

TPS versus Lean: The Law of Unintended Consequences

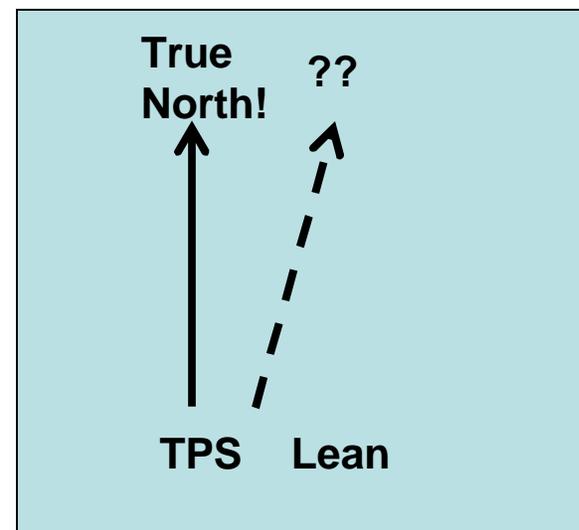
Shingo Prize Conference

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Art of Lean, Inc.

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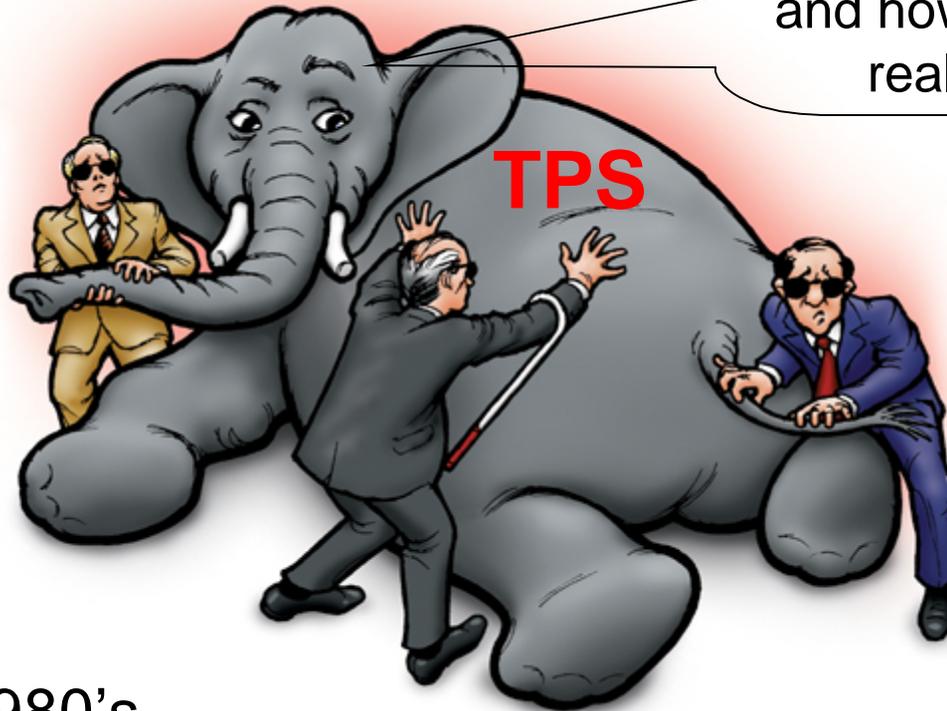
TPS/Lean is a widely accepted improvement program

- Starting from simple roots in Toyota in the 1950's TPS has spread around the world to become a dominant improvement methodology
- Toyota will overtake GM in 2006 or 2007 as the automotive industry leader in volume and add this to their already dominant positions in quality and profitability – “Triple Crown”
- 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 parable of the elephant and the blind men...

It is not what you call it that counts but why and how you do it that really matters!

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 no results...in several cases it has even somehow added cost.
- Why is this proving so difficult?

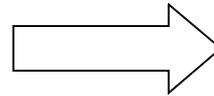
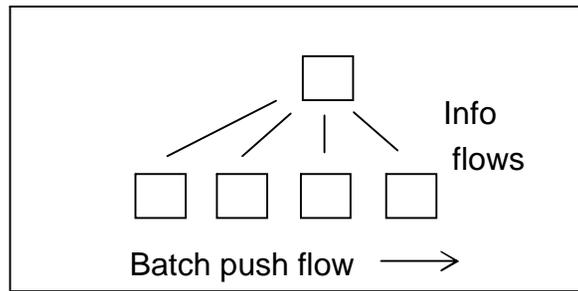
Multiple possible explanations exist...

- 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...
- A short term emphasis in our North American business model keeps us overly focused on quarterly profits...
- There is a shortage of talented TPS implementation leaders...Most of us don't have Taiichi Ohno for example (and for the record Toyota struggles 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?)
- Others?

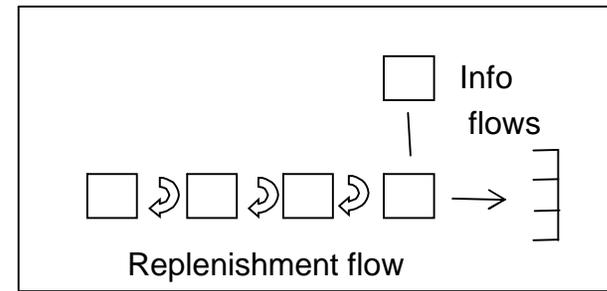
One point is usually not questioned however...

Perhaps the methods and techniques that some companies are using are either insufficient or incorrect...

