



The Art *and* Science of Knowledge Transfer

July 26th, 2017

Scott Curtis, President/CEO, TWI Institute

Bob Kocik, Director, Central New York Technology Development Center (TDO)



...is a nonprofit organization that resurrected the TWI Program in 2001.

The Institute has since trained a rapidly expanding global network of over 1335 certified trainers that deliver TWI training in:

- manufacturing
- health care
- energy
- Construction
- service industries



TWI Institute Headquarters in
Syracuse, NY USA

Serving the Global Market



What is TWI ?

TWI is an essential element of Lean and continuous improvement programs around the world including the Toyota Production System. Its proven methods will:

Provides a foundation for developing organizational excellence and transforming business culture.

Complement Lean solutions by providing your frontline personnel with skills to establish a culture for change, improve methods and facilitate Standardized Work

Drive stability, develop true Standardized Work, create a sustainable improvement culture and teach "Respect for People"

June 22, 1940

TWI was one of the first emergency service established by the U.S. Department of War Manpower Commission Planning Board:

“to help industry to help itself to get out more materials than have ever been thought possible, and at constantly accelerating speed”

“The real job had to be done
by industry, within industry.”

1945 - Mission Accomplished!

Of the 600 client companies monitored by the TWI Service throughout the war:

- 86% increased production by at least 25%
- 100% reduced training time by 25% or more
- 88% reduced labor-hours by over 25%
- 55% reduced scrap by at least 25%
- 100% reduced grievances by more than 25%



Industry Abandoned TWI in 1945

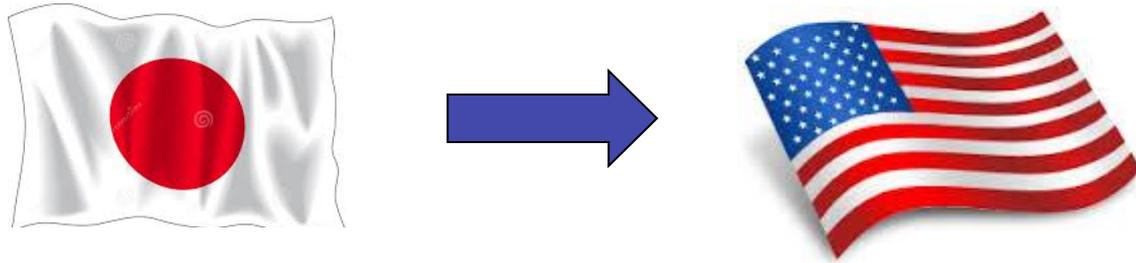
- Viewed TWI as being a war program.
- Millions of people returned to their jobs after leaving the military displacing TWI trained people.
- US infrastructure was not damaged enabling manufacturers to quickly produce consumer goods.
- The attention that TWI put on how people were treated and how work was performed made management uncomfortable at this time in history.

How TWI Ended up in Japan



- US Occupational Government introduced TWI along with quality methods (Deming and Juran) in Japan to quickly rebuild their industrial base as a deterrent to the spread of Communism.
- Japanese industry, eager to learn from the industrial base that had defeated them, quickly made TWI a staple of their industrial training keeping the training alive to this day.
- Toyota embraced TWI in 1951 to train their people in the evolving Toyota Production System where JI remains as a cornerstone of their team leader training and standard work.

How TWI Came Back to the US



- **1951** – Kenji Ogawa is one of the original TWI Master Trainers taught and certified by the TWI, Inc. American trainers in Japan
- **1960** - Mr. Ogawa trains Kazuhiko Shibuya for SANYO Electric Corporation
- **1980** – Mr. Shibuya, Manager Overseas Training trains newly hired American Patrick Graupp
- **2002** – Patrick Graupp leaves Sanyo to partner with the TWI Institute to resurrect TWI in the U.S.
- **2017** – The TWI Institute has trained over 1335 certified trainers for companies around the globe

Overview of the “J” Programs

Five Basic Needs of a Supervisor

Knowledge

unique to the Company and/or the Industry

that supervisors must know to do their job:

1. Knowledge of the Work
2. Knowledge of Responsibilities

Knowledge training is the responsibility of each company and therefore not the focus of TWI.

