMTs on each TPS-M step. Advise them on how and who to contact to get some of the examples.

5. Track MCE (recommended, through MQS) to ensure that class maintains progress is complete on time.

6. Include MCE status in monthly AMT meetings with faculty.

7. Arrange and conduct appropriate presentations as projects are completed.

8. Coordinate with NAPSC and arrange for end-of-semester AMT presentations as part of regional review.

MATERIALS NEEDED

◊

I CERTIFY THAT ALL SEMESTER 3/TPS OUTCOMES HAVE BEEN COMPLETED:

DATE

_____

SIGNATURE

_____

AMT Leader

TPS Essay

You have completed your TPS for Maintenance (TPS-M) Exercise Outcomes. You have also participated in activities to deepen your understanding of TPS. As your understanding of TPS has increased you should have begun seeing your workplace and your school in a different light. This essay will reflect on whether or not you think that your workplace or school exhibits good TPS practice.

Your assignment is to write an essay discussing the TPS condition of your workplace or school.

Another goal of the essay is to give you the opportunity to develop your good writing skills, both in using effective writing basics such as grammar, structure, and spelling, and in effectively communicating a message.

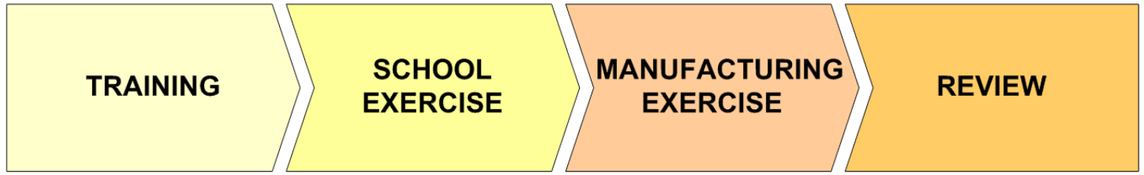
Guidelines:

- Length: 1-3 pages.
- Content: Items to consider include what TPS practices that you see in your workplace or school. What TPS practices do you think that your work place or school lack? Do you see how the practice of, or lack of, good TPS practice affects how well that your company does business? If it was yoru decision, what is the first way that you would strengthen the practice of TPS in your workplace or in your school? There is much more that can be included.
- This essay does not need to be foot-noted unless your writing needs it. Use any accepted writing standard or structure that you wish, but be sure to use correct practices and techniques.
- Write in any medium that you wish (paper, computer, etc.) The final product should be in electronic form so that it can be both e-mailed and saved as a file. It should be in a form that can easily be converted to Microsoft Word.
- Double check spelling!
- Print a copy of your final product.
- E-mail your file to the following parties:
  - ◊ AMT Leader: _____ (e-mail address)
  - ◊ School AMT Coordinator: _____ (e-mail address)
  - ◊ North American Toyota AMT Regional Assistant: jim.mattingly@tema.toyota.com
  - ◊ Additional parties as directed: _____ (e-mail address)

DUE DATE

_____

TPS-M Overview



LEARN IT	***DO IT***	***APPLY IT***	***TELL IT***
TOYOTA TPS-M Class	**Standard Work Exercise** **Problem Solving Exercise** **Kaizen Exercise** **Pokayoke Exercise** **Takt Time Exercise** **Heijunka Exercise** **Mura/Muri/Muda Exerise** **Write an Essay**	*None* *Activity in Internship*	*None*

TPS-M Notes

- AMTs should plan on staying at least 2 hours after class on every school day.
- Always coordinate with the College Partner to ensure that someone is leading the AMTs.
- 5S activities are led mostly be the school staff, however, company should give much support.
- The AMT Leader should participate as much as possible, especially at reviews.
- This is a very hands-on activity. Be sure to teach and reinforce 5S principles through the activities.
- For new programs, first projects will be targeted toward establishing the initial 5S condition in the Advanced Manufacturing Center. Later projects will focus on expanding 5S practice or improving existing 5S practice.
- Be sure that AMTs maintain/sustain all previous 5S standards set on the floor. We lost the 5th S if we do not learn to sustain what is in place.
- Company and school need to carefully consider each proposed 5S project and agree to any cost and/or material needs.