From: Current State

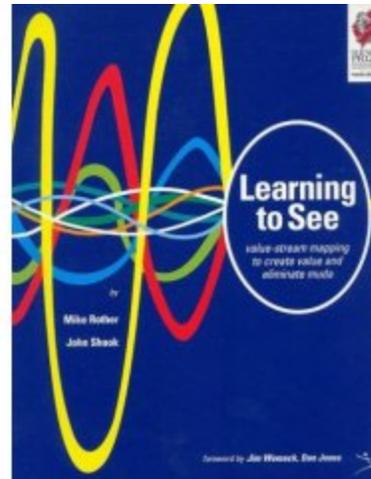
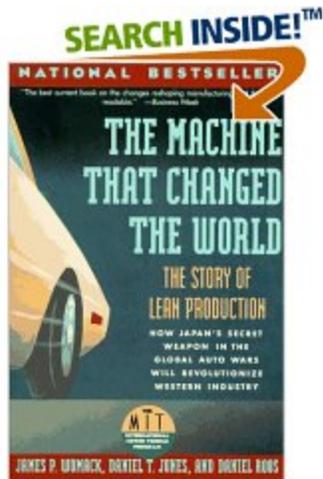


To: Future State

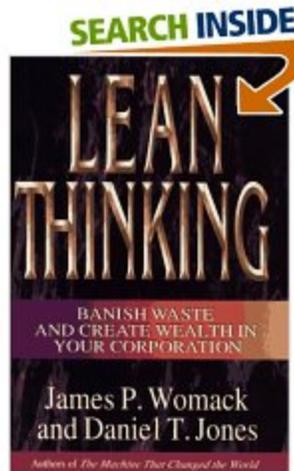


We will VSM, Flow, & Pull our way there!

TPS is viewed is the U.S. through a very “lean” lens...



(CLP 12Q's, etc.)



ART of LEAN

LTS Q's - Map the value stream

1. What is takt time?
2. Where can you use continuous flow?
3. What is the pacemaker?
4. Where will you need a supermarket pull system?
5. Will you build to a finished goods supermarket or to customer order?
6. How will you level production mix at the pacemaker?
7. What increment of work will you consistently release and take away at the pacemaker?
8. What process improvements will be necessary for the value stream to flow as your future state design specifies?

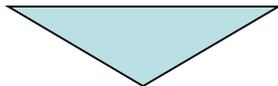
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Any lens affects how well and what you see...



Eye Glasses

Blurred image

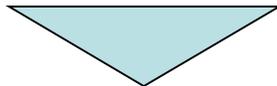


Clear image



Microscope

Small image

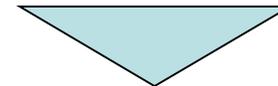


Magnified image



Telescope

Distant image



Closer image

But no one lens can do everything!