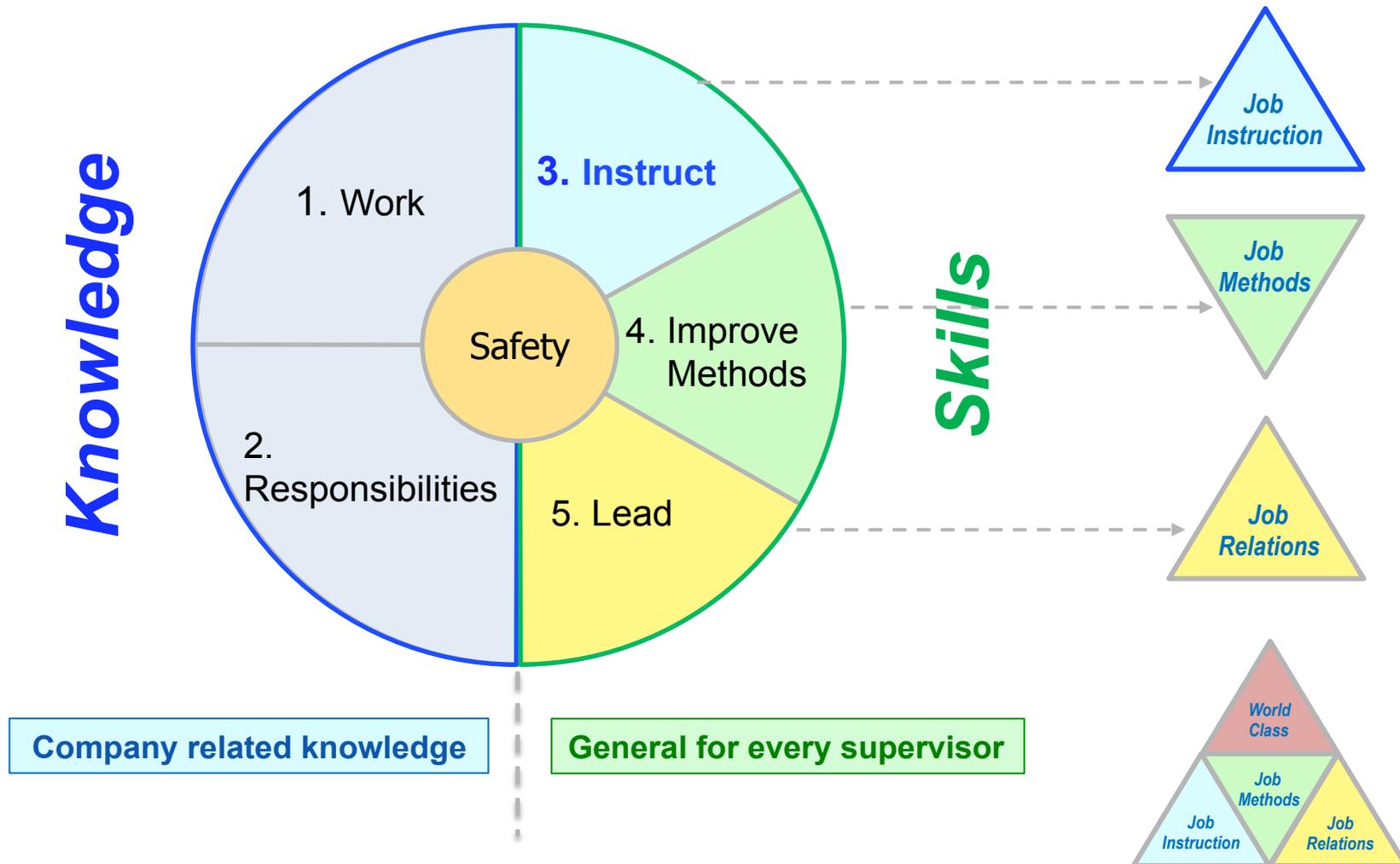
Five Basic Needs of a Supervisor

Skills

that are required for supervisors to perform within their role, *regardless of the industry*:

3. Skill in Leading
4. Skill in Instruction
5. Skill in Methods Improvement

5 Needs for Good Supervisors



Three Essential Skills

Job Instruction Training (JI)

How to teach people to quickly learn to do jobs correctly, safely, and conscientiously.