Outcomes

AMT Semester 2 Manufacturing Core Exercise Activity Outcomes

TOYOTA PRODUCTION SYSTEM for MAINTENANCE

- ☐ Complete initial TPS-M training.
- ☐ Explain the "Value Added Product."
- ☐ Explain the Maintenance "Value Added Product."
- ☐ Explain Value-Added Work and Necessary Work.
- ☐ Explain how Toyota earns profit.
- ☐ Draw/fill-in all elements of the TPS-M House.
- ☐ Explain each element of the TPS-M House.
- ☐ State each of the 3 M's and the 7 Mudas.
- ☐ Explain each of the 3 M's and the 7 Mudas.
- ☐ Complete Standardized Work Exercise (JIS/WIS).
- ☐ Complete Problem Solving Work Exercise (Step 1)
- ☐ Complete Kaizen Exercise (School)
- ☐ Complete Pokayoke Exercise (School)
- ☐ Complete Takt Time Exercise.
- ☐ Identify an example of Heijunka.
- ☐ Identify 2 examples each of Mura, Muri and Muda.
- ☐ Re-take and Pass the TPS-M tests (end of semester).
- ☐ Submit an essay on TPS.

COMPLETE THE END-OF-SEMESTER TPS-M TESTS. SCORE AT LEAST 80% ON BOTH.

DATE

_____

Include Examples here.

IDENTIFY AND EXPLAIN 2 EXAMPLES EACH OF MURA, MURI, AND MUDA.

DATE

Include Examples here.

TPS-M Basics

EXPLAIN THE VALUE-ADDED PRODUCT.

DATE

EXPLAIN THE MAINTENANCE VALUE-ADDED PRODUCT.

DATE

EXPLAIN VALUE-ADDED WORK AND NECESSARY WORK.

DATE

EXPLAIN HOW TOYOTA EARNS PROFIT.

DATE

ON THE BLANK FORM DRAW THE HOUSE OF TPS-M.
CORRECTLY FILL IN AT LEAST 80% OF CONTENT.

DATE

_____

CORRECTLY EXPLAIN EACH ELEMENT OF THE TPS-M HOUSE.

DATE

_____

STATE EACH OF THE 3Ms AND THE 7 MUDAS.

DATE

_____

CORRECTLY EXPLAIN EACH OF THE 3Ms AND THE 7 MUDAS.

DATE

_____

These elements of TPS-M may be some of the more difficult concepts for the AMTs to initially grasp. Please pay particular attention to helping the AMTs to truly grasp these concepts.

Use the provided guides on the following pages to help with teaching and coaching the AMTs.

IDENTIFY AND EXPLAIN AN EXAMPLE OF HEIJUNKA.

DATE

_____

Include Example here.

COMPLETE THE TAKT TIME EXERCISE.

DATE

Include Example here.

OUTCOME: *EXPLAIN THE VAUE ADDED PRODUCE*

Use the explanation to assist AMT students in achieving their MCE 3 Outcomes.

The *Value-Added Product* is that product which directly earns money for the company. The *Value-Added Product* is any product that the company sales and which can produce profit. Because it is the item which brings in revenue it is, therefore, the item which sustains the company. Without the *Value Added Product,* the company could not survive as a business operation.

Examples of *Value-Added Products* include: new vehicles (at vehicle plants), new engines (at engine unit plants), wheels at unit casting plants, stamped parts at unit plants with press operations, and service parts at all plants.

The importance of clearly understanding what the *Value-Added Product* is that, overall, it serves to focus the purpose and target of TPS activities. Understanding what the value-added product is also enables distinguishing between *Value-Added Work,* and *Non-Value-Added Work.* Without clearly understanding what the *Value-Added Product* is, it is impossible to truly distinguish between *Value-Added,* and *Non-Value-Added Work.*

OUTCOME: *EXPLAIN VAIUE ADDED WORK AND NECESSARY WORK*

Use the explanation to assist AMT students in achieving their MCE 3 Outcomes.