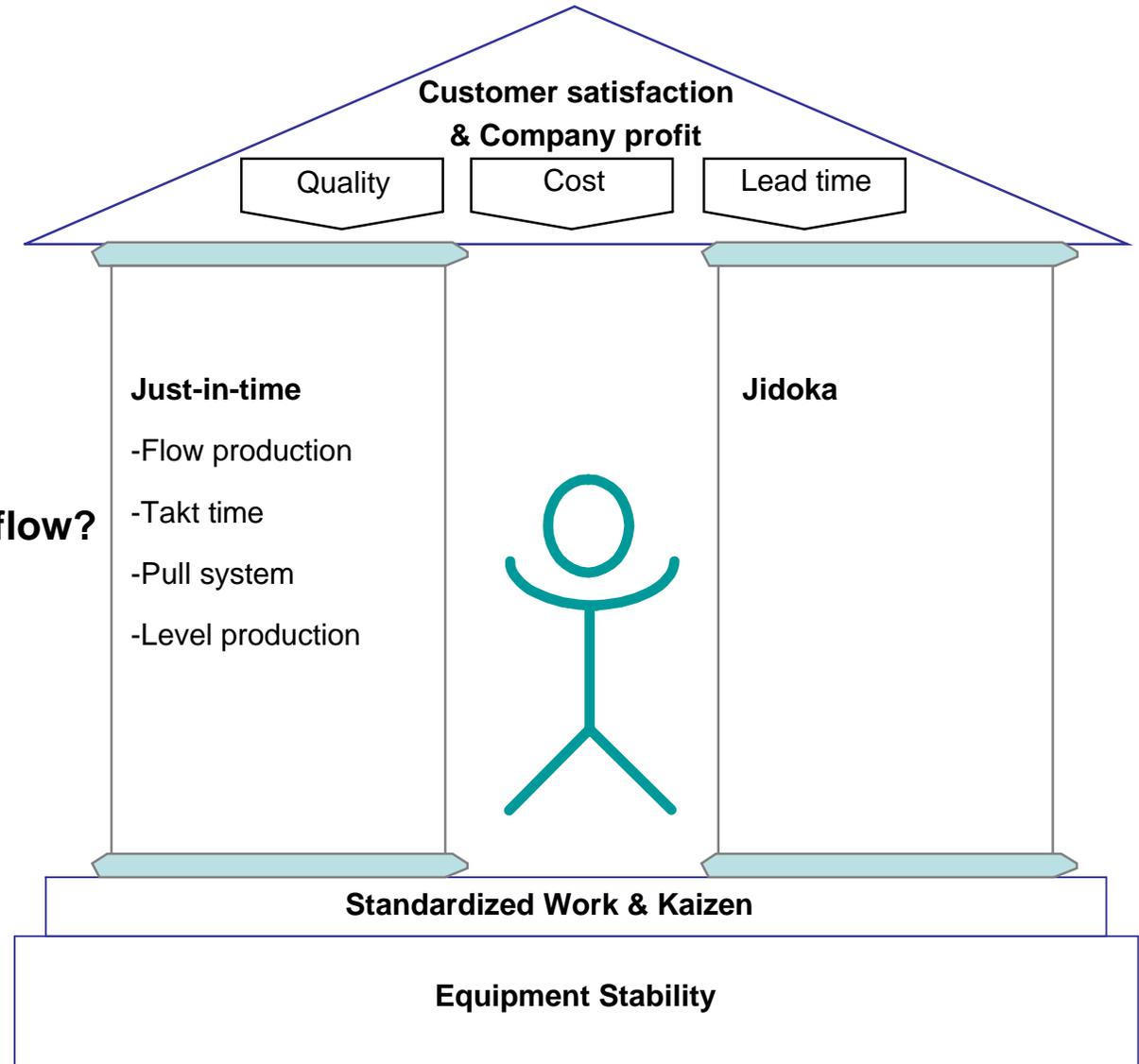
TPS Framework

LTS* - Map the value stream

1. Takt time?
2. Continuous flow?
3. Pacemaker?
4. Supermarket pull system?
5. MTO/MTS?
6. Level production?
7. Pitch increment?
8. Process improvements for flow?

(Add in CCF, MMF, CLP, etc.)

Where is the focus?



*LTS - Learning to See, followed by CCF - Creating Continuous Flow, MMF - Making Materials Flow, & CLP – Creating Level Pull

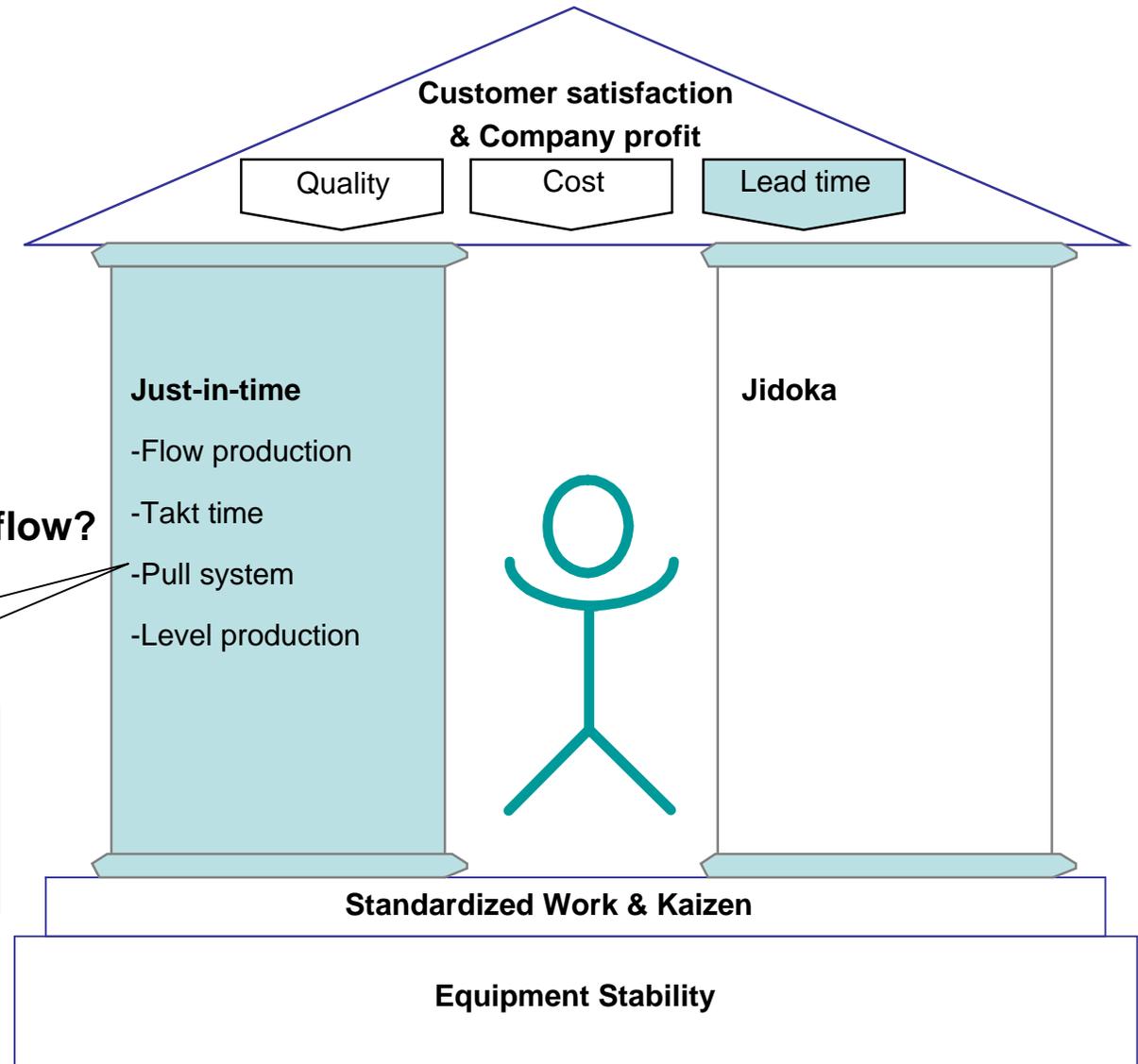
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TPS Framework

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8. Process improvements for flow?

Most of the Lean focus in the U.S. today is on just a part of overall TPS – mainly JIT, inventory and lead-time reduction



*LTS - Learning to See, followed by CCF - Creating Continuous Flow, MMF - Making Materials Flow, & CLP – Creating Level Pull

What would Mr. Ohno or Mr. Shingo think about this?



Mr. Ohno

My suspicion is that they would be highly critical...

- TPS is a complete system and not just JIT!
- Achieve Jidoka (Build in quality / separate man from machine)
- Improve equipment availability to 100% when needed
- Practice kaizen and develop people through improvement
- Improve quality, cost, and delivery. Get this done...now!

