A3 Thinking & Standardized Work

Art Smalley, President
Art of Lean, Inc.

Agenda

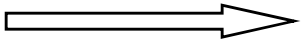
Time Place	Subject	Presenter/ Moderator	Objectives
7:30-7:35 AM	Breakfast, Welcome, Safety	Dr. Ron Bennett John Settineri	Start on time; guests fed, caffeinated and ready to learn; guests know building logistics and emergency procedures.
7:35-9:15 AM	A3 Thinking	Bob Bennett Dr. Mike Morrison Jim Hall	• Purpose x Process x People and for A3 • A3 Thinking and logic flow—key points in creating an A3, and how A3 Thinking applies without an A3 • A3 communications, consensus, coordination, commitment • A3 as human resources development and organizational learning tool • How A3 Thinking strengthens implementation of Lean Thinking Rules In Use
9:15 -9:30 AM	Break		
9:30-10:30 AM	Highly Defined Activity: Standardized Work and Other Methods to Institute and Sustain Best Practices	Jim Hall Dave Graham Dr. Mike Morrison Bob Bennett	• Introduction to Standardized Work Thinking and application • Using SIPOC+M for DC SOPs • Standardizing and defining office and knowledge work
10:30 AM-11:57 AM	Standardized Work and A3 Thinking in Toyota Japan and North America	Art Smalley	Deeper understanding of Standardized Work and A3 Thinking as core components of Toyota's business culture and how they contribute to growth, success and respect.
11:57 AM-12:00 Noon	Announcements Depart	Dr. Ron Bennett	What's next End on time.

First - What questions do you have?

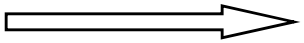
Stages of Ability

Stages of ability

1. Knowledge
2. Understanding
3. Capability
4. Do well
5. Can do and improve



Knowledge: Only this portion is taught in a class room in "Off-JT" manner

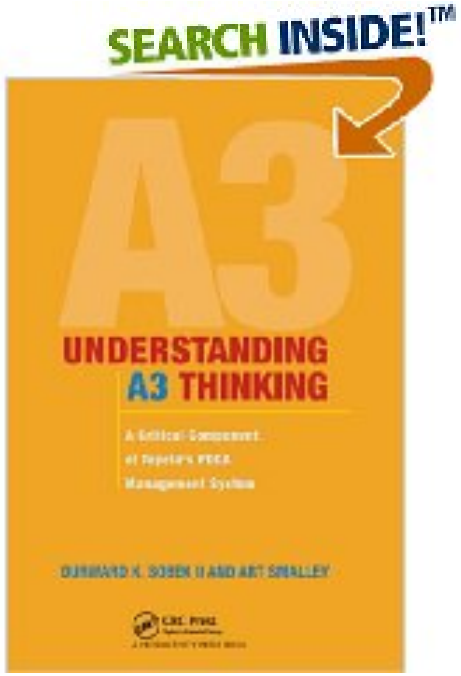


Skill: This portion must be taught with actual problems and situations "OJT" with mentoring from capable superiors. Skill usually can not be developed in a class room setting

Depth takes time to develop…

A3 Thinking Intent

1. Focus on some of the thinking patterns inside Toyota
2. Help foster critical thinking and communication skills
3. Stay away from “tools” (of course an A3 can be considered a tool…)
4. Put focus on both process (i.e. Toyota Way) and results!
5. Reinforce the importance of the PDCA management cycle
6. Create something useful for any environment to try



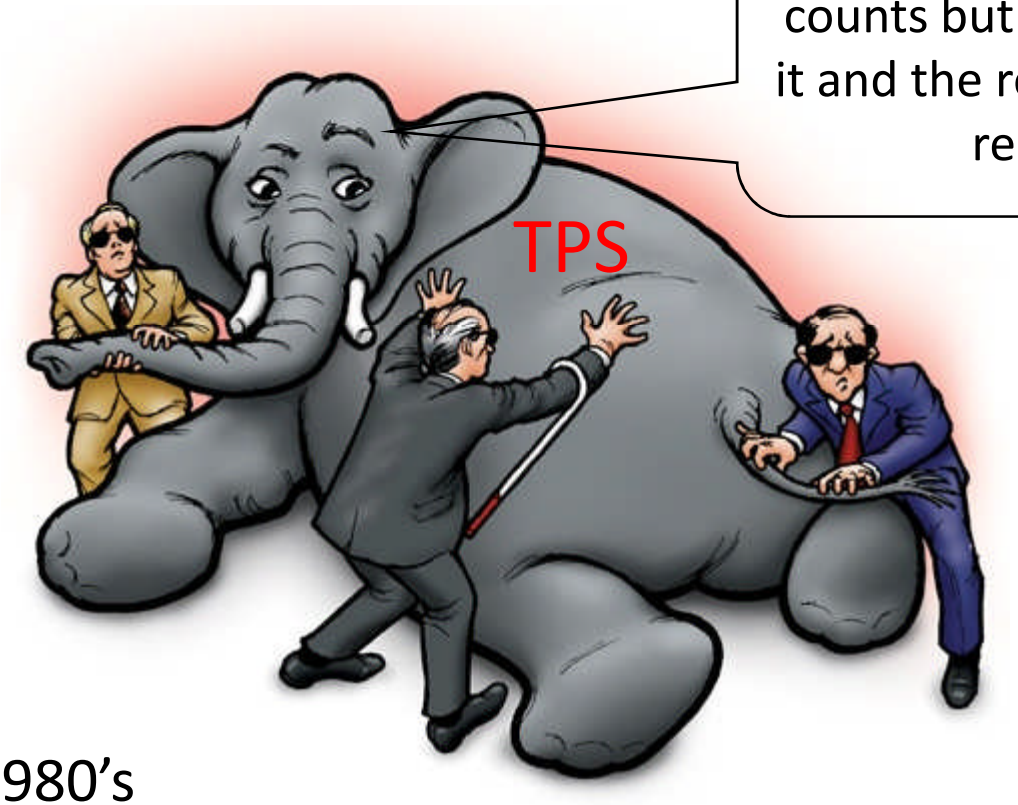
Prof. Sobek

Art Smalley

Background Context

- Starting from simple roots in Toyota in the 1950's TPS has spread around the world to become a dominant improvement methodology
- Annually for the several years Toyota has earned in excess of $10 Billion in profits…(until this last year of course!)
- Toyota has overtaken icons such as Ford and GM and become the automotive industry leader in volume adding to their dominant positions in quality and productivity
- TPS has been "discovered" by multiple people over the years and identified as various different items such as:
  - QC circles
  - Kanban system
  - Kaizen events
  - Value stream mapping
  - What's next?

The Blind Men and the Elephant



1970's
QC circles!

2000
It's all about flow and the Value Stream!

1980's
It's Kanban!

1990's
It's Kaizen!

However…

- Despite all this “discovery” and wealth of information no one has been able to consistently copy this elusive system and produce the same type of results…

- Additionally as Lean/TPS spreads I am starting to see more implementation instances with either limited or poor results to show for all the hard work…in several cases it has even somehow added cost.

- Why is this proving so difficult?

Multiple possible explanations exist…

- Toyota took about 20 years or so between 1950-1970 to build up the system and implement it across several plants. Most practitioners are in about year five or less…
- TPS in Toyota is fairly different from Lean programs I observe in North America. (This may or may not be a problem…)
- There is a shortage of talented TPS implementation leaders…Most of us don't have Taiichi Ohno in manufacturing or Eiji Toyoda for example (and for the record Toyota struggles sometimes overseas as well).
- Perhaps creating this new system in companies with an established culture and old way of doing things is just inherently very difficult…(i.e. we are fighting some form of invisible law of change / gravity?)
- Other reasons no doubt exist as well

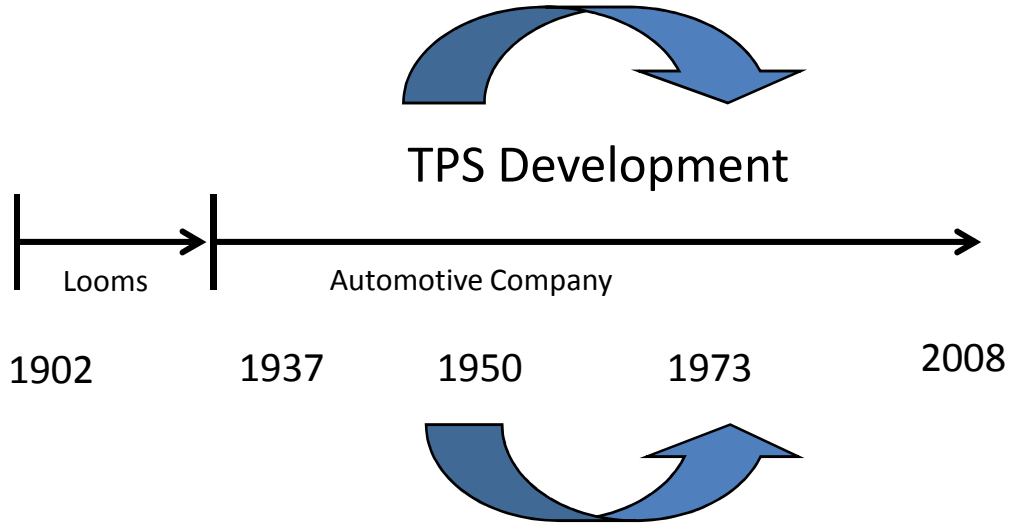
TPS development timeline

<u>Influences</u>

Mass Production moving conveyor lines

Scientific Principles Of Management

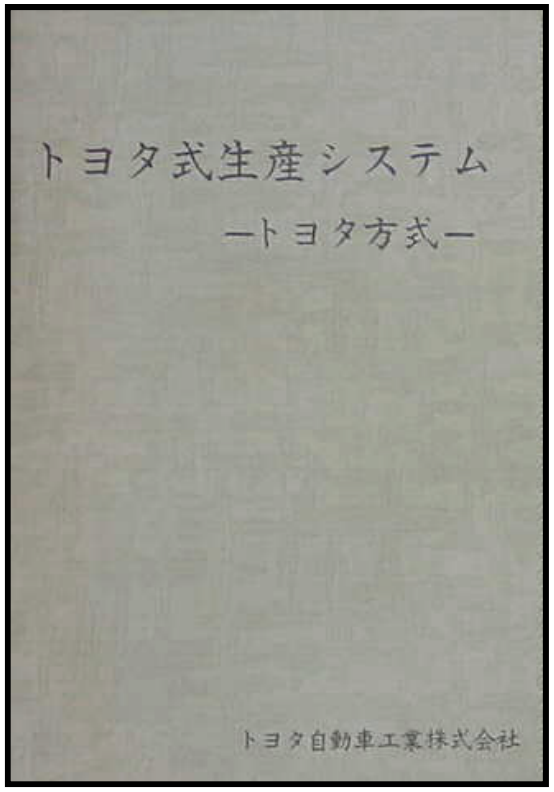
Standardization Of Parts



Sakichi Toyoda | Kiichiro Toyoda | Eiji Toyoda | Taiichi Ohno | Fujio Cho

Guess what – it did not just happen overnight!

TPS Summary 1973



First TPS Manual.
1973 Education & Training Department

論 よ り 実 践

"Practice over theory"

専務取締役 Managing Director

大野耐一

Ohno Taiichi

1. TPS is a series of related activities aimed at elimination of waste in order to reduce cost, improve quality, and improve productivity.

2. Scientific Mindset: On the shop floor it is important to start with actual phenomenon and search for the root cause in order to solve the problem. In other words we must emphasize getting the facts..

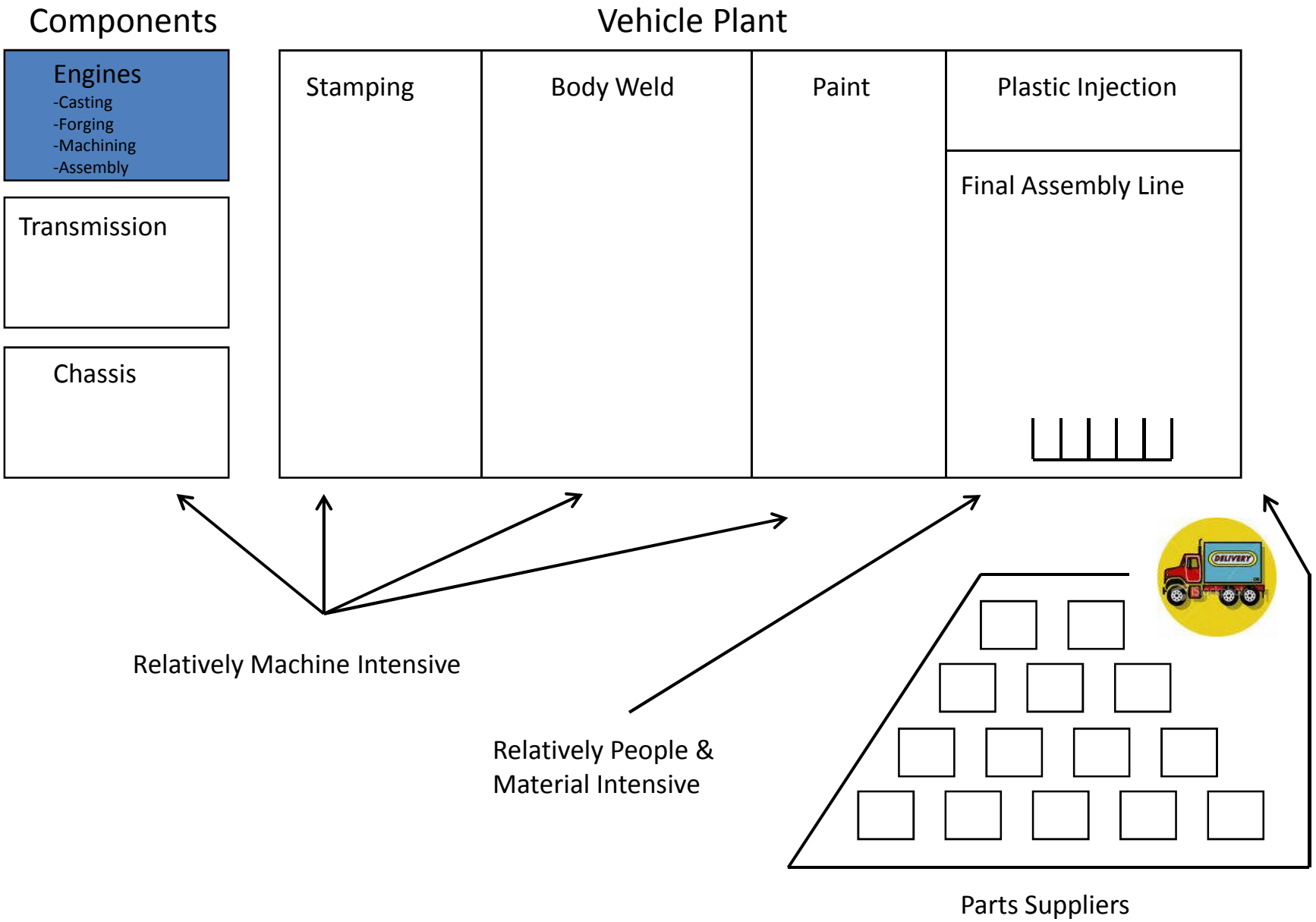
3. In problem solving the purpose must be made clear…in Kaizen the needs must be made clear.