Value-Added Work is that work which directly transforms any *Value-Added Product* to make it closer to reaching the point of being able to sell. For example, putting a piston into an engine block transforms the engine. It is different than it was before, and it is one step closer to being assembled and ready for sale. A key understanding of *Value-Added Work* is that the product itself has changed in some material way. If the product has not changed, *Value-Added Work* has not been performed. Examples of *Non-Value Added Work* include moving the engine block noted above from one work station to the next (say, Station-A to Station-B) so that the piston may be installed. When the engine block arrives at Station-B it is still in the same condition as it was when it left Station-A. Much effort and cost has been invested in the ability to transfer if from station A to B, but since the product itself did not change all of the transfer effort is considered to be *Non-Value Added Work.*

Necessary Work is that work which must be done to enable the manufacturing operation in some way, but which adds no *Value* (transforming the product to be closer to salability) to the product. For example, while it adds no value to the product, transferring the engine block from Station A to Station B, above, is very *Necessary Work.* Examples of *Necessary Work* include performing PMs on machinery to maintain it in operational order and troubleshooting and repairing dysfunctional equipment.

OUTCOME: *HOW TOYOTA EARNS PROFIT*

Use the explanation to assist AMT students in achieving their MCE 3 Outcomes.

A key concept in TPS is how Toyota earns profit. The vast majority of companies earn profit by, basically, calculating the cost of operations (including manufacturing), then using that cost to determine how much must be charged on each unit for sale to break even, and then adding a margin on top of that to generate profit. The basic principle is to sell the product for more than it costs to make it, and the extra is profit.

The variable in this model is the margin. The company can decide how much profit it wishes to earn, and then set the margin—the amount charged above the cost of the product—to earn profit.

COST OF OPERATIONS + PROFIT = COST OF THE PRODUCT

Toyota takes a very different approach. Toyota considers the COST OF THE PRODUCT to not be a variable. It is a fixed cost based on what the market will pay to buy the product. So, therefore, the only way to earn profit is to lower the cost of operations (manufacturing) and create some space between the cost of the product and the cost to make the product. So in the Toyota model the variable is the Cost of Manufacturing.

COST OF THE PRODUCT - COST OF OPERATIONS = PROFIT

TOYOTA EARNS PROFIT BE REDUCING THE COST OF MANUFACTURING!!

This is a key concept for team member at Toyota to understand because it helps to keep attention tightly focused on constant cost reduction. Every penny of wasted money in manufacturing directly undermines the company's ability to earn profit and to remain viable in the competitive marketplace.

OUTCOME: DRAW/FILL-IN ALL ELMEENTS OF THE TPS HOUSE

AMT Students should consistently correctly fill-in from memory 80% or more of the blank TPS House drawing.

OUTCOME: EXPLAIN EACH ELEMENT OF THE TPS HOUSE

Standard Work produces safe, repeatable, predictable work that is efficient and correct. Standard work must be a documented best practice.

Problem Solving (Event type) sustains the Standard Work condition through quick, logical identification and countermeasure of problems (deviations from the Standard).

Problem Solving (Setting type) drives fast and significant improvements to the Standard Work condition when business needs dictate that more dramatic improvement than can normally be achieved through Kaizen is needed.

Kaizen continuously improves the Standard Work condition. Improvements are sustained through modifying the Standard to include the kaizen improvement as part of the new Standard condition.

The three elements of Standard Work, Problem Solving, Kaizen work as part of a continuous activity cycle to help achieve the daily condition of **Stabilized Work**.

Heijunka (leveled work) helps to achieve a consistent, even work burden and work flow so that dramatic daily swings in burden or flow do not cause Quality problems (impacting Jidoka) or efficiency problems (impacting Just-in-Time). A continuously improving condition of Heijunka strengthens business outcomes of Standard Work to contribute to achieving a **Stabilized Work** condition.