Job Relations Training (JR)

How to evaluate and take proper actions to handle and to prevent people problems.

Job Methods Training (JM)

How to analyze jobs to make the best use of the resources currently available.

Standardized Delivery

Each Program has a 4-Step Method *

1. Preparation (Plan)

Helps the learner comprehend the new idea

2. Presentation (Do)

Adds the new idea to the learner's mind

3. Application (Check)

Trains the learner to apply the idea and check results

4. Testing (Act)

Tests the ability of the learner to apply the new idea

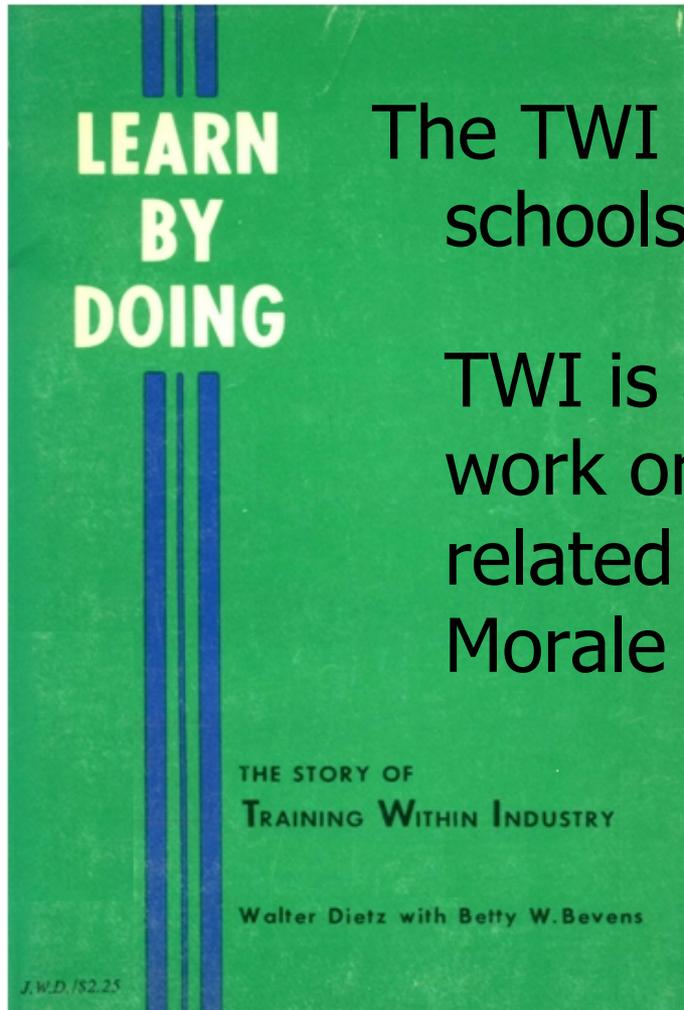
* *The Instructor, the Man, and the Job*, Charles R. Allen, J. B. Lippincott Company 1919

Standardized Delivery

- Each method is stated in shop terms
- Scheduling of five 2-hour meetings to keep the subject fresh and not keep people away from their jobs over long periods of time
- Small groups of 10 people
- Each participant must demonstrate in class that they know how to use the method



“Learn by Doing”



The TWI approach is not about schools, classes or lessons –

TWI is about individual and/or group work on *current day problems* related to Quality, Cost, Delivery, Morale & Safety

Ability to Recall Instructions

Source: Western Michigan University Study

Training Method	Recall after 3 Hours	Recall after 3 Days
Telling alone	70%	10%
Showing alone	72%	20%
Showing and telling	85%	65%
JI - Show, Tell, Do*	95%	92%

Long term retention requires teaching the new skill to others

* TWI Institute client data

Job Instruction

- **Quickly training employees to do a job Correctly, Safely, and Conscientiously**
- Job Instruction is designed to develop basic stability of your processes (standardized work). This program teaches the method to instruct an operator how to perform a job correctly, safely and conscientiously.
- As is frequently the case, most processes are performed by various workers using different methods.
- Job Instruction requires you identify the “**One Best Way**”, teach the process to this one way, and thereby creates a standard method.