Sample early training courses in Toyota

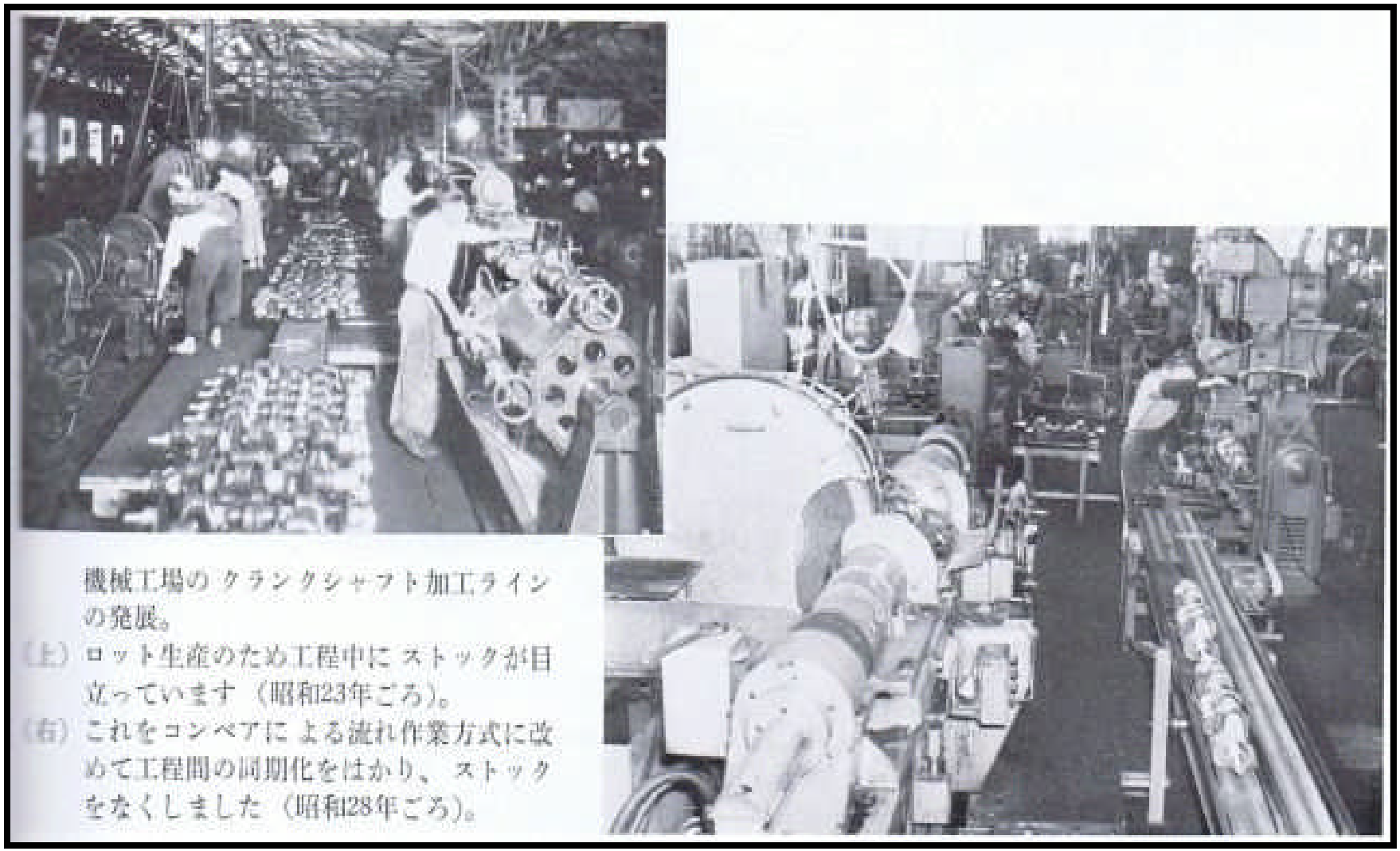
- Training Within Industry (TWI) Courses - Started in 1951 & its influence continues today
  1. Job Instruction
  2. Job Relations
  3. Job Methods -- Replaced in 1955 by the P-course training
  4. Job Safety -- Added later by Toyota to the above courses
- Various "P-Courses" taught by Mr. Shingo – Started in 1955 and continued until 1980 taught on average 3 times per year mainly on:
  1. Motion analysis
  2. Time study analysis
  3. Operational analysis
  4. Process analysis
- TQC related courses (Starting around 1962 with the TQC program)
  1. QC Circle activity
  2. Basic problem solving
  3. Statistical quality control

  } A3 Thinking Origins
- Standardized work – established in the early 1950's and refined up until1978
- Kaizen training course – formalized in 1978 and replaced the P-course
- Role of a Supervisor – formalized in 1970 and continues today
  1. Role of a Team Leader
  2. Role of a Group Leader

Generic Automotive Plant



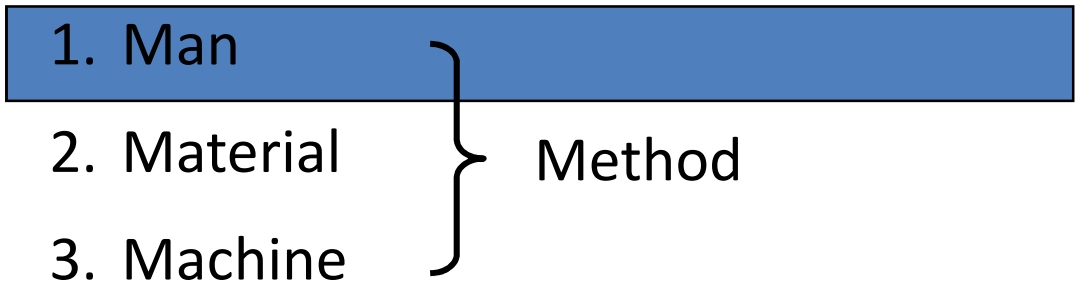
1950’s Line Conversion Example



機械工場のクランクシャフト加工ラインの発展。
（上）ロット生産のため工程中にストックが目立っています（昭和23年ごろ）。
（右）これをコンベアによる流れ作業方式に改めて工程間の同期化をはかり、ストックをなくしました（昭和28年ごろ）。

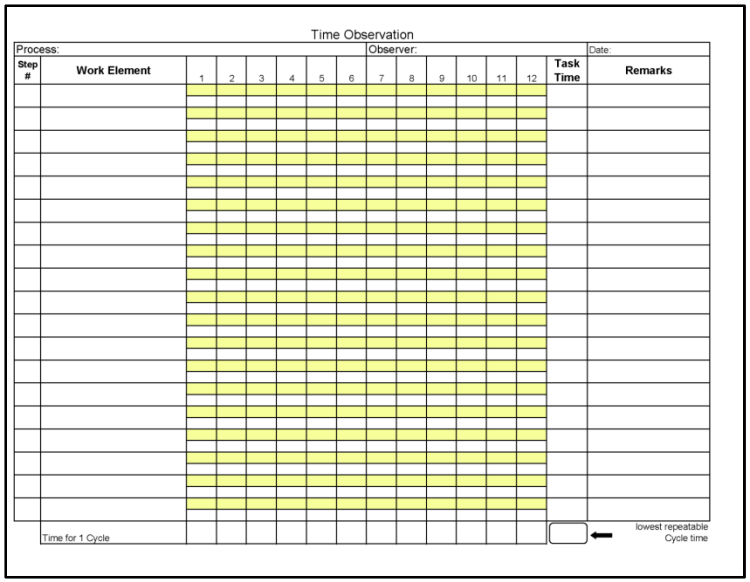
TPS Improvement Patterns (e.g. “Method”)

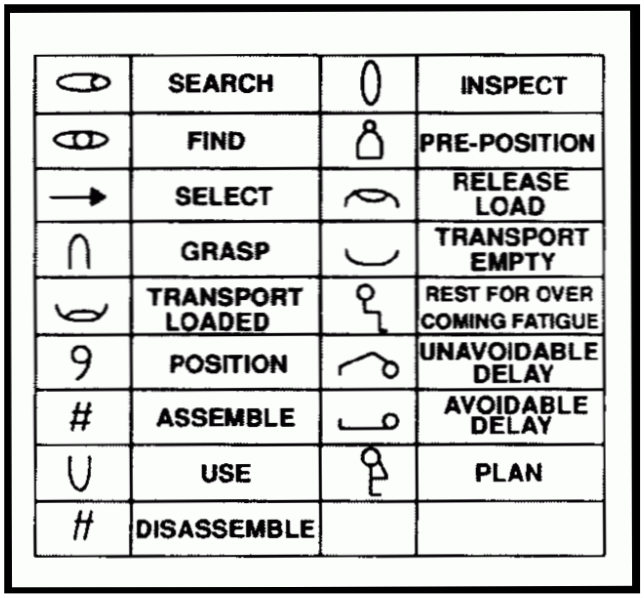
- Three main types (and many derivatives…)

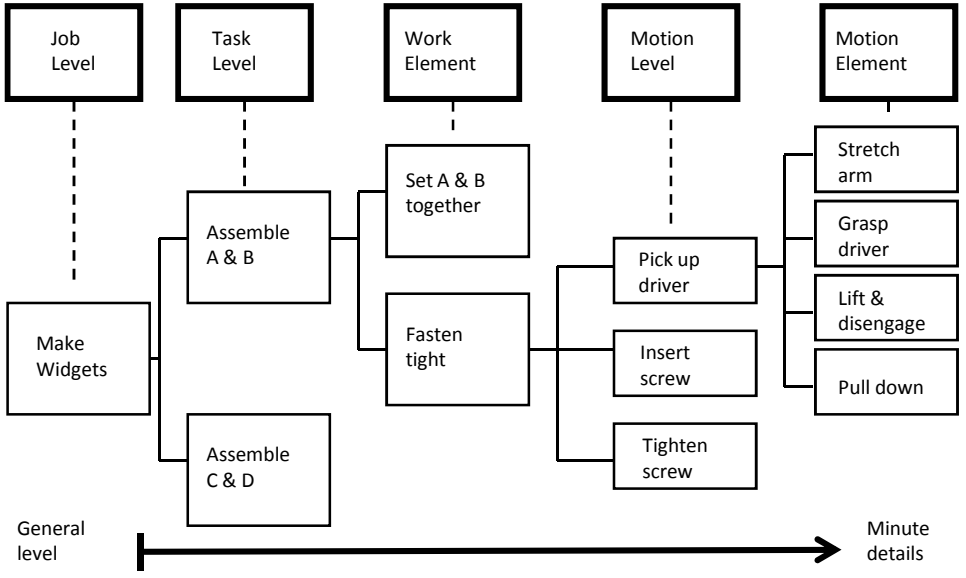


Manpower Related Kaizen

- Time Study
- Motion Analysis
- Work Element Analysis
- Standardized Work & Kaizen







Standardized Work Forms

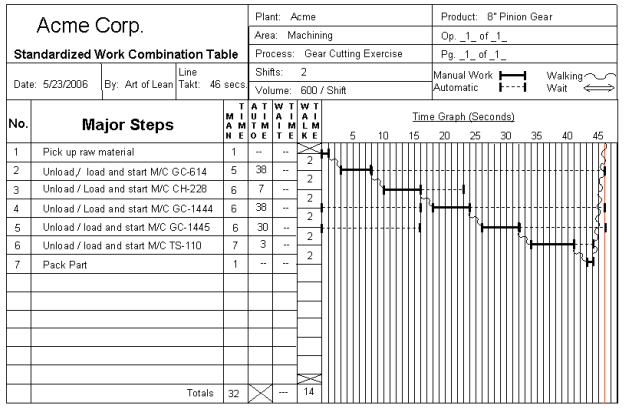
Sample Process Capacity Sheet

Definition:

A basic tool used to measure process output capability considering the time available and time required for change over work. It represents the maximum output possible from the process under current operating conditions.

Process Capacity Sheet					Dept: Product:			Line: Created by:	
Step #	Process Name	Machine Number	Manual Time	Auto Time	Total CT	# Pcs. / Change	Time to Change	Time Per Pc.	Shift Capacity
1	Mill Face	MI1764	3”	25”	28”	100	60”	0.6”	965
2	Drill Holes	DR2424	3”	21”	24”	1000	30”	0.03”	1148
3	Tap Holes	TP1101	3”	11”	14”	1000	30”	0.03”	1967

Standardized Work Combination Table

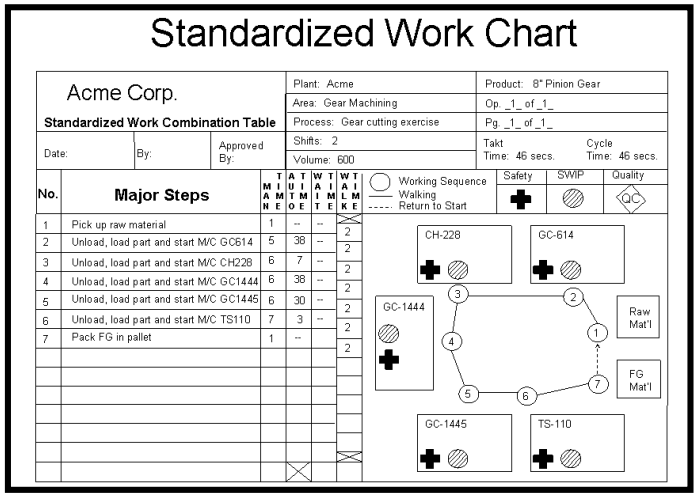


Acme Corp.
Standardized Work Combination Table
Date: 5/23/2006 By: Art of Lean Line Takt: 46 secs.
Plant: Acme | Product: 8" Pinion Gear
Area: Machining | Op. _1_ of _1_
Process: Gear Cutting Exercise | Pg. _1_ of _1_
Shifts: 2
Volume: 600 / Shift
Manual Work / Automatic / Walking / Wait
Time Graph (Seconds) 5 10 15 20 25 30 35 40 45

No.	Major Steps	MAN	AUTO	WAIT	WALK
1	Pick up raw material	1	--	--	2
2	Unload / load and start M/C GC-614	5	38	--	2
3	Unload / Load and start M/C CH-228	6	7	--	2
4	Unload / Load and start M/C GC-1444	6	38	--	2
5	Unload / load and start M/C GC-1445	6	30	--	2
6	Unload / load and start M/C TS-110	7	3	--	2
7	Pack Part	1	--	--	
	Totals	32		---	14

TT 46 Secs.