The first pillar of the TPS House for Maintenance is **Jidoka,** which in the Maintenance world means to Consistently Pass on 100% Quality (of work) to the Next Customer. Certain key practices help to achieve Maintenance Jidoka:

Right First Time emphasizes the importance of doing work the right way the first time so that it does not have to be corrected later, costing additional time and expense.

Pokayoke emphasizes the importance of developing machine-based practices which prevent the flow-out of a problem condition. A true Pokayoke never needs human action or intervention to work. Because Pokayoke prevents the flow-out of problems it helps to ensure that 100% good quality passes to the next process (Customer) every time.

Andon addresses the importance of quickly summoning others to help when a problem exists so that the problem can both be resolved in a short amount of time and so that 100% quality is passed on to the next process.

Just-in-Time (JIT is the second pillar of the TPS for Maintenance House. JIT in Maintenance achieves efficient, low cost, and productive work which contributes to lowering the Cost of Manufacturing, which supports the TPS practice of how Toyota earns profit.

Right Skill Now emphasizes the need to have the correct technical and process skill at each job need as instantly as possible. This need is what drives the Toyota requirement of Multiskilled Maintenance team members who possess all of the technical skills for each job (Electricity, Fluid Power, Mechanics, Fabrication, Troubleshooting).

Pull System ensures that work or material needed for a process are provided by the proceeding process only when needed on the working floor. TMs only go to training when it's needed to improve OA, spare parts are maintained only when actually needed on the floor and in an amount that matches the rate of usage, etc.

Take Time, in Maintenance, is the shortest amount of time (as evidenced by the best practice) needed to perform a job safely. In Maintenance Takt Time can vary, but is always the shortest, safest amount of time. All TMs should perform within Takt Time.

To achieve a **Customer First** level of work, Maintenance should provide to Production (the Customer of Maintenance) work of the **Highest Quality**, at the **Lowest** (Manufacturing) **Cost**, in the **Shortest Lead Time**. The pillar of Jidoka helps to achieve the Highest Quality, the pillar of Just-in-Time helps to achieve the Shortest Lead Time, and both pillars help to achieve the Lowest Cost.

COMPLETE THE KAIZEN WORK EXERCISE.

DATE

Include Before/After Examples here.

OUTCOME: COMPLETE KAIZEN EXERCISE

AMT Students should implement a real improvement on the school floor. The improvement should be captured in photographs (before and after condition), and should be publicly presented to both school and company representatives.

OUTCOME: COMPLETE THE POKAYOKE EXERCISE

AMT Students should identify and take a photograph of an active Pokayoke in place. Students should explain how the Pokayoke works, and what the impact would be if no Pokayoke were in place.

OUTCOME: COMPLETE THE TAKT TIME EXERCISE

AMT Students should find examples of *Maintenance* Takt Time. Students should explain the basic job to which the Takt Time (time in which the job should be completed) applies, and should describe some impacts on work and business if a Takt Time was not in place for this particular job.

OUTCOME: IDENTIFY AN EXAMPLE OF HEIJUNKA

AMT Students should identify an example of where Heijunka (work leveling) has occurred. They should explain the process, why it was done, the impact of the leveling, and the work and business impact of leveling was not used in this situation.

OUTCOME: ID 2 EXAMPLES EACH OF MURA, MURI, AND MUDA

Examples can be school or work based. Photographs of the situations (which can be included in the Student workbook).

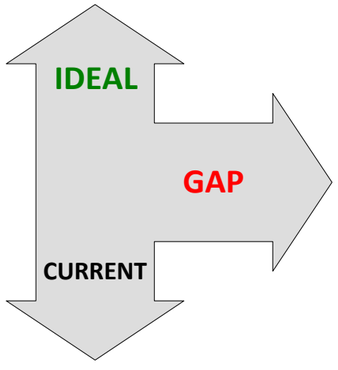
COMPLETE THE STANDARDIZED WORK EXERCISE.