JI 4-Step Method

Step 1 - Prepare the Worker

Step 2 - Present the Operation

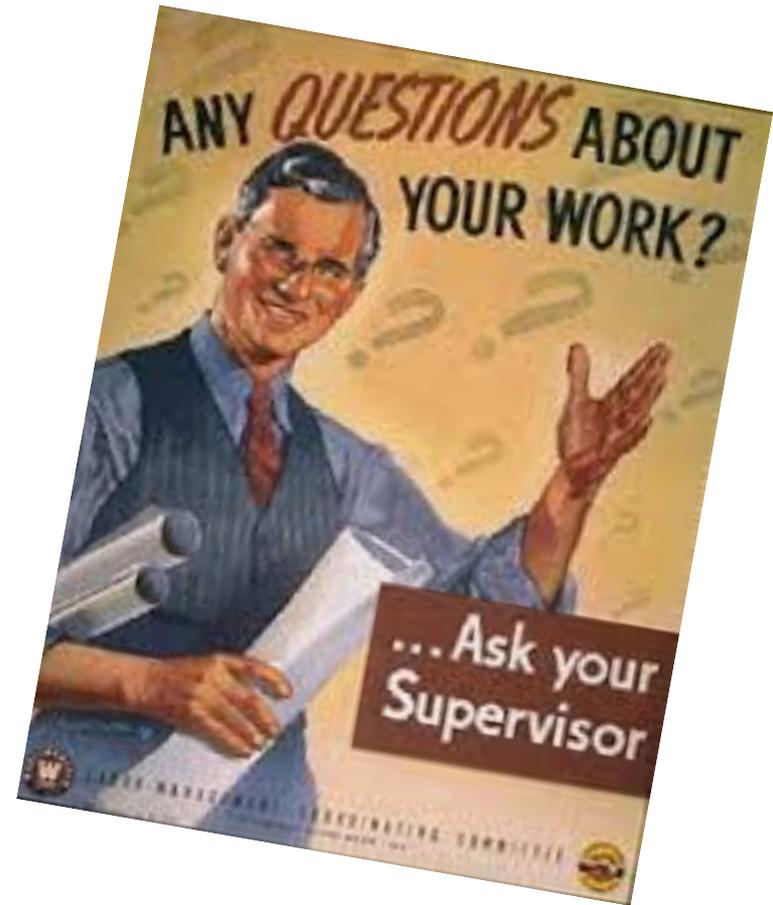
Step 3 - Try-out Performance

Step 4 - Follow-up

**“If the worker hasn’t learned
the instructor hasn’t taught.”**

Job Instruction Training Demonstration

Break



No. _____

JOB INSTRUCTION BREAKDOWN SHEET

Operation: _____

Parts: _____

Tools & Materials: _____

IMPORTANT STEPS <i>What</i>	KEY POINTS <i>How</i>	REASONS <i>Why</i>
A logical segment of the operation when something happens to advance the work.	Anything that might— 1. Make or break the job 2. Injure the worker 3. Make the work easier to do, i.e. “knack”, “trick”, special timing, bit of special information	Reasons for key points
	<i>That 5 or 10% of a the hard or tricky parts of a job.</i>	<i>People learn better when they know why they do things.</i>