Standardized Work Chart



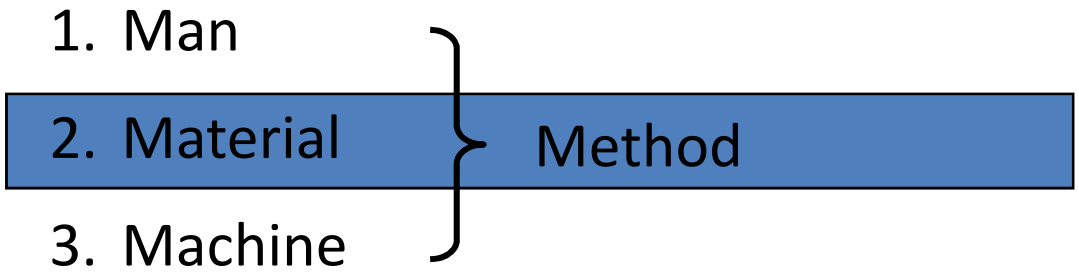
Acme Corp.
Standardized Work Combination Table
Date: By: Approved By:
Plant: Acme | Product: 8" Pinion Gear
Area: Gear Machining | Op. _1_ of _1_
Process: Gear cutting exercise | Pg. _1_ of _1_
Shifts: 2
Volume: 600
Takt Time: 46 secs. Cycle Time: 46 secs.
Working Sequence / Walking / Return to Start
Safety | SWIP | Quality

No.	Major Steps	MAN	AUTO	WAIT	WALK
1	Pick up raw material	1	--	--	2
2	Unload, load part and start M/C GC614	5	38	--	2
3	Unload, load part and start M/C CH228	6	7	--	2
4	Unload, load part and start M/C GC1444	6	38	--	2
5	Unload, load part and start M/C GC1445	6	30	--	2
6	Unload, load part and start M/C TS110	7	3	--	2
7	Pack FG in pallet	1	--		2

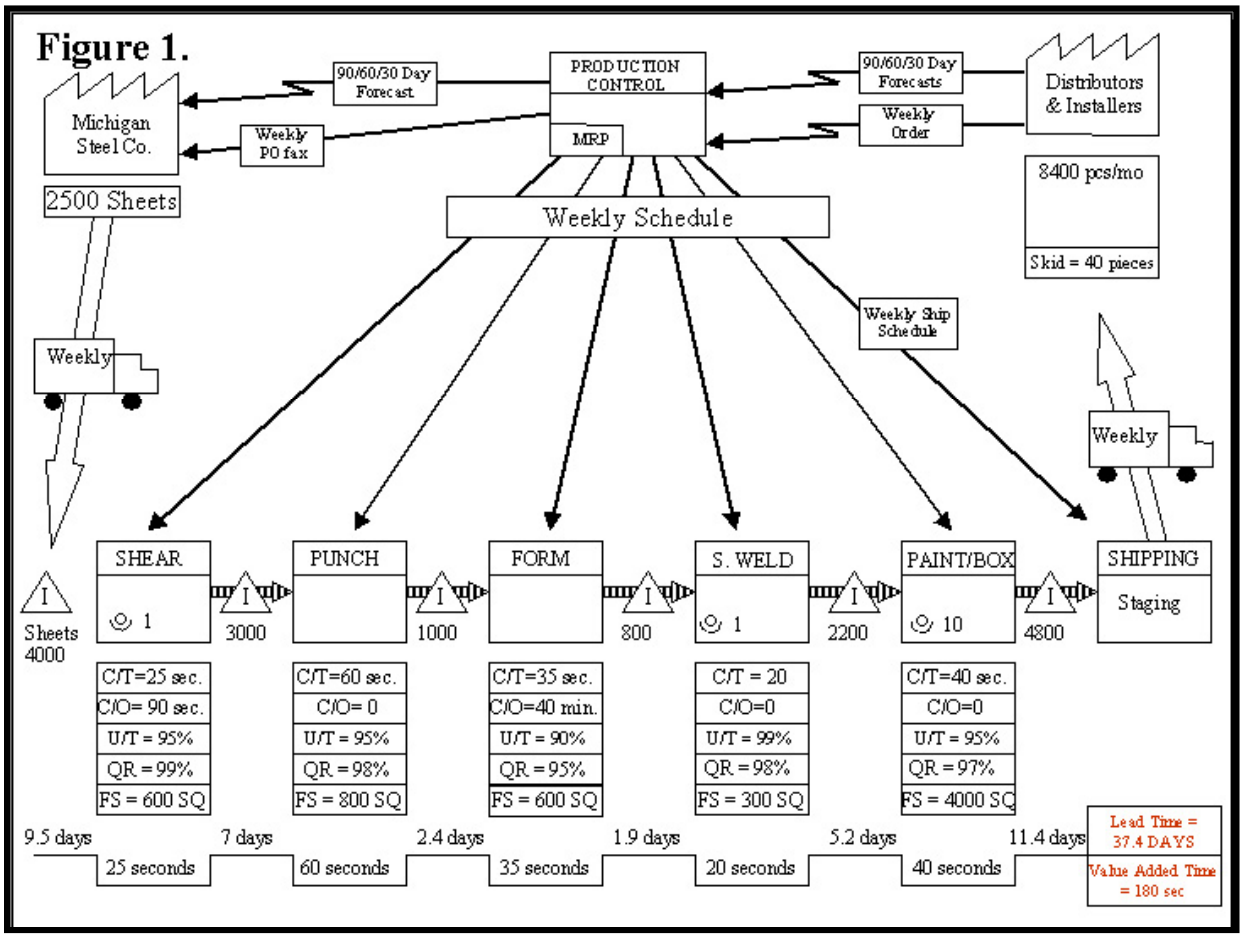
CH-228, GC-614, GC-1444, GC-1445, TS-110, Raw Mat'l, FG Mat'l, 1 2 3 4 5 6 7

Kaizen Patterns

- Three main types (and many derivatives…)



Material & Information Flow Analysis (MIFA/VSM)



Takt Time

Flow
-Material
-Information

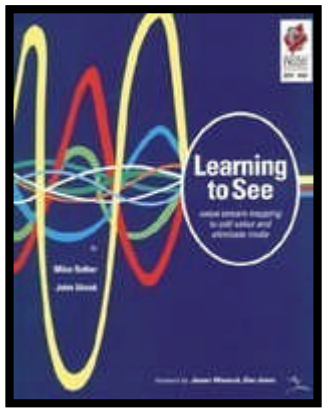
Inventory

Process Info

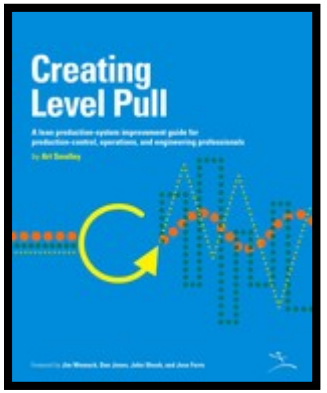
Lead-time

Material Flow Focused Approaches

1. What is takt time?
2. How to create flow?
3. Where is the pacemaker?
4. How to implement pull?
5. Make to order to make to stock?
6. How to level production?
7. What pitch increment?
8. How to improve process flow?

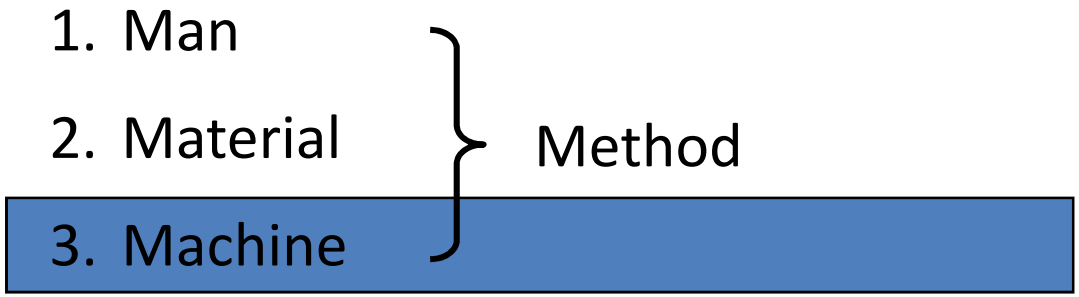


1. Which products should you hold in a finished-goods inventory, and which to stock?
2. How much of each product should you hold in finished goods?
3. How will you organize and control the finished-goods store?
4. At what single point will you schedule the value stream?
5. How will you level production at the pacemaker?
6. How will you convey demand to the pacemaker
7. How will you manage information and material flow upstream?
8. How will you size your markets and trigger withdrawal pull?
9. How will you control batch processes upstream from the market?
10. How will you expand the level pull system across the facility?
11. How will you sustain your level pull system?
12. How will you improve your level pull system?

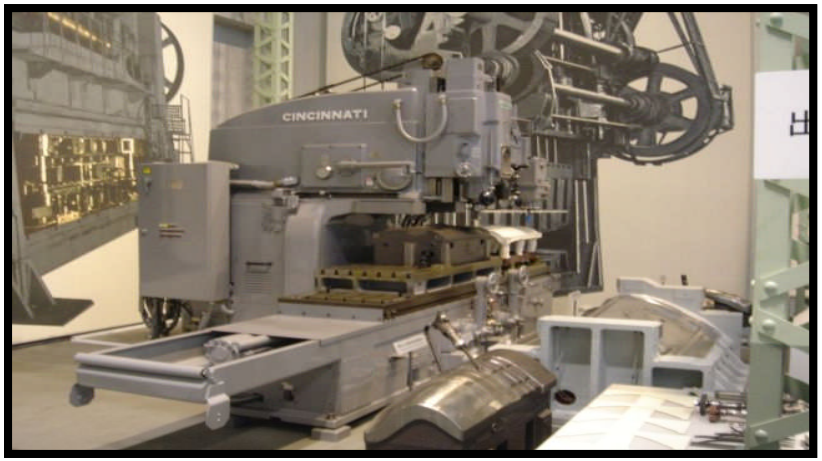


Kaizen Patterns

- Three main types (and many derivatives…)



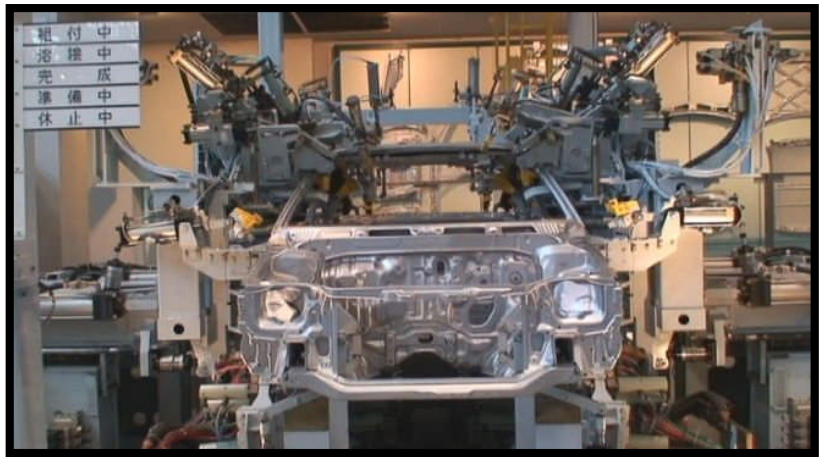
Old Toyota Machines 1950's – 1960's



Cincinnati Milling Machine

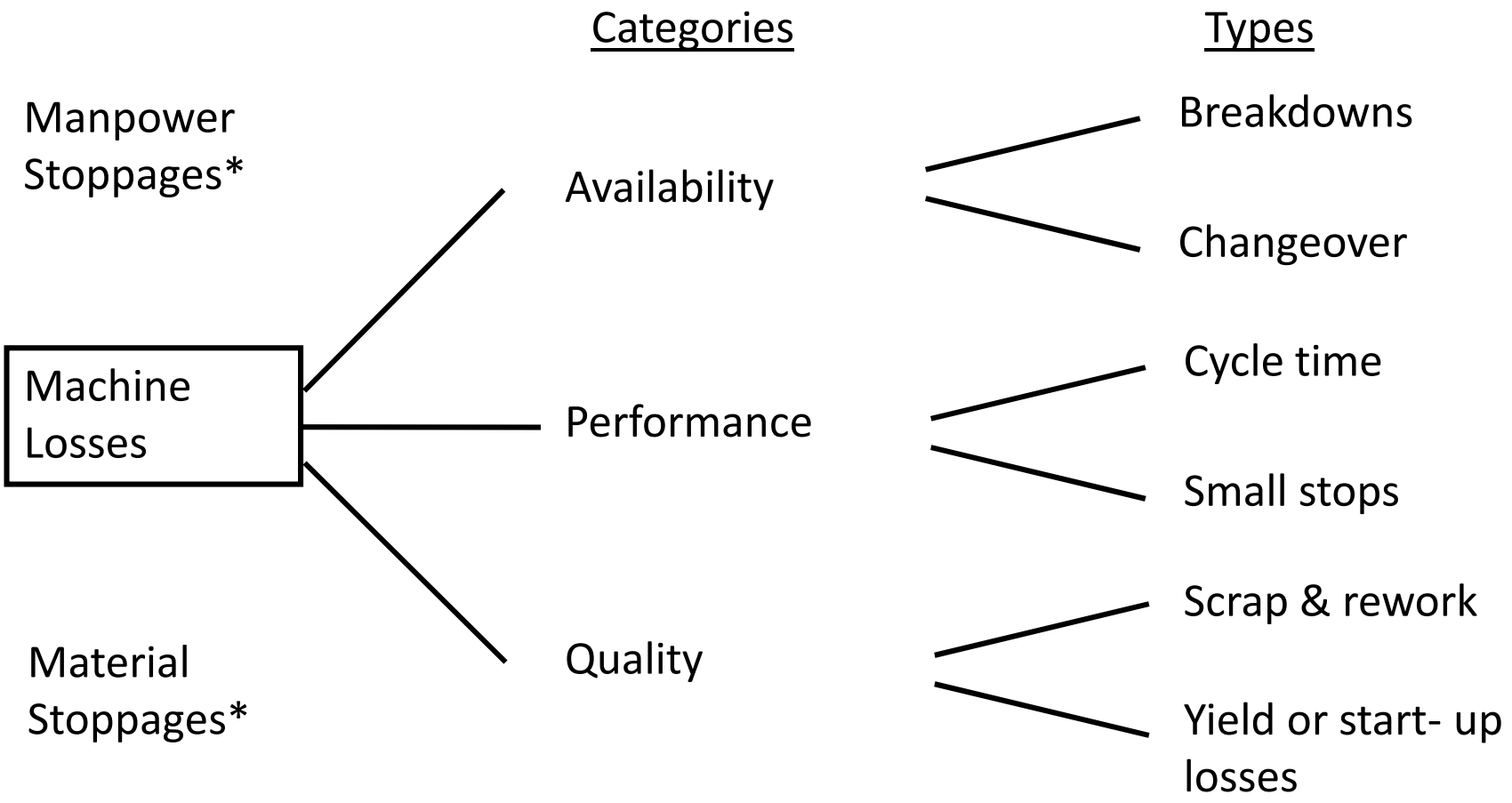
Toyoda Transfer Machine

Danly Stamping Press



Automated Body Welding Machine

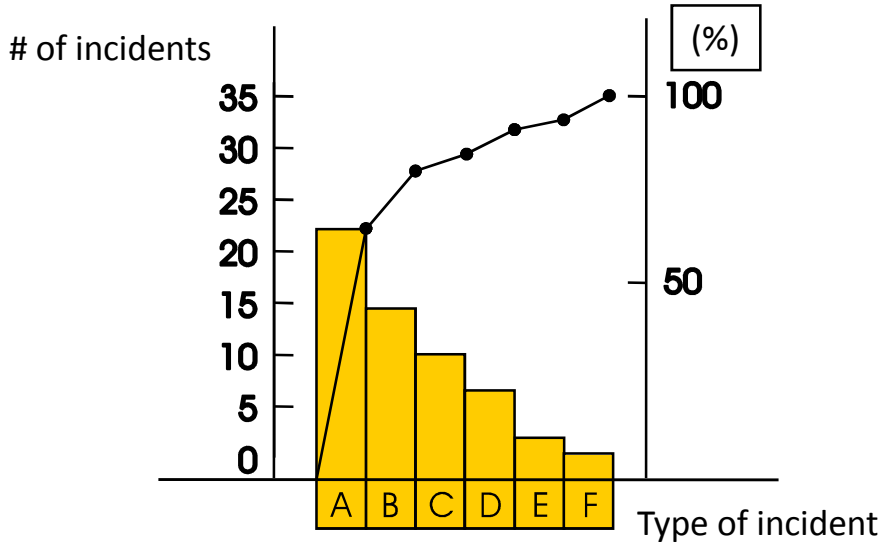
Six Machine Losses



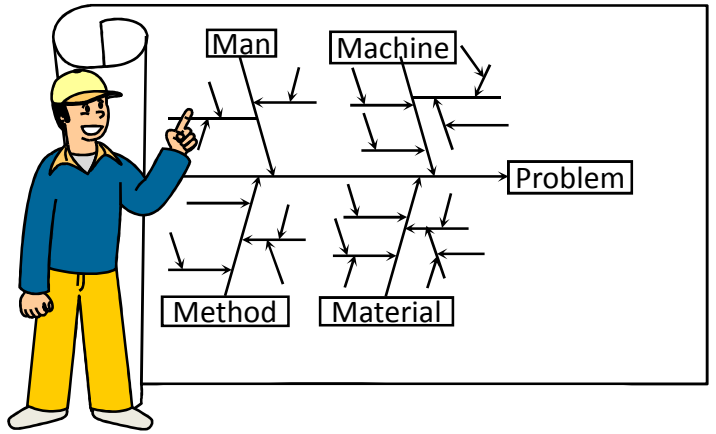
*Note: Considered separately in the previous two sections