DATE

COMPLETE THE PROBLEM SOLVING EXERCISE.

DATE

Include an example of a real Step 1 Problem Solving example here (if your workplace or school has it):



Using a situation based at school (at work is a local option), AMT students should set up a STEP 1 of the TBP process.
A real situation should be identified. Students should be clearly identity the IDEAL situation in measureable terms, the CURRENT situation in measureable terms, and then describe the GAP as a direct contrast of the IDEAL & CURRENT.

If possible, the IDEAL Condition should be sourced from a piece of Standardized Work (can also be a JIS) that is already in place at the school, reinforcing the concept that when a good piece of Standardized Work exists that it serves as the IDEAL Condition for the purpose of sustaining the standard through Problem Solving.

Use the Step 1 portion of the standard manufacturing-based TBP form, or any form that you find most useful for your location.

OUTCOME: STATE EACH OF THE 3M's AND THE 7 MUDA's. EXPLAIN EACH OF THE 3M's AND THE 7 MUDA's.

MURA is unevenness. It can apply to any aspect of work (man or machine burden, scheduling, material flow, etc.) Mura is the opposite of Heijunka.

MURI is overburden. It can apply to any aspect of work, and is essentially a more extreme condition of Mura.

MUDA is non-value added. It refers to any condition or action which does add value to the Value-Added Product. It can be more loosely interpreted as "waste," but striving to really understand the condition of Non-Value Added is more powerful knowledge.

The 7 Mudas

One Mnemonic for remembering the 7 Mudas is:

CCMOOWI

Ce Ce Moooooooo eeeeeeeeeee!

The Muda of Conveyance
In Maintenance, the Muda of Conveyance primarily occurs when needed resources travel from Point A to Point B to perform a job. While the travel is necessary the job itself experiences no change or improvement while the travel (conveyance) is in process.

The Muda of Correction
In Maintenance, the Muda of Correction occurs when work has to be repeated. It costs extra time and extra expense (adding to the Cost of Manufacturing), and often delays delivery to the Customer in the Shortest Lead Time.