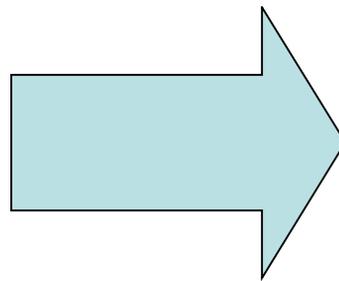


Dr. Shingo

- You must know why you are doing something
- Time, motion, work elements, etc. are symptoms / shadows
- Learn to see the real problem from different angles
- Scientifically establish cause and effect
- Learn by doing...now!

JIT/VSM focus is “necessary”...but not “sufficient”

“Process A”
Availability = 65%
Capability = .8 Cpk
Flexibility = 1 Hr. C/O



Sometimes the “process” is what needs to be fixed and not just the “JIT flow” across the process...

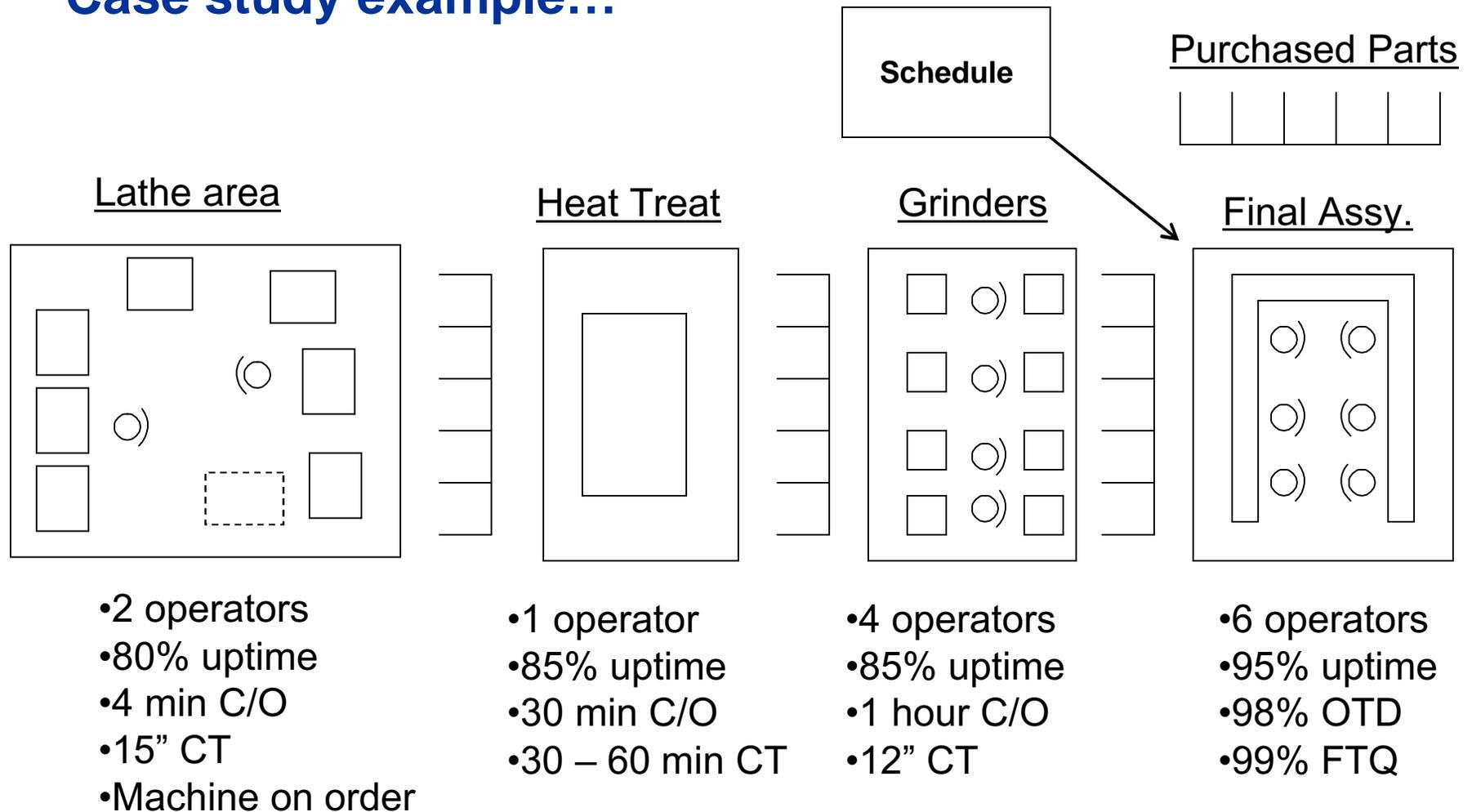
In other words truly “learning to see” certain problems involves crawling under the hood and getting the 1 foot view and not the 10,000 foot VSM view...

**+ Supervisors
inundated with
other “problems”**

(First 20 years of TPS)

Companies won't improve quality, cost, and delivery significantly until all these types of problems are addressed better than today.

Case study example...



Multi-year effort to improve “Flow” via VSM & JIT
 On the surface it “looked OK” in many respects



Question 1: What is your current situation?

Answer:

- We have implemented flow end to end
- We have established markets and have a form of basic pull
- We have moved many machines around to improve the flow
- We have a U-shaped cell in final assembly
- Most areas have one man multiple machine operations
- We have posted standardized work charts on every machine
- We have started regular 5S audits
- We want to implement a “heijunka box” next to level and improve the pull to final assembly.

Very interesting...However these are all just “activities”...what about results? (What do you need to do next?)



Question 2: Tell me what has improved?

Answer:

- We have improved lots of things in many ways as you can see we are much more “Lean” than we were 2-3 years ago.
- On our Lean audit sheets we are scoring much, much higher on all the 8 questions of LTS and other aspects of a Lean value stream that we regularly check ourselves against...