1. Breakdowns

Pareto's Curve Graph



Cause and Effect Diagram



The same type of rigor that is used in "quality" problem solving should be applied to "machine breakdown" problem solving…

2. Set Up Reduction For Changeover

Line Name		Set Up Reduction Worksheet						
Part Name		(Work element analysis, time study, problem identification sheet)						
Process Name	Machine Name				Part Number			
No.	Main Set Up Work Elements	Time Study			Category		Problem Point	Countermeasure
		Start	End	Total	Int.	Ext.		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								

3. Machine Cycle Time Study

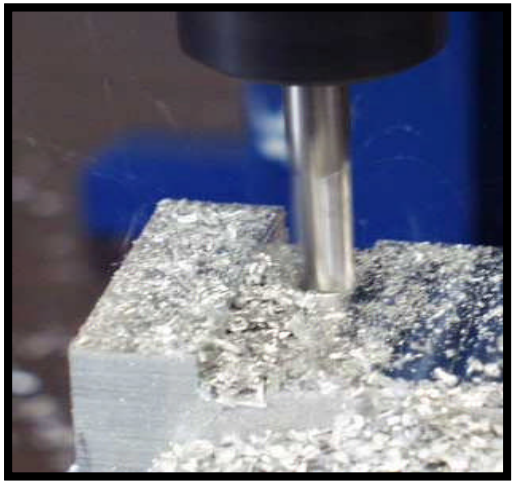
Illustrative Example

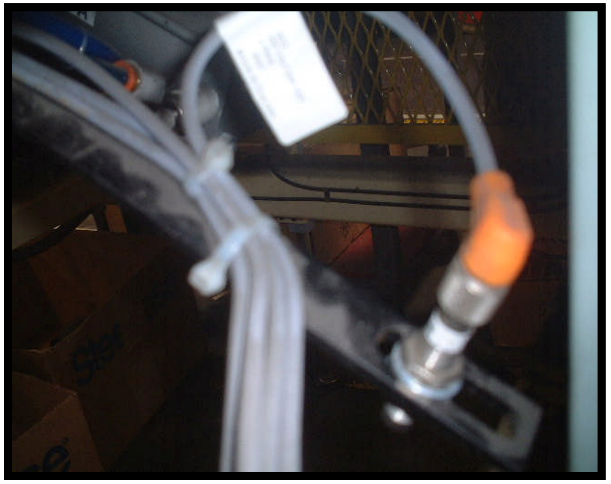
1.	Automatic doors open	2”
2.	Remove part from machine (or auto eject, etc.)	2”
3.	Load next part	2”
4.	Clamp part / Coolant on	3”
5.	Table index	3”
6.	Grinding wheel on (or tool rotates, etc)	4”
7.	Rapid feed advance	4”
8.	Air cut	2”
9.	Rough cut	18”
10.	Dwell	2”
11.	Finish cut	20”
12.	Air cut	2”
13.	Rapid feed retract	4”
14.	Table return / Coolant off / Air blow	4”
15.	Unclamp part	2”
16.	Automatic door open – Repeat cycle	76”

Usually not all of the machine cycle time is value added…

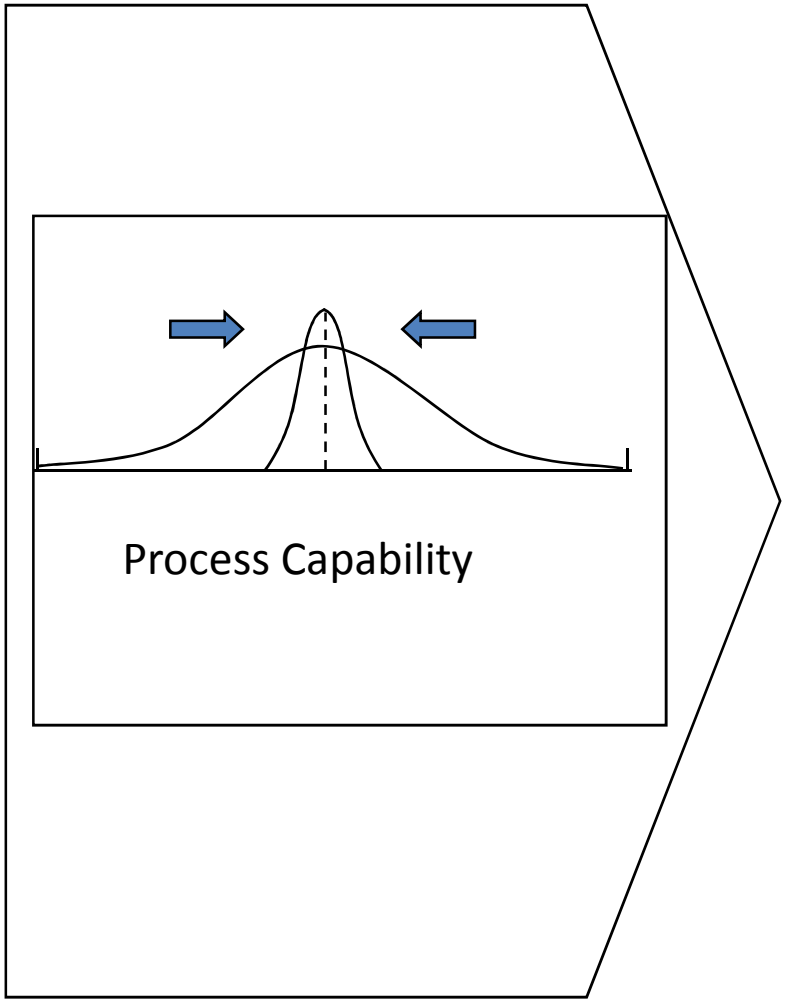
4. Minor Stops チョコ停(Machining example)

1. Cutting chips on fixtures
2. Limit or proximity switch problems
3. Part jamming
4. Operator adjusting “something”
5. Confusion of on-line and off-line work for operator
6. Etc.





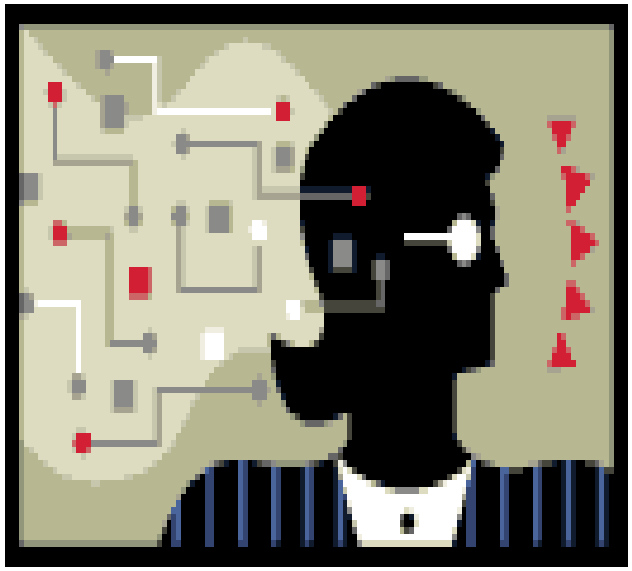
5 & 6. Scrap and Yield Losses



Machining Example

1. What is the actual capability of the process?
2. Which dimension is in trouble? By exactly how much? Since when?
3. How is the condition of the tool?
4. Where is the datum? What is its condition?
5. How is the part located and clamped?
6. How is the part measured and gauged?
7. What is the condition of the various fluids (coolant, oil, grease, etc.)
8. What is the actual machining cycle?
9. What mechanical interference might be occurring?
10. What is misaligned in the machine – how much?
11. What is the condition of the spindle head / bearing unit (e.g. run out)
12. How is the tool holder condition?
13. How good is the incoming material?
14. What else is worn that can cause variation?

TPS is built on the scientific way of thinking*…



*Quote by Taiichi Ohno. Graphic and comment by Hajime Ohba Toyota Supplier Support Center

General Scientific Method

1. Define the question / make observations
2. Gather information and facts
3. Form hypothesis
4. Perform experiment and collect data
5. Analyze data
6. Interpret data and draw conclusions
7. Summarize results

TPS Basic Problem Solving / Kaizen

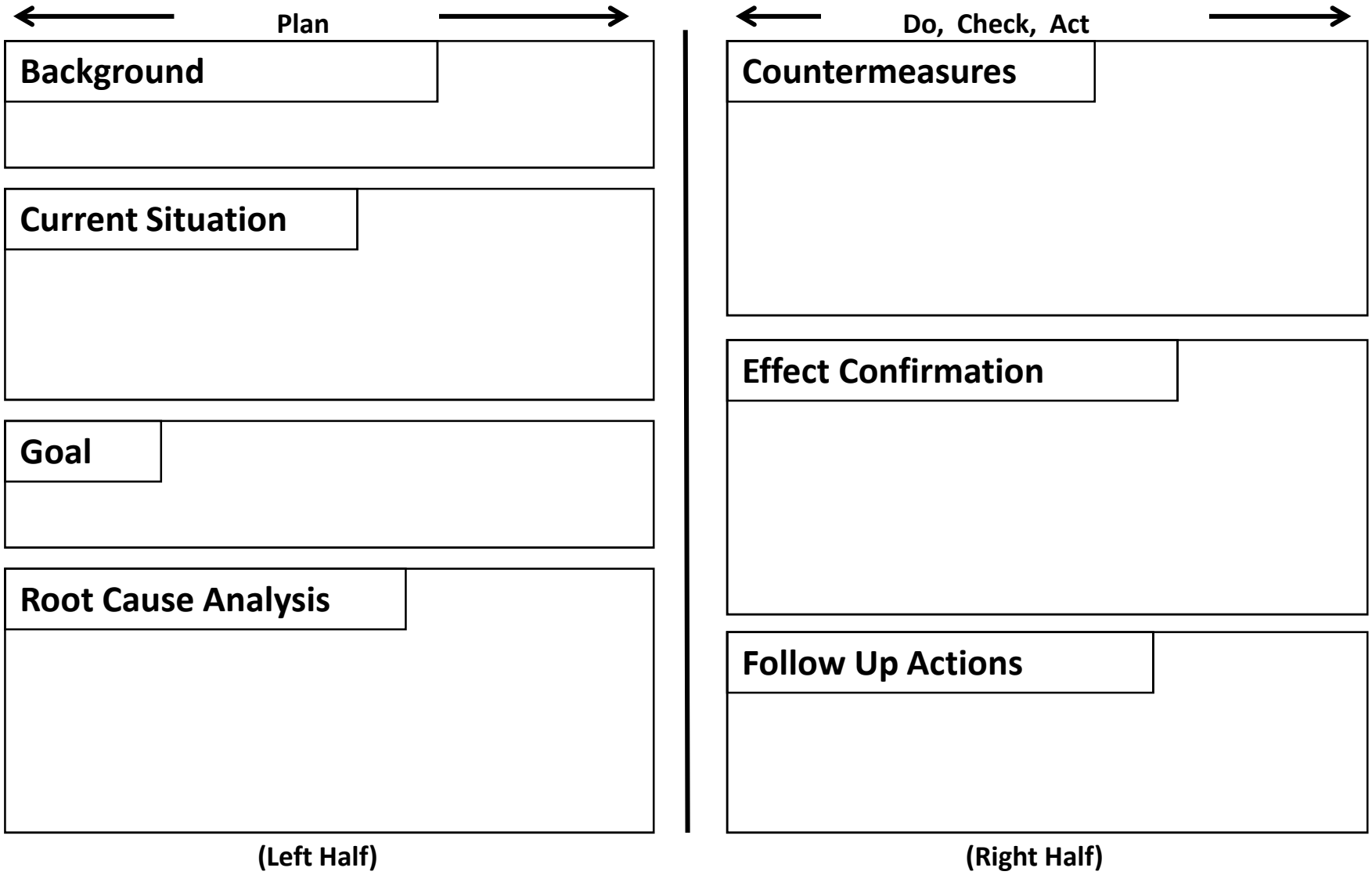
1. Define the problem / opportunity
2. Analyze the causes
3. Set a goal
4. Implement the action items
5. Check the results
6. Follow up / Standardize

It's the "Thinking Pattern" that matters…

Scientific Method*	Problem Solving*	Kaizen Steps*
•Make Observations	•Define Problem	•Clarify the Goal
•Gather Information	•Analyze Causes	•Analyze Situation
•Form Hypothesis	•Set a Goal	•Generate Original Ideas
•Perform Experiment to Test Hypothesis	•Implement Corrective Action Items	•Develop an Implementation Plan
•Analyze Data	•Check Results	•Implement Action Items
•Draw Conclusions & Summarize	•Follow Up / Standardize	•Evaluate Results / Standardize

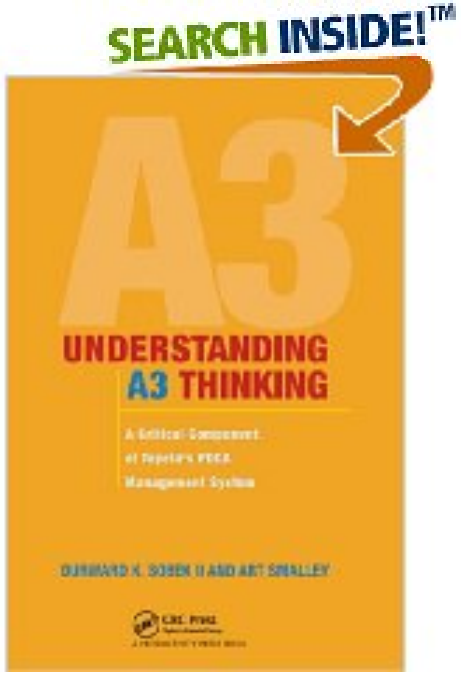
*Generic patterns. Other versions exist.