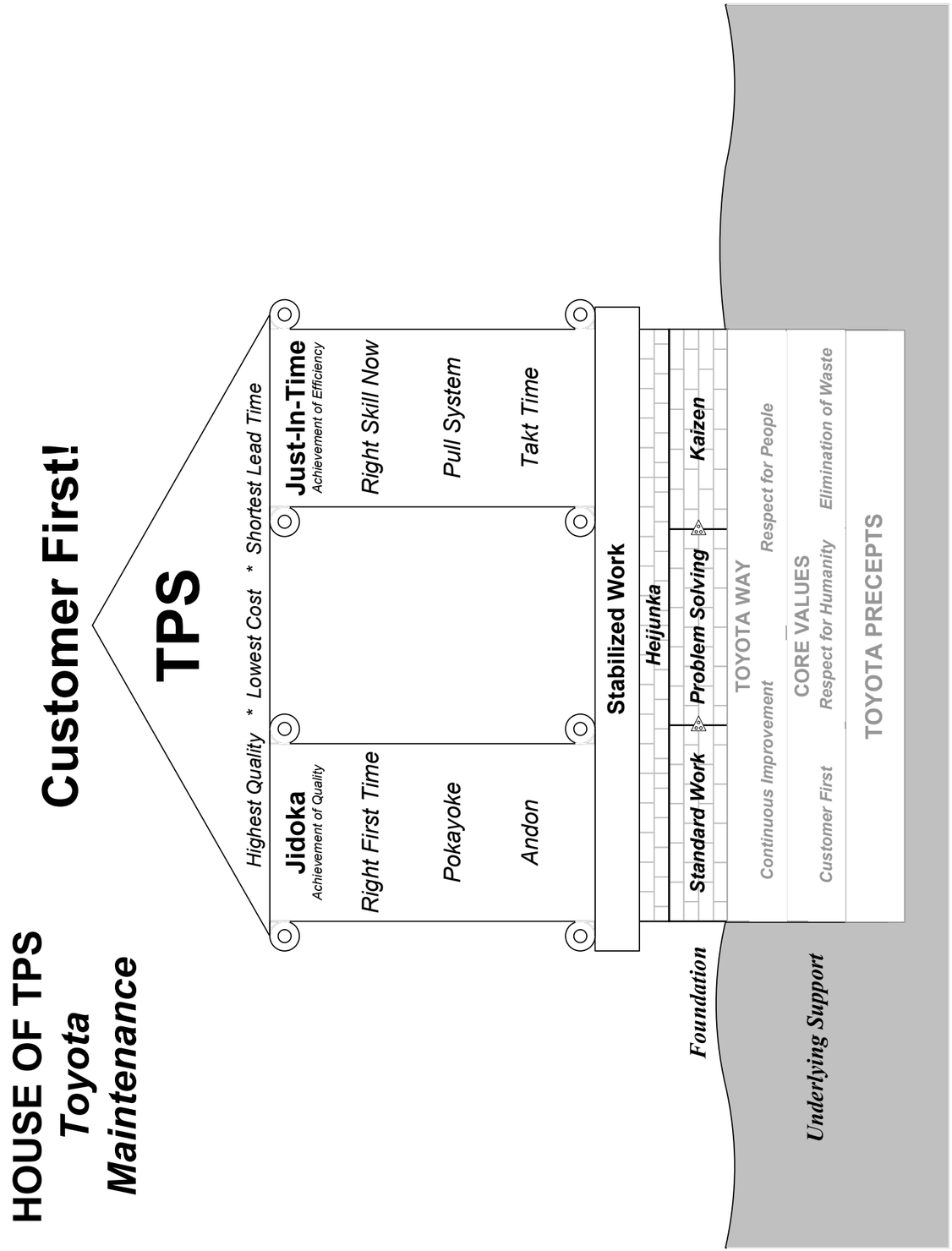
The Muda of Motion
In Maintenance, the Muda of Motion occurs when extra movements are used while performing a job. A TM going back and forth between a tool box or up and down a ladder is Muda of Motion. Mude of Motion is distinguished between Muda of Conveyance because one occurs while the work is being done (Motion) and the other occurs while transporting to/from the job (Conveyance).

The Muda of Over Production
In Maintenance, the Muda of Over Production occurs when there are too many units for the job needed. If there are 7 welding units in the Maintenance area (and all are periodically being used) but only 4 are needed to meet needs Over Production (Maintenance) has occurred. If a team has 6 team members, but only 5 are needed to fully cover the team responsibilities (without Muri, overburden) then Over Production has occurred.

The Muda of Over Processing
In Maintenance, the Muda of Over Processing occurs when too much work is done to achieve a needed outcome. For example, if a large, broadly functional PLC is used for a certain application when a simple shoe-box PLC will suffice,, then Over Processing has occurred.

The Muda of Waiting
In Maintenance, the Muda of Waiting occurs when needed resources for a job are ready but are delayed for some reason, impacting the completion of the job. For example a team member may be responding to a breakdown call but then has to stop (delaying resolution of the repair and return to production) but then has to stop while a long line of Production Conveyance vehicles are stopped at an intersection.