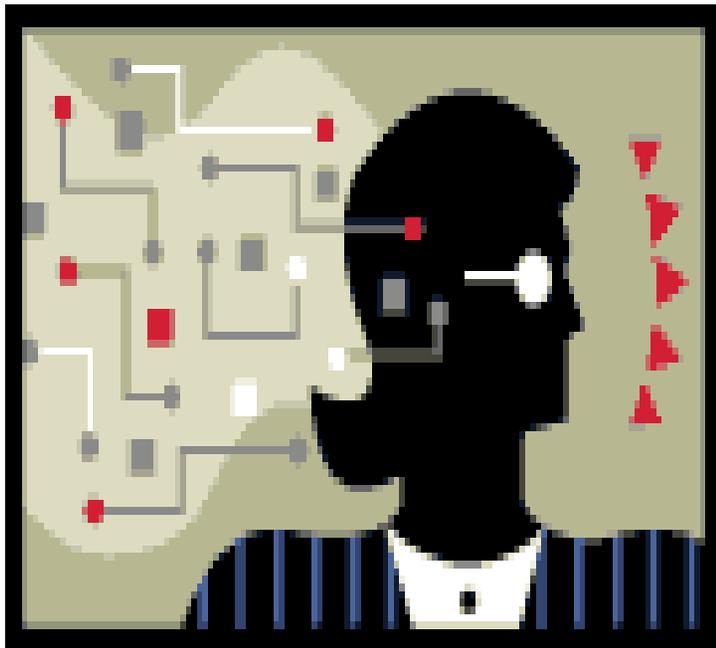
I'm afraid I can't see/verify the improvement even though I hear the buzz words...

Question 3: How much have you actually improved?

<u>Metric:</u>	<u>2004</u>	<u>2005</u>	<u>2006</u>	<u>Answer:</u>
Quality				<ul style="list-style-type: none">•I'm not sure...•To be quite honest I think we are just even or slightly worse in some cases•But on our VS Map we have a much shorter lead-time and better flow! (Hence we are lean).
Cost		?		
Delivery				
Productivity				

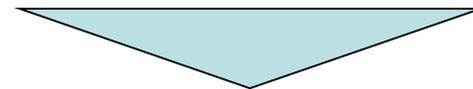
You may be “lean” by some definition but you have not really done any TPS activities...

TPS is built on the scientific way of thinking...



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

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

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TPS Development / Scientific Method / PDCA

1-2. Sample problem statement / question	3-4. Hypothesis / root cause	5-7. Analysis or countermeasures developed / tested
Poor work motion and material flow in line layouts	Insufficient detail in layout planning or line conversions	Value stream mapping (MIFA) and work motion analysis.
Right stamped parts not available when needed despite much inventory	Long change over time and too large of a batch size in production	SMED. Analyze and separate internal from external work.
Right parts not delivered to downstream when needed	No physical or accurate signal. Push style of production.	Pull system and kanban cards to signal replenishment.
High level of scrap and defects	Low process capability	Build in quality at the process. Not through inspection.
Low labor productivity in man machine combination areas	One man one machine layout and work assignment	Separate man from machine. Create standardized work. Promote a multi-skilled work force with better job instruction.



TPS 101: What's the problem? Pick one...

OK, Delivery

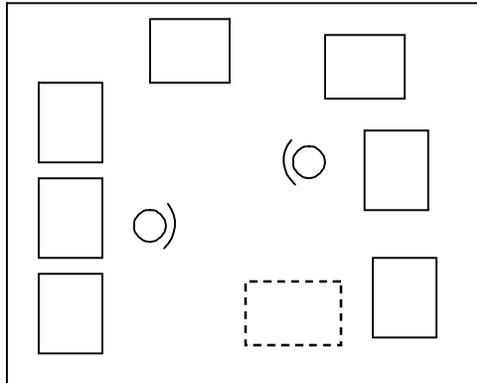
- Um...for one we have lot of overtime in final assembly and either expedite shipments or just barely make it on time... → Why?
- We think we need a heijunka box and even better flow. → I doubt it but why?
- We need the right parts from up stream on-time. → What parts are late and why?
- The lathes are slow to get us parts all the time → Why?
- I don't know...the machines are old and worn out. → Take me to the lathes...



TPS 101: What's the problem?

 New Machine Planned

Lathe area



- 2 operators
- 80% uptime
- 4 min C/O
- 15" CT
- Machine on order

Perception

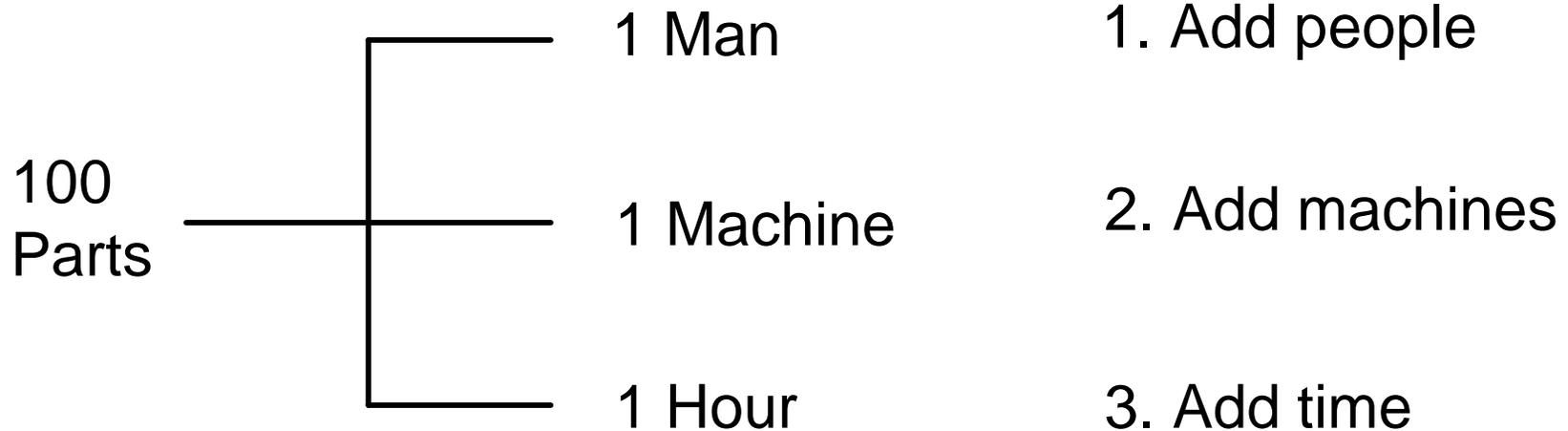
- We can't keep up with downstream and we are shutting down final assembly
- Operator won't follow standardized work