Generic A3 Report Format Example



A3 Thinking Intent

1. Focus on the thinking pattern
2. Develop critical thinking and communication skills
3. Stay away from “tools” (of course an A3 can be considered a tool…)
4. Put focus on both process (i.e. Toyota Way) and results!
5. Reinforce the importance of the PDCA management cycle
6. Create something useful for any environment to try

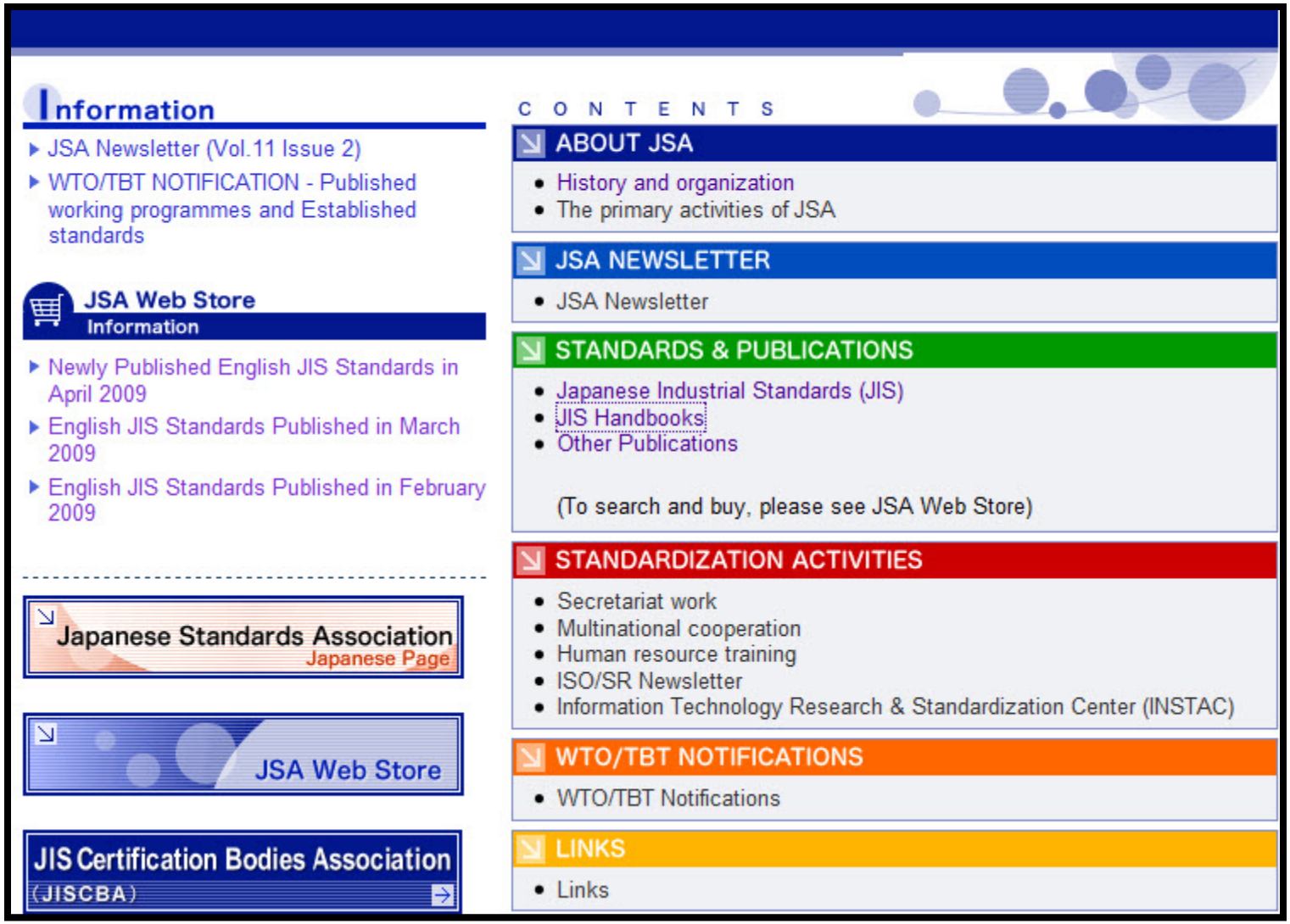


Questions on A3 Thinking?

Documents & Standards in Toyota

National Standards (JSA/JIS)	Open National Standards
Company Standards (TMS/TMR)	
Process Standards (MTS, etc.)	
Documents in Manufacturing •Job Instruction •Work Standards •Standardized Work •Kaizen	Generally open in Toyota. You can obtain a copy of the form and an outline of the training course. The exception is the category known as “Work Standards”. 

National Standards-JSA/JIS



Company Standards-TMS*

秘

TMS/TMR 15-20 Volumes

Tooling Standards

- Drills
- Reams
- Taps
- Grinding Wheels
- Broaches
- Hones
- Inserts
- End Mills
- Tool Holders

Mechanical Elements

- Fasteners
- Couplings
- Bearings
- Seals
- Springs
- Pins
- Bushings
- Etc.

***Toyota Manufacturing Standards / Toyota Manufacturing Regulations**

Tooling Standard Example

秘

SI

確認・訂正箇所 . .

全 3 ページ中 1 ページ

生 産 技 術 標 準

TMS MTH 3020B

ストレートシャンク強力エンドミル

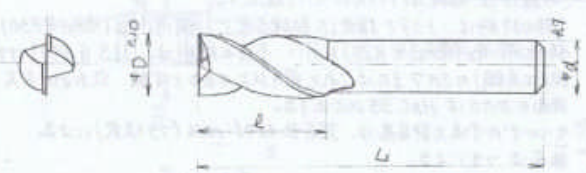
ECA

新 定 昭和 46.11.1

1回改正 昭和 57.7.15

主管部署 第1生産技術部工場技術課

2枚刃



単位mm

標準刃					特長刃				
呼び	D	d	ℓ	L	呼び	D	d	ℓ	L
203	3	6	10	45	203L	3	6	15	50
204	4	6	12	45	204L	4	6	20	55
205	5	6	15	50	205L	5	6	25	60
206	6	6	15	50	206L	6	6	25	60
208	8	8	20	60	208L	8	8	35	75
210	10	10	25	70	210L	10	10	45	90
212	12	12	30	80	212L	12	12	55	105
214	14	16	35	85	214L	14	16	55	105
215	15	16	40	95	215L	15	16	65	120
216	16	16	40	95	216L	16	16	65	120
218	18	16	40	95	218L	18	16	65	120
220	20	20	45	110	220L	20	20	75	140
222	22	20	45	110	222L	22	20	75	140
224	24	25	50	120	224L	24	25	90	160
225	25	25	50	120	225L	25	25	90	160
226	26	25	50	120	226L	26	25	90	160
228	28	25	55	125	228L	28	25	90	160
230	30	25	55	125	230L	30	25	90	160

全 3 ページ中 2 ページ

生 産 技 術 標 準

TMS MTH 3020B

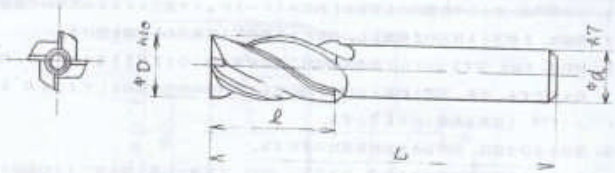
ストレートシャンク強力エンドミル

ECA

新 定 昭和 46.11.1

1回改正 昭和 57.7.15

4枚刃



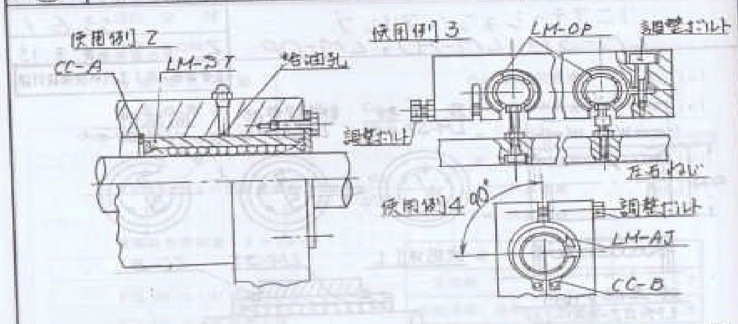
単位mm

標準刃					特長刃				
呼び	D	d	ℓ	L	呼び	D	d	ℓ	L
403	3	6	10	45	403L	3	6	15	50
404	4	6	12	45	404L	4	6	20	55
405	5	6	15	50	405L	5	6	25	60
406	6	6	15	50	406L	6	6	25	60
408	8	8	20	60	408L	8	8	35	75
410	10	10	25	70	410L	10	10	45	90
412	12	12	30	80	412L	12	12	55	105
414	14	16	35	85	414L	14	16	55	105
415	15	16	40	95	415L	15	16	65	120
416	16	16	40	95	416L	16	16	65	120
418	18	16	40	95	418L	18	16	65	120
420	20	20	45	110	420L	20	20	75	140
422	22	20	45	110	422L	22	20	75	140
424	24	25	50	120	424L	24	25	90	160
425	25	25	50	120	425L	25	25	90	160
426	26	25	50	120	426L	26	25	90	160
428	28	25	55	125	428L	28	25	90	160
430	30	25	55	125	430L	30	25	90	160

Mechanical Element Standard

秘

生産技術標準 TMS.SKH3031



単位mm

呼び	ST形質量 (gf)	ST形 偏心(最大) 精	ST形 偏心(最大) 上	ラジアルすきま 調整値	基本動定格荷重 C (kgf) {N}	基本静定格荷重 Co (kgf) {N}	適応する軸径 寸法	普通すきま 精密	普通すきま 上	緊密すきま 精	緊密すきま 上	適応するハウジング径 寸法	すきまばめ 精	すきまばめ 上	とまりばめ 精	とまりばめ 上
(85)	97				8 {78.41}	12 {117.6}		-0.005 / -0.011	-0.005 / -0.014	0 / -0.006	0 / -0.008	15	+0.011 / 0	+0.018 / 0	+0.006 / -0.005	+0.010 / -0.008
(8)	17			-0.005	11 {107.8}	22 {215.6}	8									
(10)	36	0.008	0.012		16 {156.8}	29 {284.2}	10					19	+0.013 / 0	+0.021 / 0	+0.008 / -0.005	+0.012 / -0.009
13	49			-0.007	27 {264.6}	49 {480.2}	13	-0.006 / -0.014	-0.006 / -0.017	0 / -0.008	0 / -0.011	23				
16	78				43 {421.4}	74 {725.2}	16					28				
20	100				57 {558.6}	99 {970.2}	20	-0.007 / -0.016	-0.007 / -0.020	0 / -0.009	0 / -0.013	32	+0.016 / 0	+0.025 / 0	+0.010 / -0.006	+0.014 / -0.011
25	260	0.010	0.015	-0.009	89 {872.2}	160 {1568}	25					40				
30	290				130 {1274}	220 {2156}	30					45				
35	385				170 {1666}	310 {3038}	35					52				
38	565	0.012	0.020	-0.013	210 {2058}	360 {3528}	38	-0.009 / -0.020	-0.009 / -0.025	0 / -0.011	0 / -0.016	57	+0.019 / 0	+0.030 / 0	+0.013 / -0.006	+0.018 / -0.012
40	675						40					60				
50	1740				390 {3822}	710 {6958}	50					80				
60	2000	0.017	0.025	-0.016	420 {4116}	820 {8036}	60	-0.010 / -0.023	-0.010 / -0.029	0 / -0.013	0 / -0.019	90	+0.022 / 0	+0.035 / 0	+0.016 / -0.006	+0.022 / -0.013
80	4490				250 {2450}	1450 {14210}	80					120				
100	9620	0.020	0.030	-0.020	1480 {14504}	2250 {22050}	100	-0.012 / -0.027	-0.012 / -0.034	0 / -0.015	0 / -0.022	150	+0.025 / 0	+0.040 / 0	+0.018 / -0.007	+0.026 / -0.014
120	14000			-0.025	1670 {16366}	3550 {34790}	120					180				
150	21100	0.025	0.040	-0.030	2130 {20874}	5540 {54292}	150	-0.014 / -0.032	-0.014 / -0.039	0 / -0.018	0 / -0.025	210	+0.029 / 0	+0.046 / 0	+0.022 / -0.007	+0.030 / -0.016

生産技術標準 TMS.SKH3031

1. この規格は直線運動に使用する、リニアモーションベアリングについて規定する。
2. 使用上の注意
   - 2.1 この軸受は、直線運動に使用し、回転運動には使用しない。
   - 2.2 許容摺動速度は 1m/s である。
   - 2.3 取付け
     - 2.3.1 軸受箱への圧入には側板部分を叩かないよう外筒側には治具（図-1参照）をあて、静かに圧入する。
     - 2.3.2 軸方向の固定は、外筒みぞに装着したサークリップ、または、側板でおこなう。
     - 2.3.3 軸受を取付けたのち、軸を挿入するときは、ボールに衝撃を与えないようにする。
     - 2.3.4 軸と軸受箱の軸芯との平行度が不安定であると走行精度が著しく悪くなる。
     - 2.3.5 ボール条列4以下では負荷ボールは真下に配置し中間負荷は摺動性能が低下するので使用しない。（図2 参照）

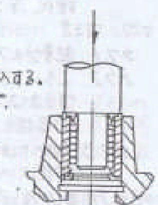


図-1

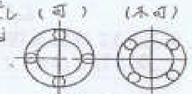


図-2

   - 2.4 潤滑
     - 2.4.1 グリース潤滑、油潤滑どちらでもよい。補給は軸の油膜が切れない程度におこなう。
     - 2.4.2 外部からの給油は軸受外筒中央部に給油孔がついているものがあり、使用例2に示すような方法により給油ができる。給油孔付の場合は、呼びの末尾に「-OH」と表示する。
   - 2.5 摺動抵抗
     - 2.5.1 シール無しの場合
       摩擦係数 0.0025～0.0050
     - 2.5.2 シール付きの場合
       両側シール及び片側シールの最大摺動抵抗の参考値を図-3に示す。片側シールのB方向への走行時の摺動抵抗は両側シールの約70%、A方向への走行時の摺動抵抗は両側シールの約30%である。

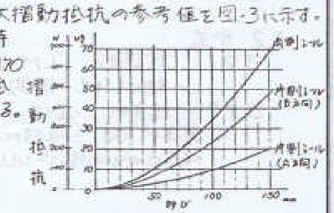


図-3

Main TPS Documents in Manufacturing

1. Job Instruction
- Training Matrix
- Job Breakdown Sheet

Open

2. Work Standards
- Operation Drawings
- Tooling Drawings
- Quality Control
- Etc.

Documents in Manufacturing At Toyota

4. Standardized Work
- Process Capacity Sheet
- SW Combination Table
- SW Chart

Open

3. Kaizen Forms
- Time Study Sheet
- Motion Study
- Work Element Analysis

TWI/Job Instruction

1. Knowledge of work
   -(e.g. how we do things)

2. Knowledge of responsibility
   -(e.g. what we need to do by when)

3. Skill in improvement
   -(e.g. how can we do this better)

4. Leadership behavior & motivation
   -(e.g. why we do things this way)

5. Teaching ability
   -(how to pass along our skills to others)

Toyota starting point in the early 1950's

Job Instruction

How to teach an employee to do a particular job

-Safely

-Correctly

-Conscientiously

JI Motto –

If the employee has not learned,
then the instructor has not taught!