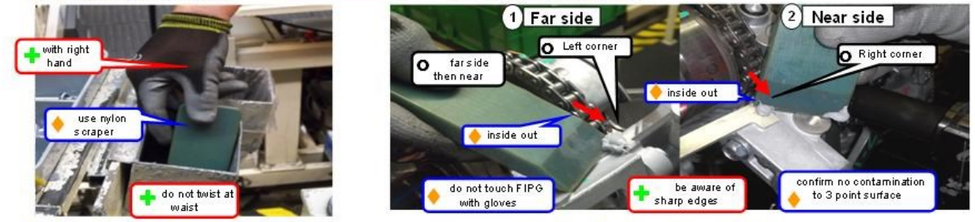
The Muda of Inventory
In Maintenance, the Muda of Inventory occurs when too much stock of anything is maintained. It requires additional floor space (raising construction cost), the space must be environmentally managed (raising facilities cost), additional human time must be devoted to manage both the space and the unnecessary inventory (raising headcount cost), and more. To illustrate the difference in the Muda of Inventory and the Muda of Over Production, in the example regarding Over Production and the welding units, it would not be an adequate answer to just store the 3 unneeded units. The Muda of Over Production would just be changed to the Muda of Inventory in this case.



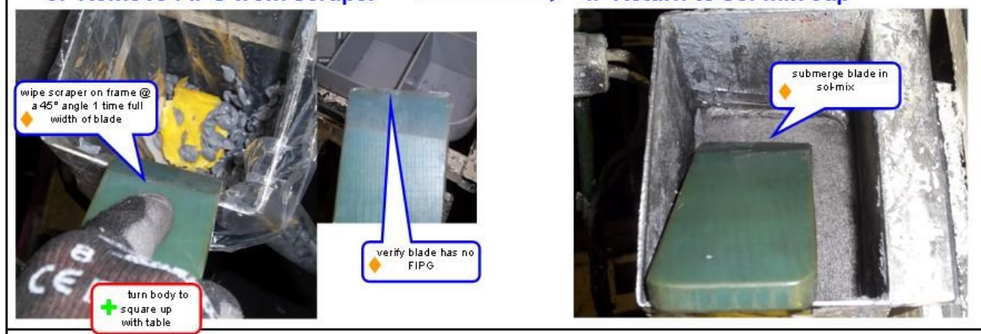
Element Job Instruction Sheet

						Mgr.	A/M	G/L	T/L
Work Name	Scrape FIPG	Line:	V-6 Final 1	Prepared on:	8/14/2012				
Process	4-L/H Headcover	Element C/T		QC Std.	Visually 100%	Revised on:	8/16/2012			

1. Pick up scraper → **2. Remove FIPG**



3. Remove FIPG from scraper → **4. Return to sol-mix cup**



Control No.	No Contamination
Work Name	Scrape FIPG

Instruction Key Points

	Work Sequence	Symbols	Keypoint	Reason
1	Pick up scraper	✚ O	with right hand (thumb on top, index and middle finger under)	using left hand will cause wasted motion
		✚	do not twist at waist	prevent cumulative injury from wasted movements
		◆	use nylon scraper	prevent scratches to cam housing or chain cover
2	Remove FIPG	✚	be aware of sharp edges while reaching over engine	prevent laceration from cam carrier edge
		O	far side then near	provide a good flow for process
		◆	inside out	prevent FIPG from falling into engine
		◆ O	left side of scraper	prevent FIPG from contaminating other parts
		◆ O	right side of scraper	prevent FIPG from contaminating other parts
		◆	do not touch FIPG with gloves	prevent contamination on gloves, for installing o-rings
		◆	confirm no contamination to 3 point surface	prevent leak and insure good seal of new FIPG
3	Remove FIPG from scraper	✚	turn body to square up with table	prevent cumulative injury from twisting at waist
		◆ O	wipe scraper on frame @ a 45° angle 1 time full width of blade	remove FIPG to prevent contamination of sol-mix
		◆ O	verify blade has no FIPG	prevent contamination of sol-mix
4	Return scraper to sol-mix	◆ O	submerge blade in sol-mix	prepare scraper for next engine