Plant decision logic

- Add another lathe to keep the line running and improve the flow to assembly (take out more inventory and reduce the time line)

Unintended consequence: Improving flow by adding machines is not the root cause to pursue...and it adds cost

Toyota textbook example: What is Kaizen?



1. Add people

2. Add machines

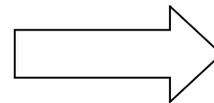
3. Add time

4. Work harder

5. Eliminate waste

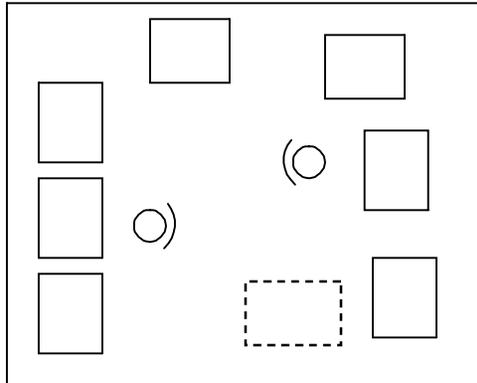
Question:

How do I make more?



Logical questions to ask for kaizen in this case

Lathe area



- 2 operators
- 80% uptime
- 4 min C/O
- 15" CT
- Machine on order

Q: What is machine capacity?

A: Not sure. CT is 15" per machine

Q: That means a max of 1,920 pieces per machine per shift doesn't it?

A: No. We never get that much. Not possible.

Q: How much do you average per machine?

A: About 1200 per shift

Q: What is demand per machine?

A: About 1580 I believe on average.

Q: So you are losing 720 pieces per shift per machine - why?

A: The machines are old and the operators do not follow standardized work!

TPS 101 continued...

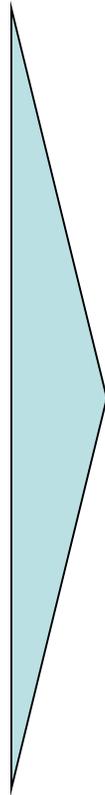
Capacity = 1920

Demand = 1580

Actual = 1200

Demand
Gap = 380

Capacity
Gap = 720



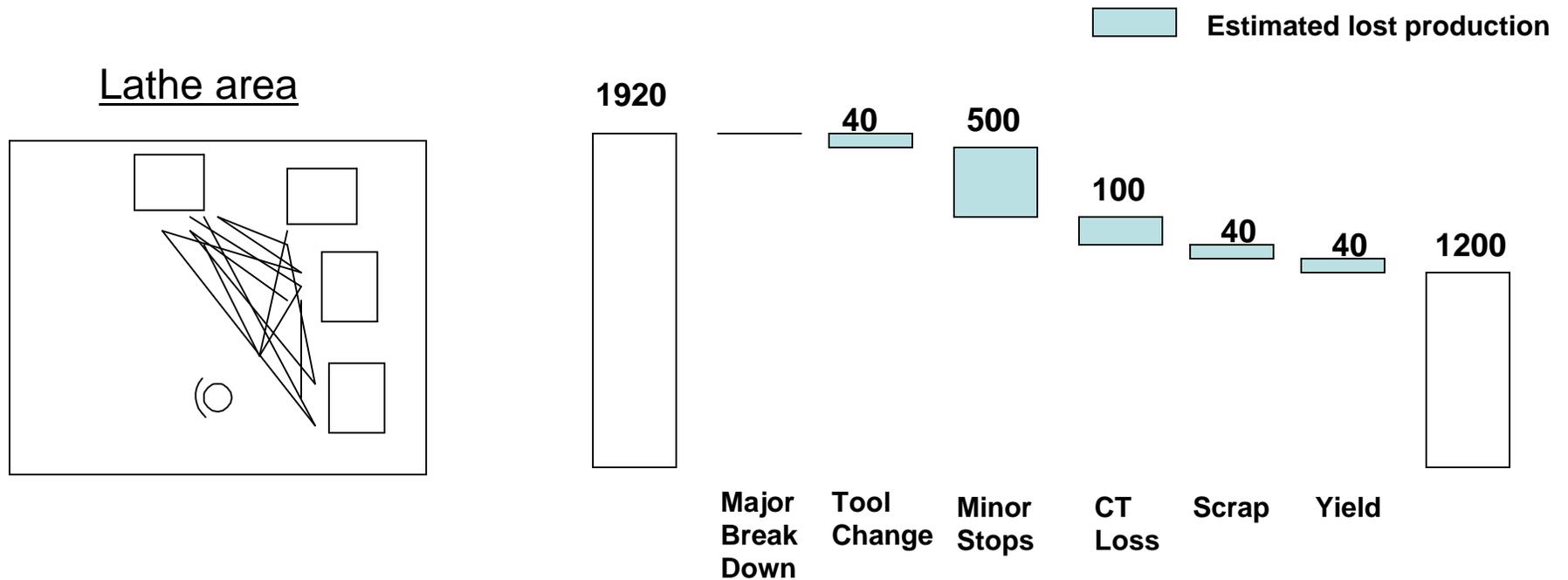
This is a **good problem** to solve and nothing in any lean text book or lean audit sheet is going to help

Only the rigor of problem solving and the scientific method will help. This is no easy answer.