JI Training Matrix

TEAM TRAINING MATRIX

Name:	Oper. Std. Sheet No.													REMARKS			
Dept: Date:	Process or Operation Name													CAPABILITIES			Personnel Needs (Reassignment) Performance Needs (Work Manner)
IDEAL NUMBER TRAINED																	
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕				
RESULT OF TRAINING	Beginning of Year													⊕ = 100% + Teaching Skill			
	Middle of Year													⊕ = 100% Performance			
	End of Year													⊕ = 50%			
Remarks	Job Needs (Production Change)													⊕ = In Training			

Job Breakdown Sheet

Job Breakdown Sheet

Operation: _____

Parts: _____

Tools & Materials: _____

Safety Equipment: _____

Major Steps	Key Points

JI Teaching Pattern

1. Prepare the learner
2. Present the operation
   - Major Steps
   - Key Points
   - Reasons Why
3. Try out the job
   - Silent
   - Major Steps
   - Key Points
   - Reasons Why
4. Follow up

Work Standards

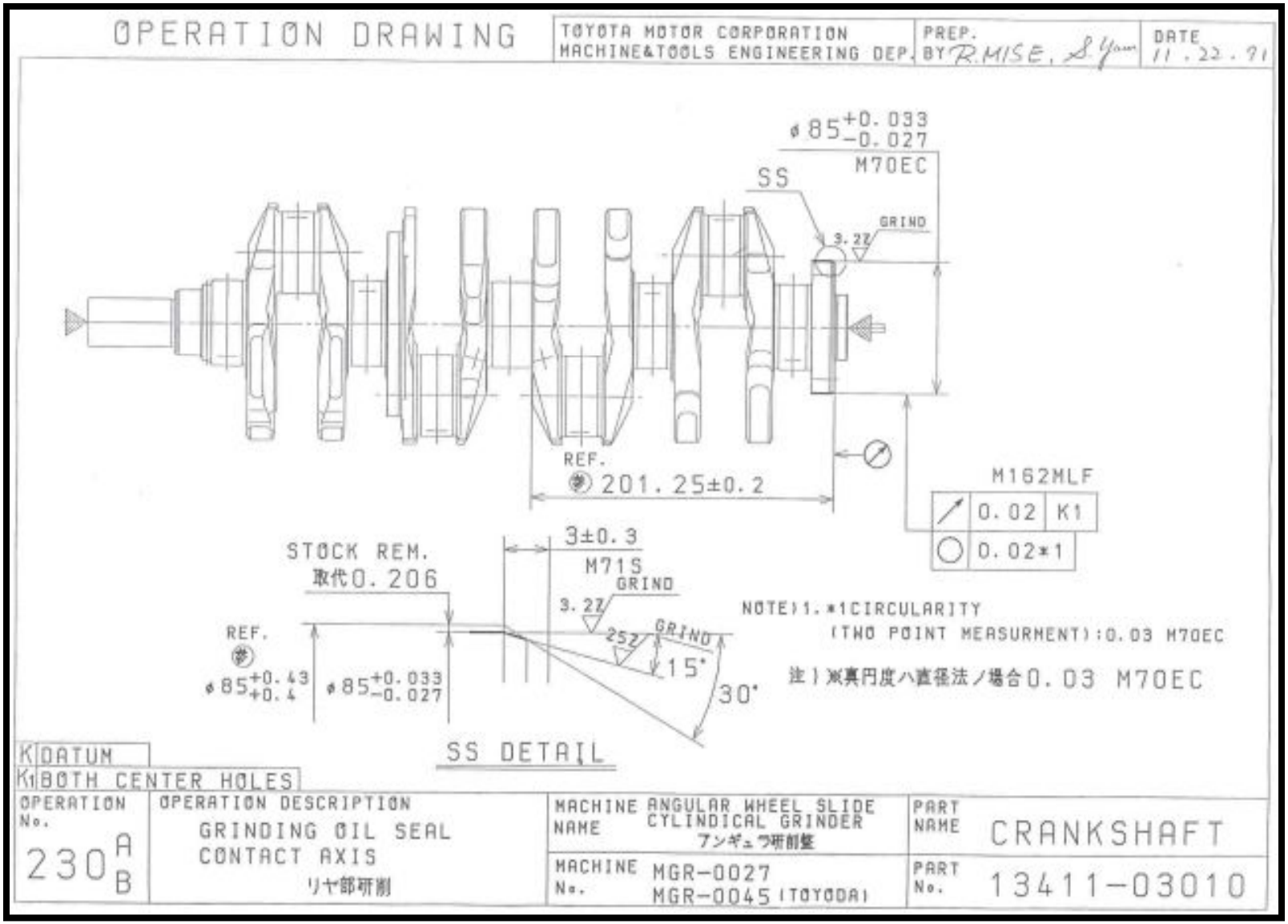
Technical documentation that form the basis for the process

- Operation drawings
- Tooling
- Gauging
- Quality checks
- Daily maintenance
- Trouble shooting

≠ Standardized Work

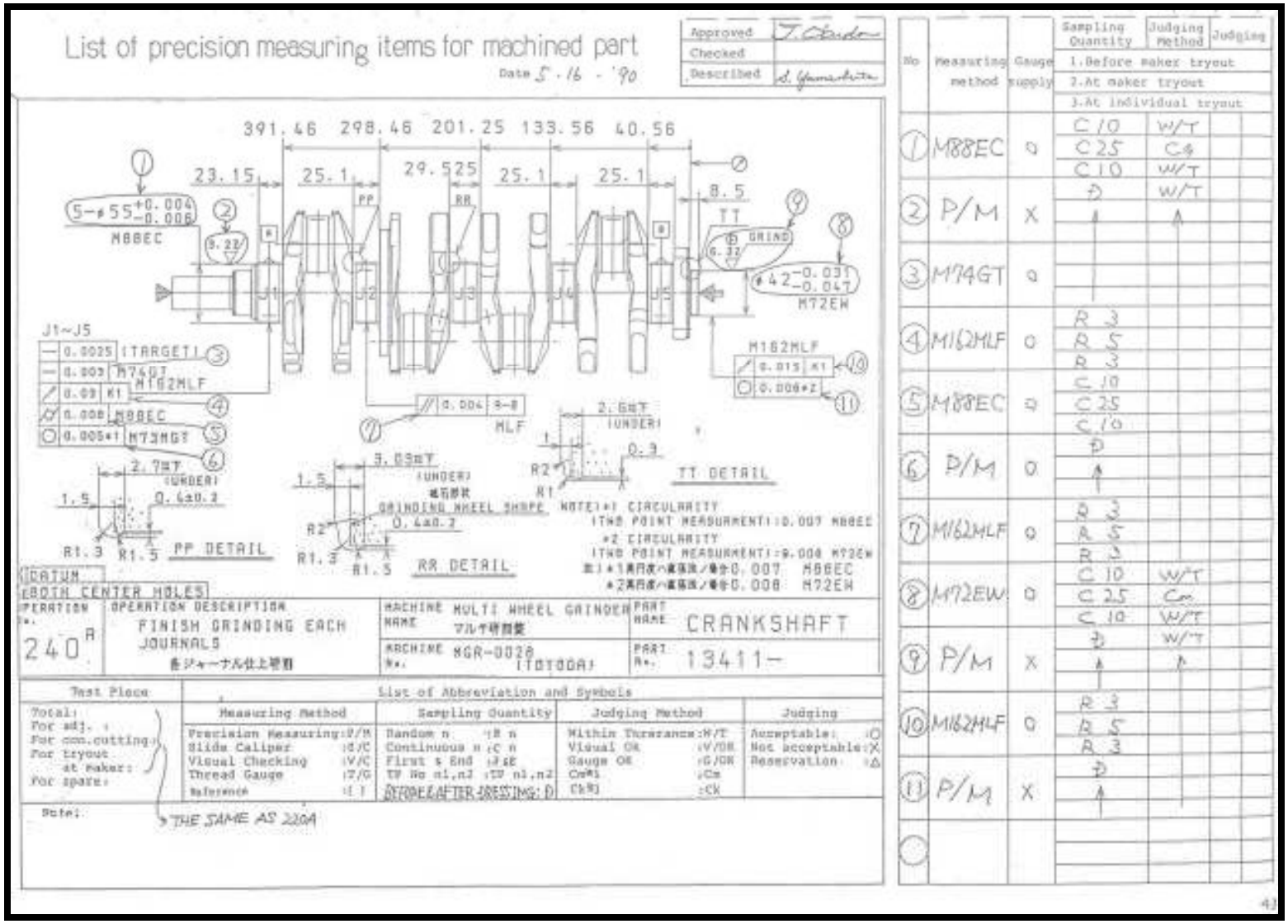
Works Standards – Operation Drawing

秘



Works Standards (Quality Check Method)

秘



List of precision measuring items for machined part

Date 5 · 16 · '90

Approved

Checked

Described

391.46 298.46 201.25 133.56 40.56

23.15 25.1 29.525 25.1 25.1 8.5

5-φ55 +0.004 −0.006 M88EC

φ42 −0.031 −0.047 M72EW

J1~J5

0.0025 (TARGET) ③

0.003 M74GT

0.03 K1 M162MLF ④

0.008 M88EC

0.005×1 M73MGT ⑤

0.004 A-B MLF ⑦

0.015 K1 ⑩

0.008×2 ⑪

PP DETAIL

RR DETAIL

TT DETAIL

GRINDING WHEEL SHAPE

NOTE) ×1 CIRCULARITY (TWO POINT MEASURMENT): 0.007 M88EC

×2 CIRCULARITY (TWO POINT MEASURMENT): 0.008 M72EW

注) ×1 真円度の直径差／巾 0.007 M88EC

×2 真円度の直径差／巾 0.008 M72EW

DATUM (BOTH CENTER HOLES)

OPERATION No.	OPERATION DESCRIPTION	MACHINE NAME	PART NAME
240 R	FINISH GRINDING EACH JOURNALS 各ジャーナル仕上研削	MULTI WHEEL GRINDER マルチ研削盤	CRANKSHAFT
		MACHINE No. MGR-0020 (TOYODA)	PART No. 13411-

Test Place

Total:
For adj.:
For con.cutting:
For tryout at Maker:
For spare:

Note: THE SAME AS 220A

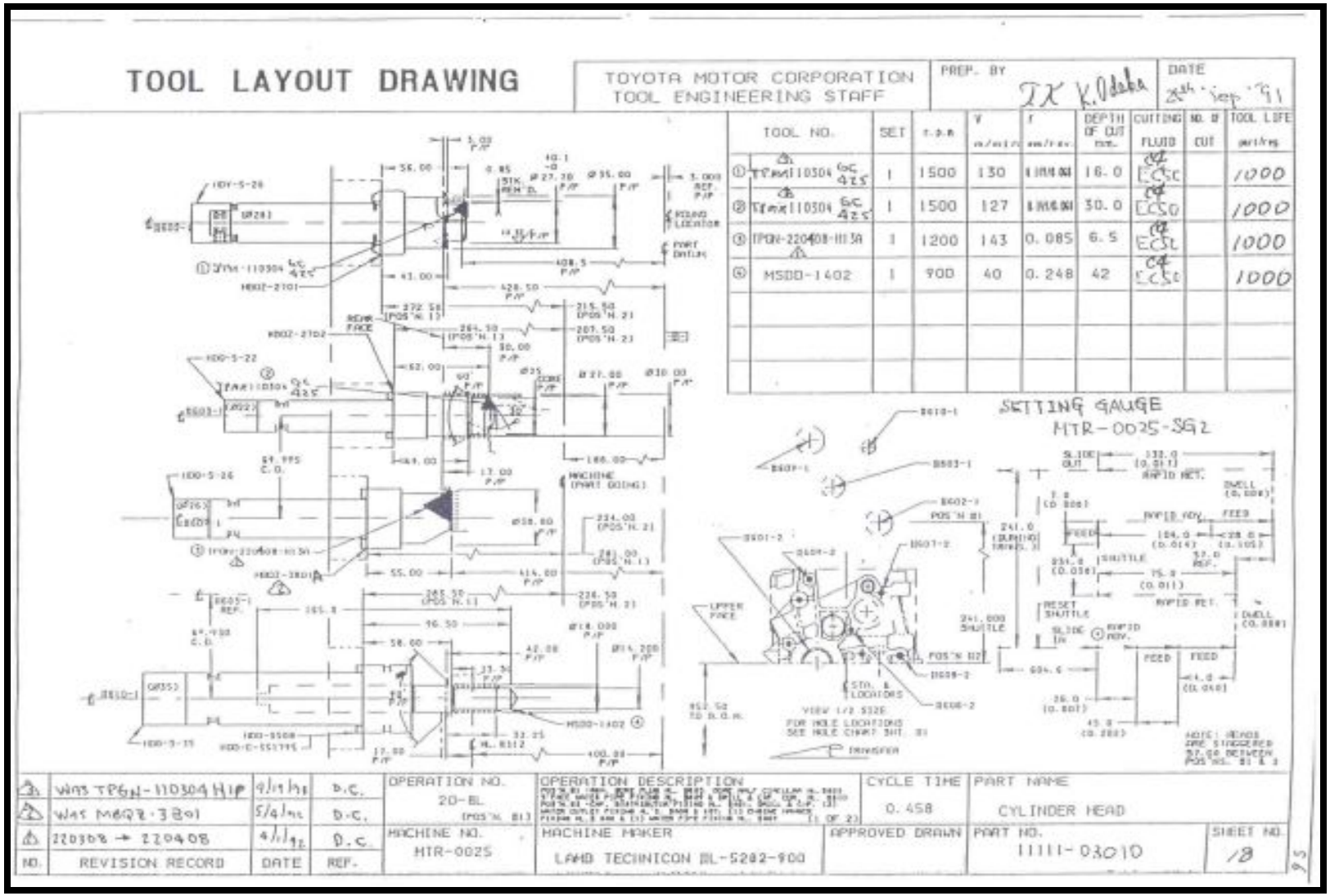
List of Abbreviation and Symbols

Measuring Method	Sampling Quantity	Judging Method	Judging
Precision Measuring: P/M	Random n: R n	Within Tolerance: W/T	Acceptable: ○
Slide Caliper: C/C	Continuous n: C n	Visual OK: V/OK	Not acceptable: X
Visual Checking: V/C	First & End: F&E	Gauge OK: G/OK	Reservation: △
Thread Gauge: T/G	TP No n1,n2: TP n1,n2	Cm²: Cm	
Reference: ( )	BEFORE/AFTER DRESSING: D	Ck: CK	