Element Job Instruction Sheet

Mgr.	A/M	G/L	T/L

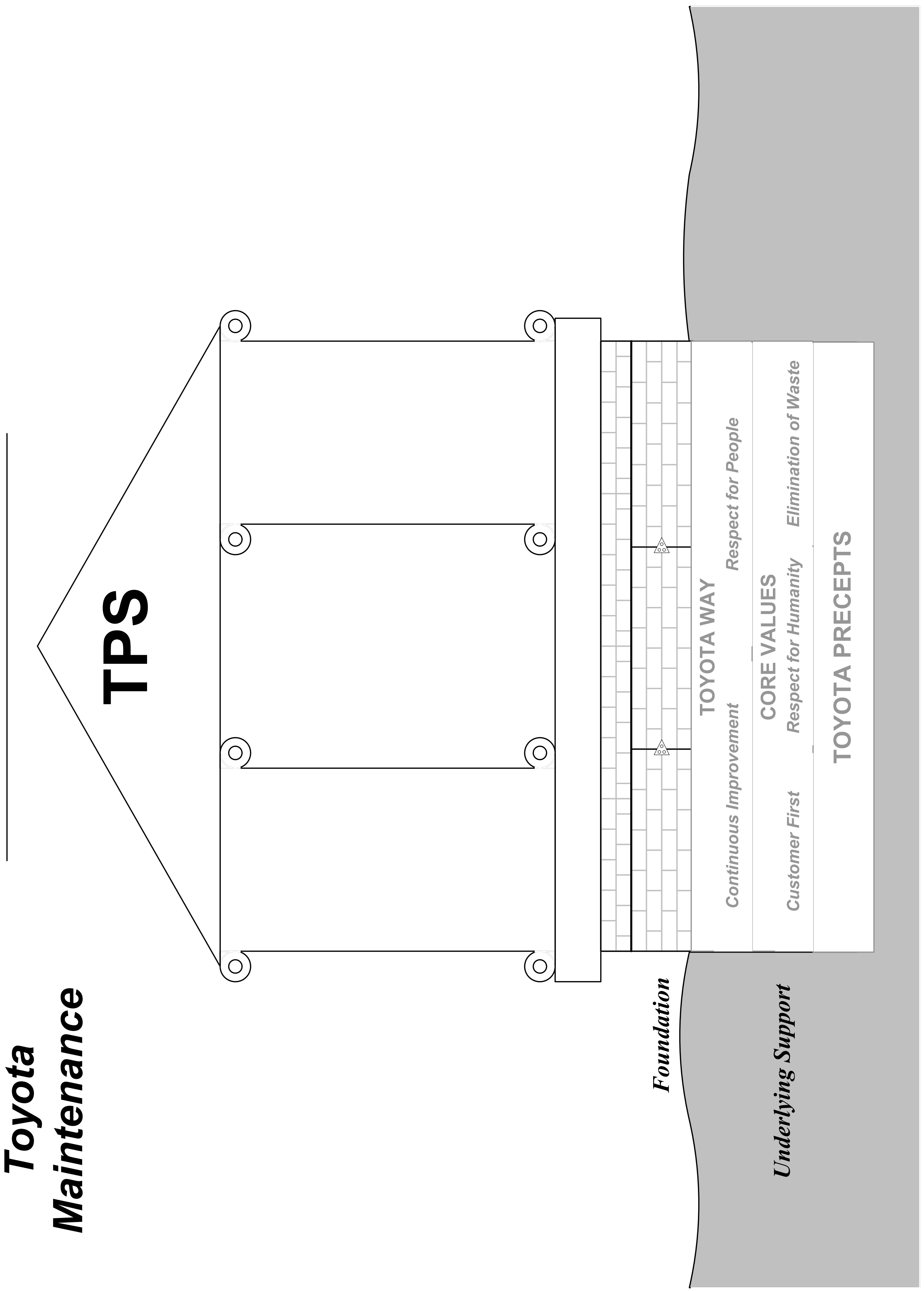
Work Name		Line:		Prepared on:	
Process	Element C/T	QC Std.		Revised on:	

Control No.	No Contamination
Work Name	Scrape FIPG

Instruction Key Points

	Work Sequence	Symbols	Keypoint	Reason

HOUSE OF TPS
Toyota Maintenance



HOUSE OF TPS
Multiskilled Maintenance