The fundamental issue here is:

- A. Will I run 8 lathes at an average of 65% up-time?
- B. Will I run 6 lathes at an average of 85% up-time?

Observation of actual situation (not theory)



1 hour observation

Results extrapolated to 1 machine 8 hours

Problem: Machine not producing 1580 parts per shift to meet takt time

Goal: We must improve 380 parts (1200 to 1580) per shift.

Why all the minor stops? (Invisible problems)

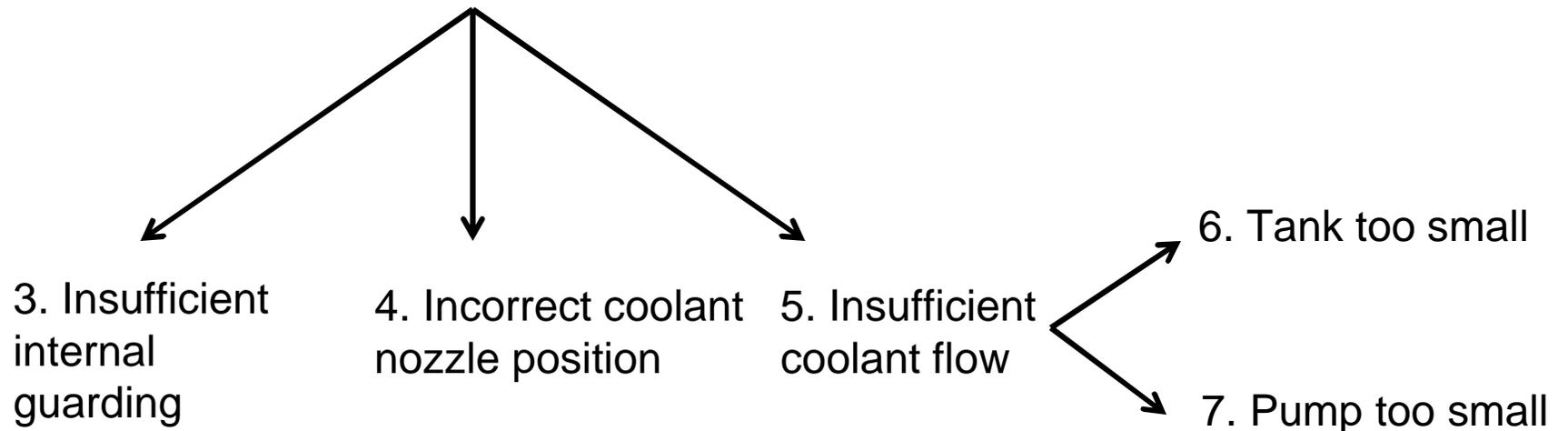
- 1) Operator's point of view: This is my daily grind – it is entirely normal...(abnormal has become normal).
- 2) I have to clean the machine constantly as there are cutting chips that accumulate everywhere. The chips stop the parts from rolling down the chute and auto loading time and time again so I have to un-jam the machine. I know that I am told not to break standardized work but unless I do the area will not run.
- 3) Also I have to gauge parts carefully even more than the quality check interval calls for...otherwise bad parts are found down stream and I get in trouble.
- 4) And I have to constantly adjust the tooling offsets at the control panel of the machine as this helps me keep the parts within specification (0.1mm tolerance)
- 5) No one will help me out on this sort of stuff...they are too busy doing lean or chasing other problems.



What are the root causes? (1/2)

Parts jamming problem

1. Why do the parts jam in the loader?
2. The cutting chips fly up in the auto loading chute inside the machine



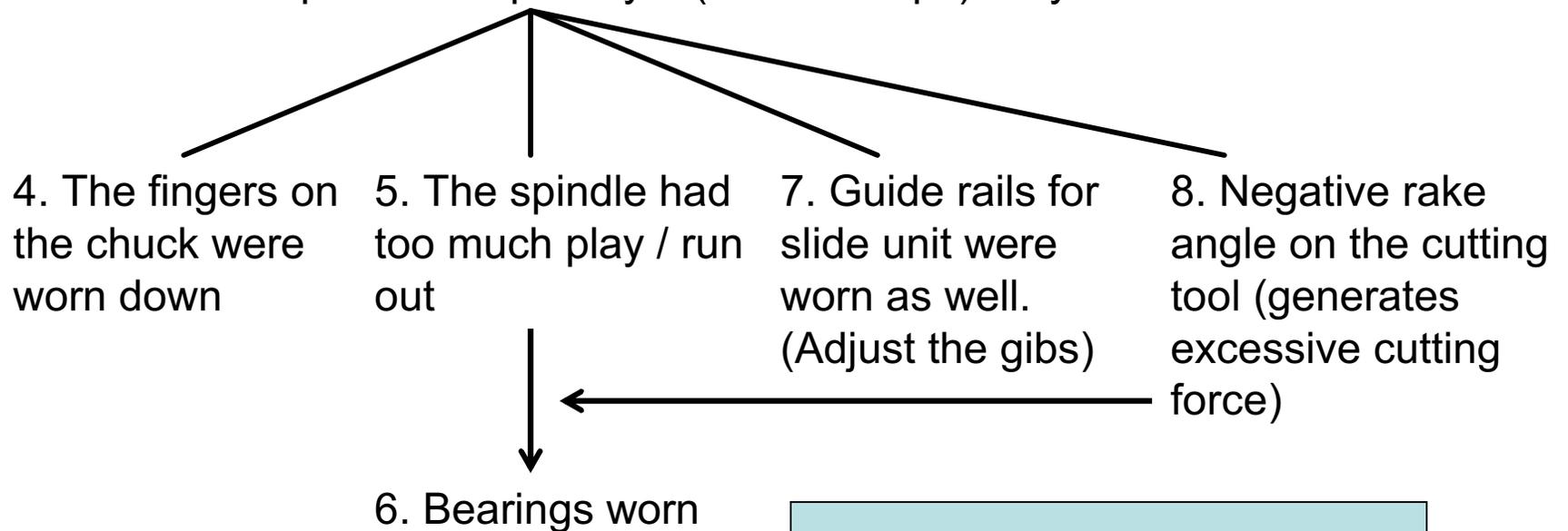
None of this was adequately considered in design and procurement of the machine. Long term this is what must be standardized and fixed...