No	Measuring method	Gauge supply	Sampling Quantity (1.Before maker tryout / 2.At maker tryout / 3.At individual tryout)	Judging Method	Judging
①	M88EC	○	C 10 / C 25 / C 10	W/T / Cm / W/T	
②	P/M	X	R	W/T	
③	M74GT	○			
④	M162MLF	○	R 3 / R 5 / R 3		
⑤	M88EC	○	C 10 / C 25 / C 10		
⑥	P/M	○	R		
⑦	M162MLF	○	R 3 / R 5 / R 3		
⑧	M72EW	○	C 10 / C 25 / C 10	W/T / Cm / W/T	
⑨	P/M	X	R	W/T	
⑩	M162MLF	○	R 3 / R 5 / R 3		
⑪	P/M	X	R		

Works Standards (Tooling Detail)

秘



Works Standards (Machine Accuracy)

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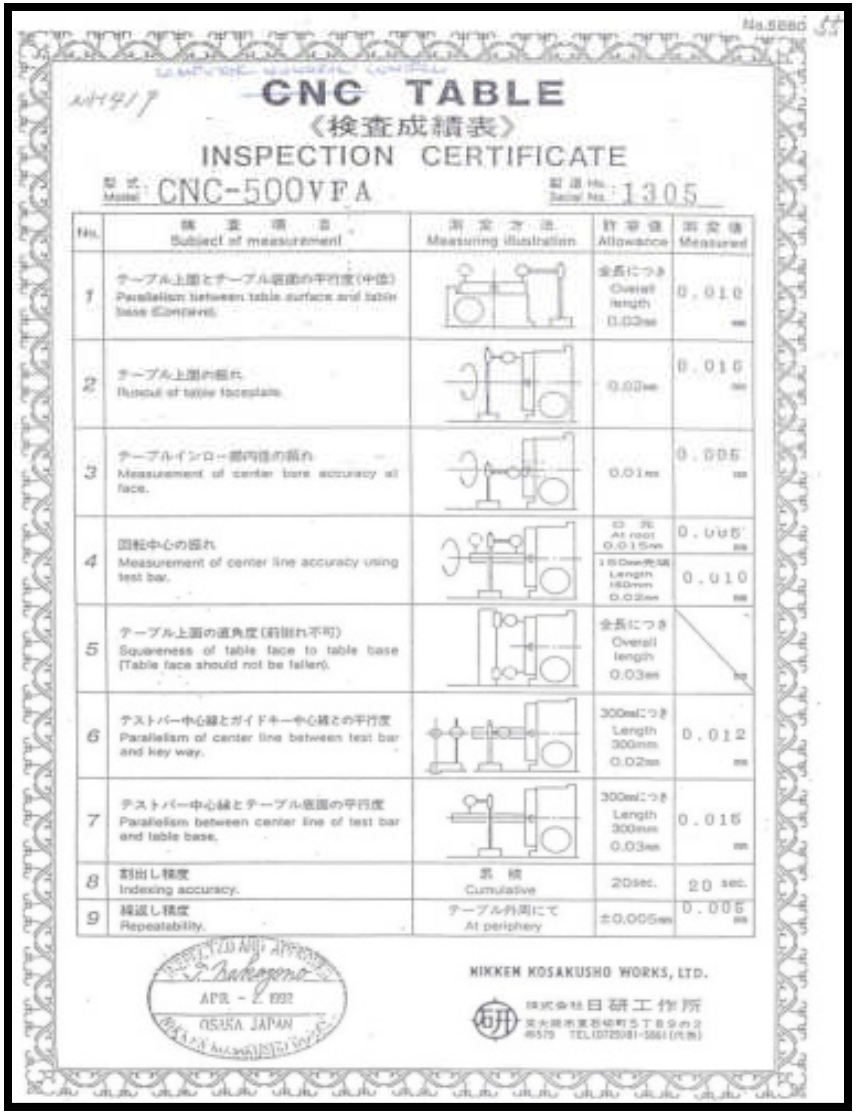


CNC TABLE

《検査成績表》

INSPECTION CERTIFICATE

型式 Model: CNC-500VFA　　製造No. Serial No.: 1305

No.	検査項目 Subject of measurement	測定方法 Measuring illustration	許容値 Allowance	実測値 Measured
1	テーブル上面とテーブル底面の平行度(中凹) Parallelism between table surface and table base (Concave).		全長につき Overall length 0.03mm	0.010 mm
2	テーブル上面の振れ Runout of table faceplate.		0.02mm	0.010 mm
3	テーブルインロー部内径の振れ Measurement of center bore accuracy at face.		0.01mm	0.005 mm
4	回転中心の振れ Measurement of center line accuracy using test bar.		0.015mm 0.02mm	0.005 mm 0.010 mm
5	テーブル上面の直角度(前出れ不可) Squareness of table face to table base (Table face should not be fallen).		全長につき Overall length 0.03mm	mm
6	テストバー中心線とガイドキー中心線との平行度 Parallelism of center line between test bar and key way.		300mmにつき Length 300mm 0.02mm	0.012 mm
7	テストバー中心線とテーブル底面の平行度 Parallelism between center line of test bar and table base.		300mmにつき Length 300mm 0.03mm	0.015 mm
8	割出し精度 Indexing accuracy.	累積 Cumulative	20sec.	20 sec.
9	繰返し精度 Repeatability.	テーブル外周にて At periphery	±0.005mm	0.005 mm

APR. - 2 1992

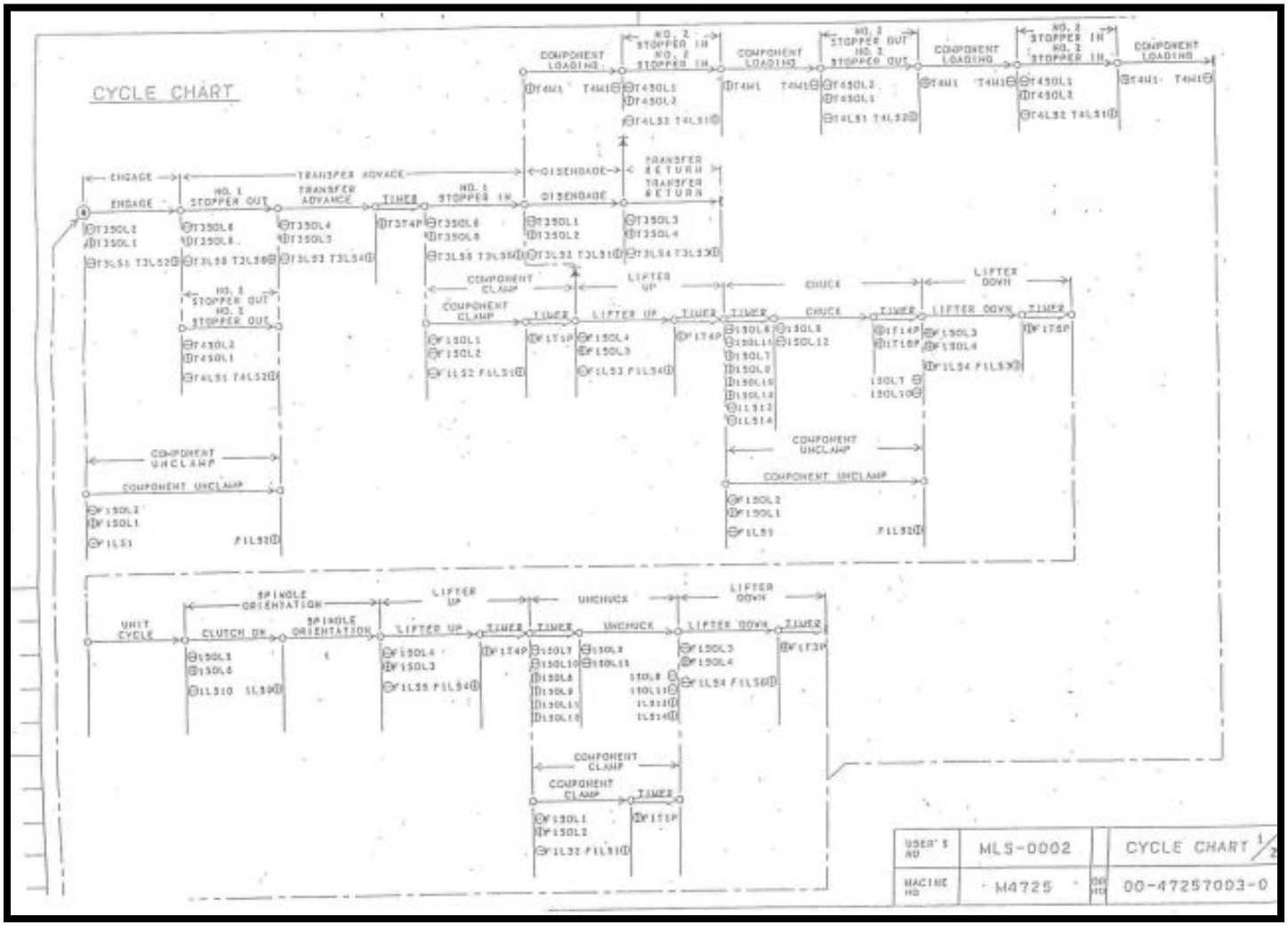
OSAKA JAPAN

NIKKEN KOSAKUSHO WORKS, LTD.

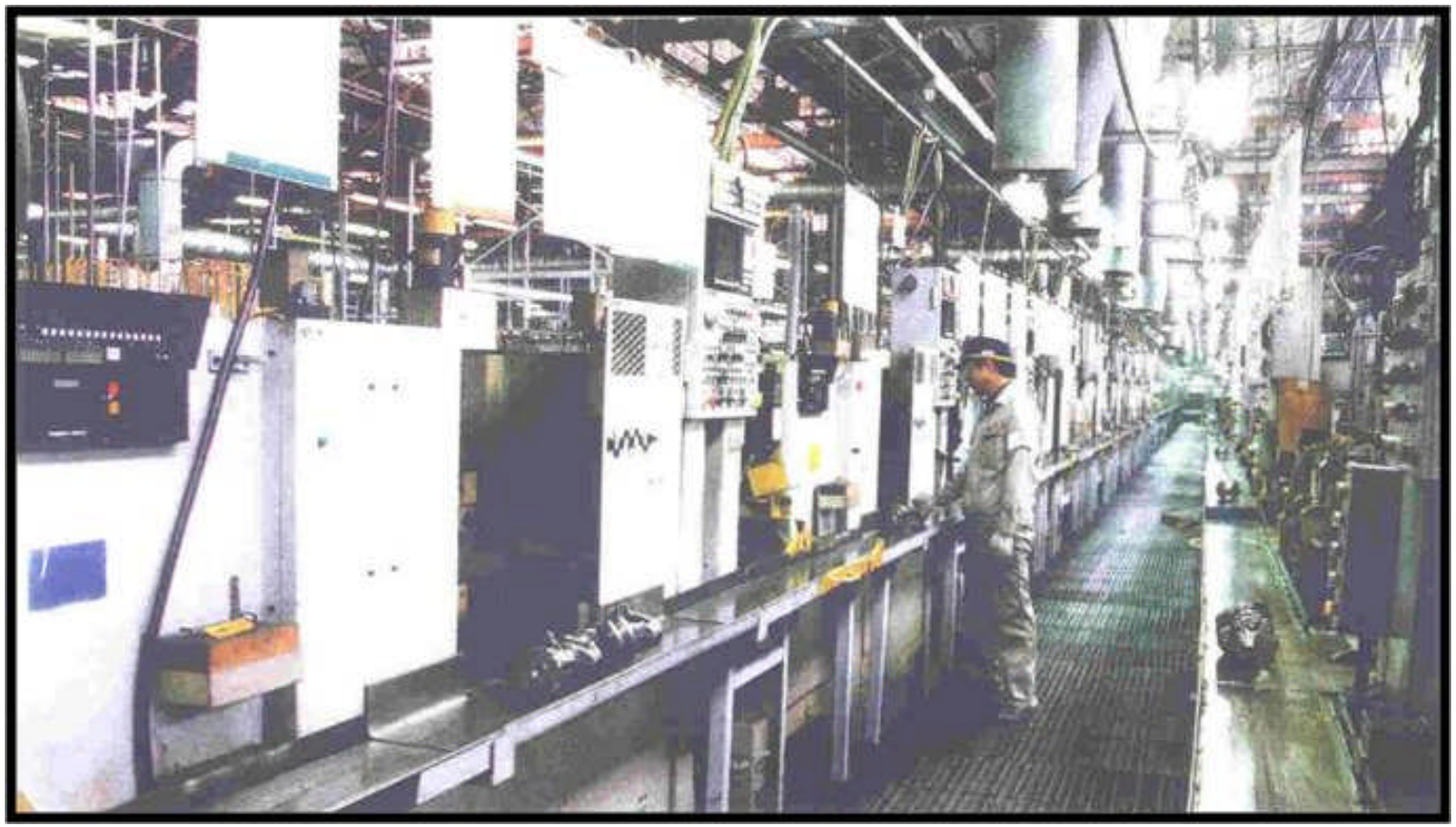
株式会社日研工作所

Works Standards (Machine Cycle Chart)

秘

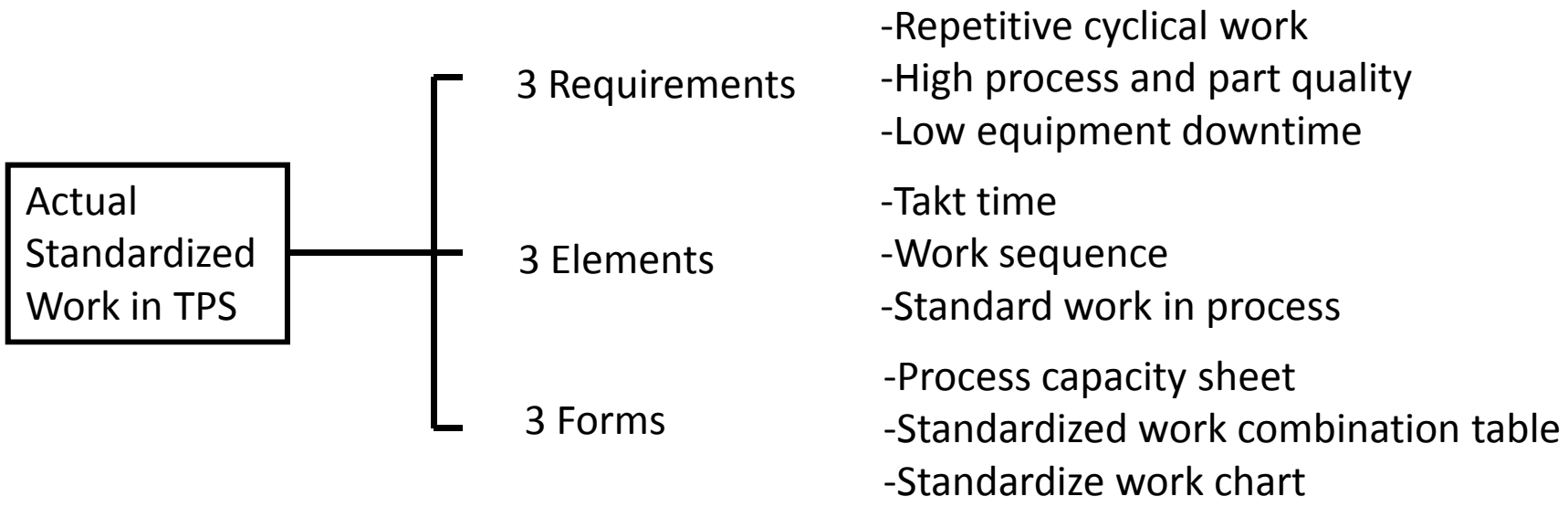


Machining Line 1990’s



Standardized Work

Definition: a document centered upon *human motion* that combines the elements of a job into the most effective sequence with minimal waste to achieve the most efficient level of production possible under current conditions.



Standardized Work - 1

Sample Process Capacity Sheet

Definition:

A basic tool used to measure process output capability considering the time available and time required for change over work. It represents the maximum output possible from the process under current operating conditions.

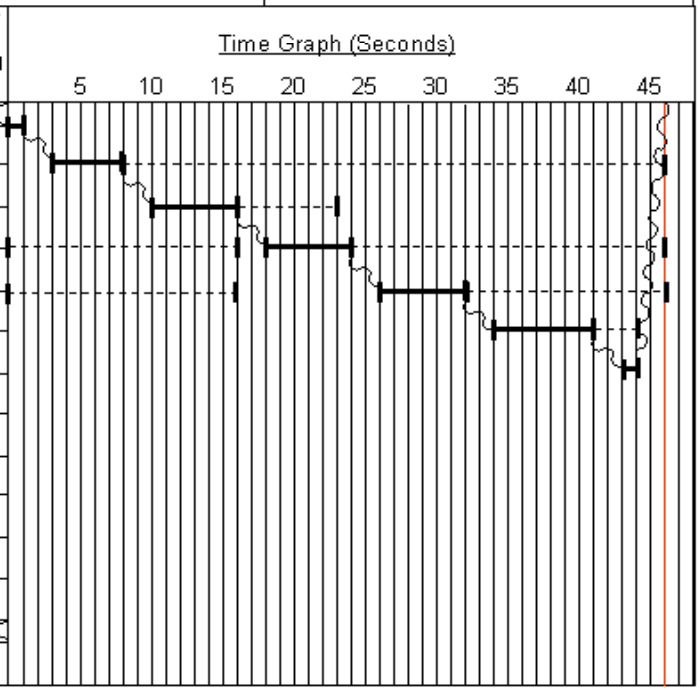
Process Capacity Sheet					Dept:			Line:	
					Product:			Created by:	
Step #	Process Name	Machine Number	Manual Time	Auto Time	Total CT	# Pcs. / Change	Time to Change	Time Per Pc.	Shift Capacity
1	Mill Face	MI1764	3”	25”	28”	100	60”	0.6”	965
2	Drill Holes	DR2424	3”	21”	24”	1000	30”	0.03”	1148
3	Tap Holes	TP1101	3”	11”	14”	1000	30”	0.03”	1967

Standardized Work - 2

Standardized Work Combination Table

Acme Corp. **Standardized Work Combination Table**			Plant: Acme	Product: 8" Pinion Gear
			Area: Machining	Op. _1_ of _1_
			Process: Gear Cutting Exercise	Pg. _1_ of _1_
Date: 5/23/2006	By: Art of Lean	Line Takt: 46 secs.	Shifts: 2 Volume: 600 / Shift	Manual Work, Automatic, Walking, Wait

No.	Major Steps	Time Man	Time Auto	Time Wait	Time Walk
1	Pick up raw material	1	--	--	2
2	Unload,/ load and start M/C GC-614	5	38	--	2
3	Unload / Load and start M/C CH-228	6	7	--	2
4	Unload / Load and start M/C GC-1444	6	38	--	2
5	Unload / load and start M/C GC-1445	6	30	--	2
6	Unload / load and start M/C TS-110	7	3	--	2
7	Pack Part	1	--	--	
	Totals	32		---	14



TT 46 Secs.

Standardized Work - 3

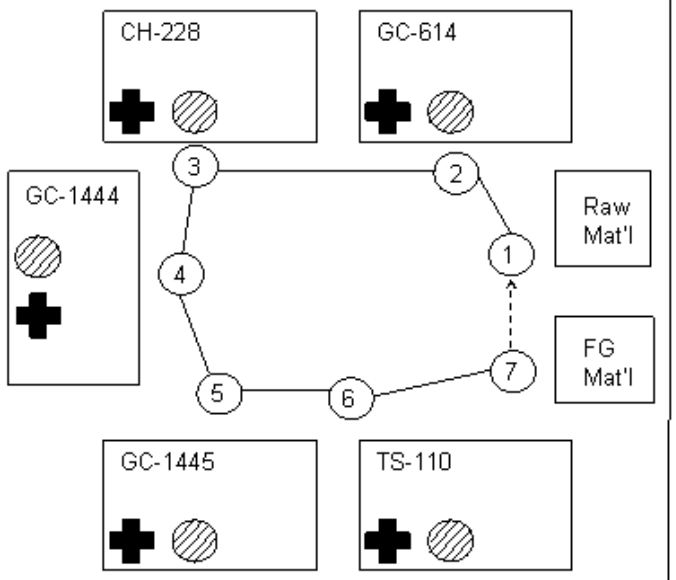
Standardized Work Chart

Acme Corp.	Plant: Acme	Product: 8" Pinion Gear
Standardized Work Combination Table	Area: Gear Machining	Op. _1_ of _1_
	Process: Gear cutting exercise	Pg. _1_ of _1_
Date: / By: / Approved By:	Shifts: 2	Takt Time: 46 secs. / Cycle Time: 46 secs.
	Volume: 600	

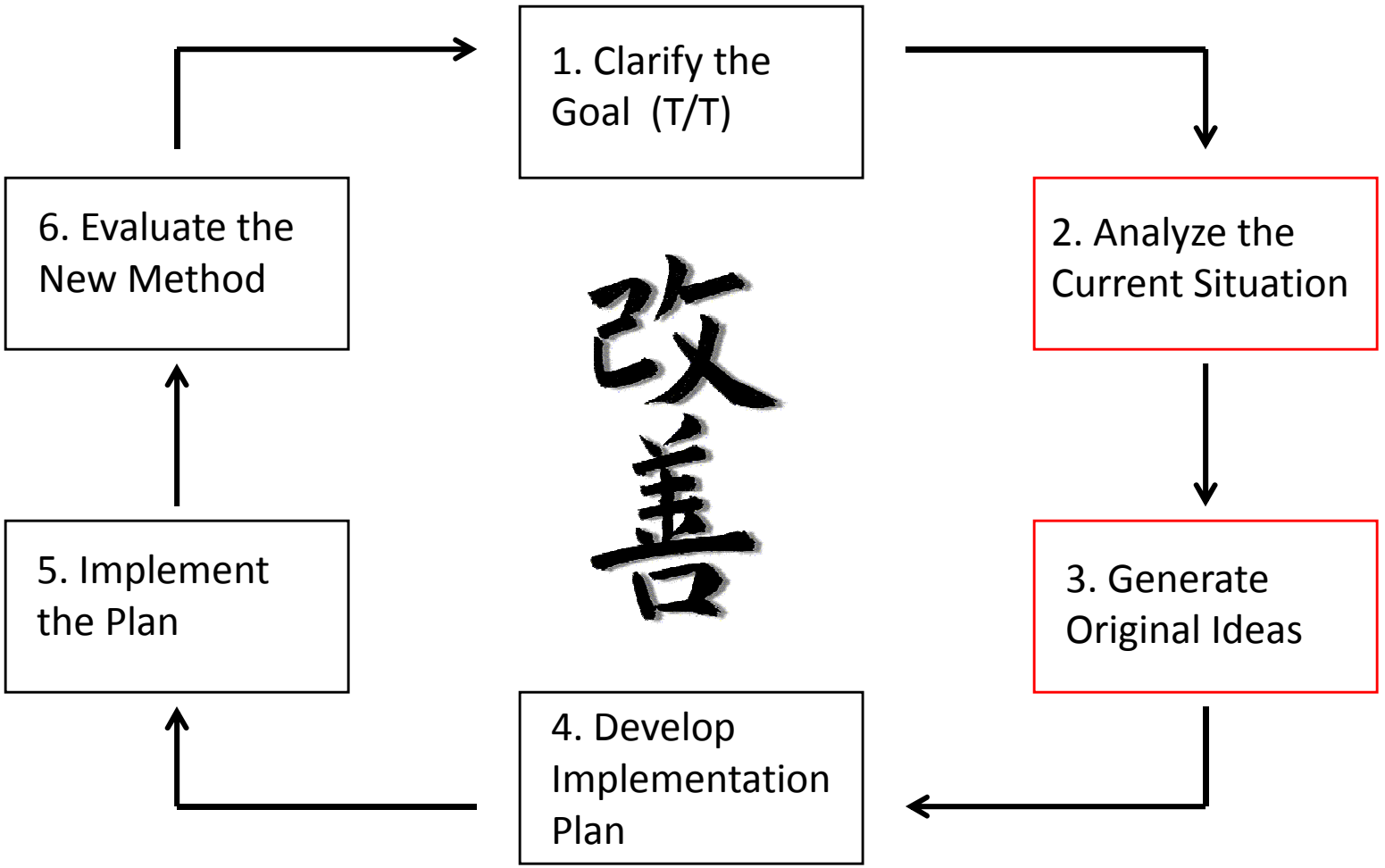
No.	Major Steps	MAN TIME	AUTO TIME	WAIT TIME	WALK TIME
1	Pick up raw material	1	--	--	
2	Unload, load part and start M/C GC614	5	38	--	2
3	Unload, load part and start M/C CH228	6	7	--	2
4	Unload, load part and start M/C GC1444	6	38	--	2
5	Unload, load part and start M/C GC1445	6	30	--	2
6	Unload, load part and start M/C TS110	7	3	--	2
7	Pack FG in pallet	1	--		2
					2

Working Sequence
Walking
Return to Start

Safety	SWIP	Quality
✚	▨	QC



Standardized Work & Kaizen

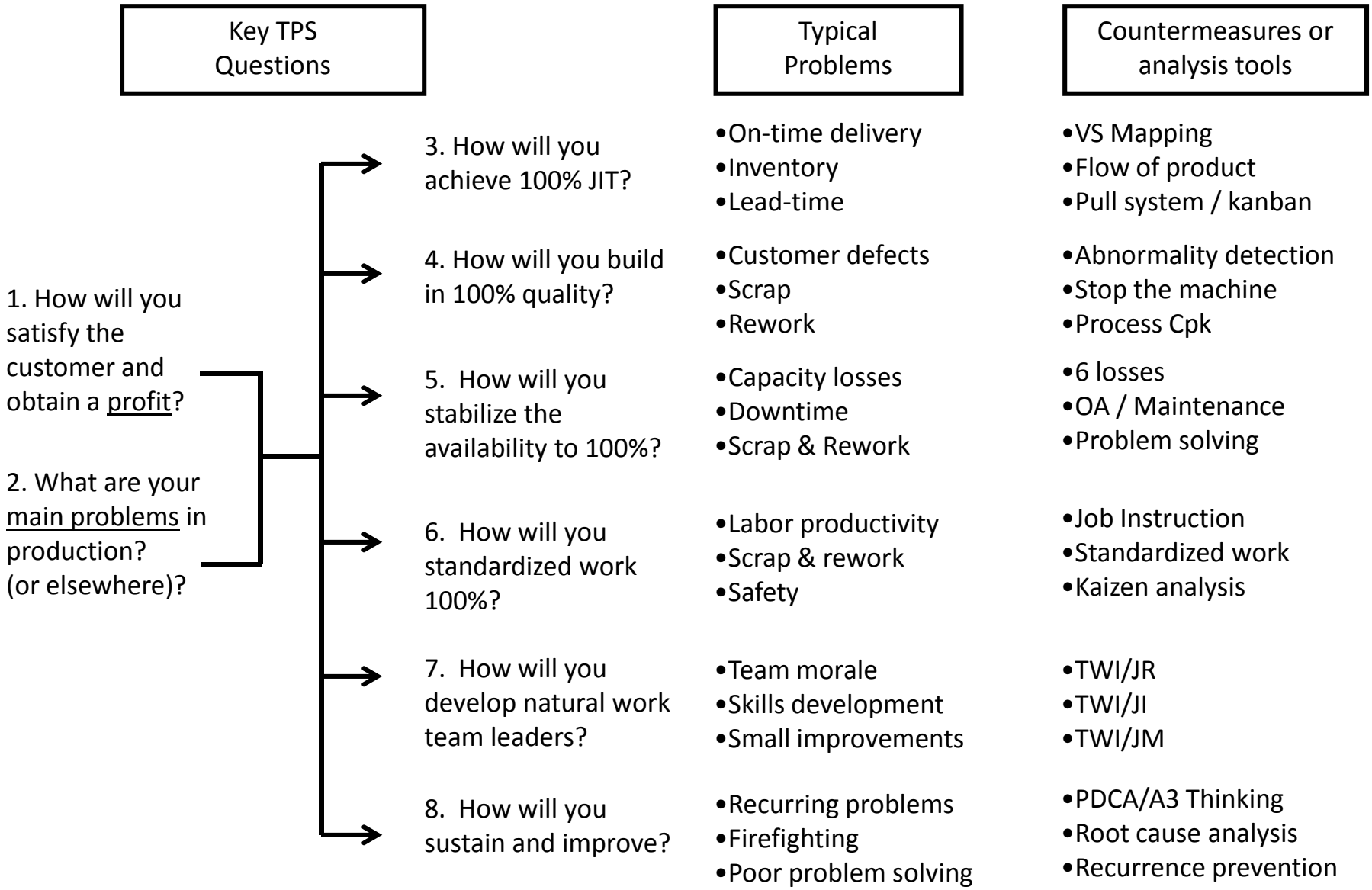


Standardized Work and Kaizen in Assembly

- Takt time changes <u>monthly</u>
- The allowed labor changes
- Work must be rebalanced
- Standardized work changes
- Kaizen is required
  - Eliminate
  - Combine
  - Rearrange
  - Simplify

Questions on Standardized Work?

Basic TPS Questions



Questions / Discussion

- A3 Thinking
- Standardized Work
- Other?
- Thank you!

Appendix

A3Thinking.com

A3Thinking

Home
What is A3 Thinking?
Types of A3 Reports
A3 Sample Exercises
Workshops

Practical Implementation Advice

FAQ's
About the Authors
A3 Thinking Blog

A Brief Introduction to A3 Thinking

Welcome to the A3Thinking.com website.

This site is aimed at providing interested parties with basic information pertaining to the topic of A3 Thinking and the Toyota Production System. Professor Durward Sobek of Montana State University and former Toyota Motor Corporation employee Art Smalley teamed up to write a book on this ground breaking topic called A3 Thinking. We realize that reading alone will never substitute for "hands on" learning. However through this site we hope you will find some useful information as well as ways to increase your knowledge and skill level. Check back from time to time and we'll provide some updates on our respective field work and research via the A3 Thinking Blog. Also feel free to submit questions for our FAQ page or contact the authors. As time allows we will get back to your questions as best we possibly can.

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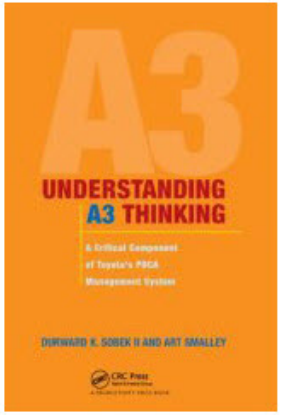
- Welcome to the A3 Thinking Blog



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