Action Items: #3, 4, 5, and 7, must be fixed tonight...no exceptions.

What are the root causes? (2/2)

Operator adjusting offsets problem

1. Why does the operator adjust the offsets?
2. He was compensating for “something” wrong in the machine
3. What is the process capability? (It was .8 Cpk) Why?



Action Items: #4, 6, 7, must be fixed tonight...no exceptions.
#7, #8 investigate further...

Check Results / Follow Up: Good News

Test Results (1 machine)

Capacity = 1920

Demand = 1580

Actual = 1680

Remain = 240



The process averaged closer to 87.5% uptime during the shift

Only one minor stop for cutting chips blocking auto loader was reported

The quality of the parts was 100% right the first time

Spread to other machines ASAP

Still more room to improve. Further study required.

Check Results / Follow Up: Bad News

2-3 Year Superficial Effort:

Heavy VS Mapping and material flow emphasis

8 Kaizen events conducted but mainly flow or assembly related

Good visual impact. At least things were cleaner.

No real impact on quality and cost however for all the effort that was put into the project

Operators dismayed with lean – seen as a burden

1 Week “TPS” Effort Uncovered:

\$500K in wasted capital identified on two lathes

6 lathes at 85% uptime possible (saved \$4-500K of overtime in 2 departments)

Scrap will be reduced as well (\$150-200K estimate)

Probable annual savings in the area of \$6-800K just by looking in more detail the lathe department. Other areas?

Operators thought this was the greatest thing ever – the job got easier, and someone finally listened.



Hansei / Reflection

Some companies just seem have the wrong “framework” for doing lean (multiple examples)

When the emphasis is to “apply the tools” then rigorous thinking is not required. Law of least mental effort is followed...

In TPS leaders must see that practitioners “solve the real problem” and apply the scientific method. This will won’t happen naturally.

TPS at its essence is developing a way to surface problems right now, and respond right away, not just building a tool kit

The real issues in this case were 1) up front mistakes in engineering, 2) inability in the lean group to even see the problem, and 3) abnormal situations had become normal. No one took action.



Some further thoughts on the matter...

We need to get better at practicing the scientific discipline of implementing TPS and improving the process of “doing lean”

Mr. Ohno drilled this in “top down” and made it happen by sheer force of personality, will, and effort. It was not all that fun I am told by those that lived through it.

Mr. Shingo helped train several thousand people in how to see problems better in Toyota between 1956-1975.

The T in TPS often is said to stand for “Thinking” but from my own experience it also stands for “Technical” ability.

In the Kamigo engine plant my boss always told me “relax in 6-7 years you will be a pretty good beginner”...In hindsight he was right, I’m just not sure we have that kind of time in some companies.



Let's revisit some basic TPS questions

= Enough done already?

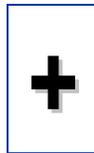
	<u>Key TPS Questions</u>	<u>Typical Problems</u>	<u>Countermeasures or analysis tools</u>
<p>1. How will you satisfy the customer and obtain a <u>profit</u>?</p> <p>2. What are your <u>main problems</u> in production?</p>	3. How will you achieve 100% JIT?	<ul style="list-style-type: none"> •On-time delivery •Inventory •Lead-time 	<div style="border: 1px solid black; background-color: #e0f2f1; padding: 5px;"> <ul style="list-style-type: none"> •VS Mapping •Flow of product •Pull system / kanban </div>
	4. How will you build in 100% quality?	<ul style="list-style-type: none"> •Customer defects •Scrap •Rework 	<ul style="list-style-type: none"> •Abnormality detection •Stop the machine •Process Cpk
	5. How will you stabilize the to availability 100%?	<ul style="list-style-type: none"> •Capacity losses •Downtime •Scrap & Rework 	<ul style="list-style-type: none"> •6 losses •OA / Maintenance •Problem solving
	6. How will you standardized work 100?	<ul style="list-style-type: none"> •Labor productivity •Scrap & rework •Safety 	<ul style="list-style-type: none"> •Job Instruction •Standardized work •Motion analysis
	7. How will you develop natural work team leaders?	<ul style="list-style-type: none"> •Team morale •Skills development •Small improvements 	<ul style="list-style-type: none"> •TWI/JR •TWI/JI •TWI/JM
	8. How will you sustain and improve?	<ul style="list-style-type: none"> •Recurring problems •Firefighting •Poor problem solving 	<ul style="list-style-type: none"> •PDCA •Root cause analysis •Recurrence prevention



TPS Vision of Ideal State: True North

Customer Satisfaction

- 0 defects
- 100% value added
- 1x1, in sequence, on demand



Human Development

- Physical & Mental Safety
- Security
- Professional Challenge

EVERYONE
every minute
every day

Current Actual Condition



Thank you for your kind attention!

- Questions?

- Comments?

- Ideas?

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