Typical First Pass at Creating a JIB

JOB BREAKDOWN SHEET		
DATE: January 21, 2008	TEAM LEADER: Donna S., Gillain A., Joan C.	SPONSOR: Donna S., MD
AREA: All areas providing direct pt care or in contact with pt care supplies, equipment or food	JOB: Hand Hygiene in compliance with CDC & WHO hand hygiene guidelines	WRITTEN BY: Joan C.
MAJOR STEPS	KEY POINTS	REASONS FOR KEY POINTS
Step #1: Identify the need for clean hands	Remove artificial fingernails or extenders when in direct contact with pts or their environment	Artificial nails house germs that can be passed on when you touch pts
	Clean hands whether or not you use gloves (i.e. before putting on gloves & after removing gloves)	Gloves are not a substitute for cleaning hands because gloves don't completely prevent germ transmission
	Before direct contact with pt, pt's environment or equipment	Protect the pt against harmful germs carried on your hands
	After direct contact with pt, pt's environment or equipment	Protect yourself & the health-care environment from harmful pt germs
Step #2: Inspect your hands to determine best cleaning method	If not visibly soiled, use alcohol-based gel	Cleaning with gel is faster, more effective, and better tolerated by your hands
	Visibly soiled hands or hand with fecal contamination require washing with soap & water	Dirt, blood, feces or other body fluids are best removed with soap & water (C. diff spores are not killed with alcohol-based gel)
Step #3: Use enough product to cover all hand surfaces & fingers	GEL: Cover all surfaces with a thumb nail-sized amount	Friction & skin contact are required to remove germs
	WASH: Wet hands with water, wash with enough soap to cover all hand/finger surfaces	
Step #4: Spend enough time cleaning your hands	GEL: Vigorously rub until product dries on your hands	Antiseptic action is not complete until fully dried (approx 15 sec.)
	WASH: A minimum of 15 sec. (the length of singing "Happy Birthday to You")	As least 15 sec. is needed to ensure complete coverage of hand surfaces
	Use paper towel to turn off water faucet	Prevent transfer of germs from faucet onto clean hands
Step #5: Let your hands completely dry	Moisturize hands with lotion available through Central Supply	To minimize contact dermatitis without interfering with antimicrobial action
	Put on gloves after hands are dry	Skin irritation may occur if moist hands come in contact with glove material
Step #6: Perform task with clean hands	Task is done immediately after cleaning hands	You may be distracted & touch unclean surface with clean hands

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	Clean hands whether or not you use gloves (i.e. before putting on gloves & after removing gloves)	Gloves are not a substitute for hand hygiene because gloves don't completely protect you from germs
	Before direct contact with pt, pt's environment or equipment	Protect yourself from germs on pt's hands
	After direct contact with pt, pt's environment or equipment	Protect yourself from germs in environment from harmful pt
Step #2: Inspect your hands to determine best cleaning method	If not visibly soiled, use alcohol-based hand sanitizer	Alcohol-based hand sanitizer is faster, more effective, and better tolerated by hands
	Use soap & water if hands are visibly soiled	Dirt, blood, feces or other body fluids are best removed with soap & water (C. diff spores are not killed with alcohol-based gel)
Step #3: Use enough soap to cover all hands & fingers	Use a dime-sized amount of soap	Friction & skin contact are required to remove germs
	Rinse hands with water, wash with enough soap to cover all hand/finger surfaces	
Step #4: Spend enough time cleaning your hands	GEL: Vigorously rub until product dries on your hands	Antiseptic action is not complete until fully dried (approx 15 sec.)
	WASH: A minimum of 15 sec. (the length of singing "Happy Birthday to You")	As least 15 sec. is needed to ensure complete coverage of hand surfaces
	Use paper towel to turn off water faucet	Prevent transfer of germs from faucet onto clean hands
Step #5: Let your hands completely dry	Moisturize hands with lotion available through Central Supply	To minimize contact dermatitis without interfering with antimicrobial action
	Put on gloves after hands are dry	Skin irritation may occur if moist hands come in contact with glove material
Step #6: Perform task with clean hands	Task is done immediately after cleaning hands	You may be distracted & touch unclean surface with clean hands

Too many words, impossible to train using 4-Step method!

Job Instruction Breakdown after JI Follow-up Coaching

Operation: Hand Hygiene-Washing

Parts: Soap, Running Water, Disposal Towel

Tools & Materials: None

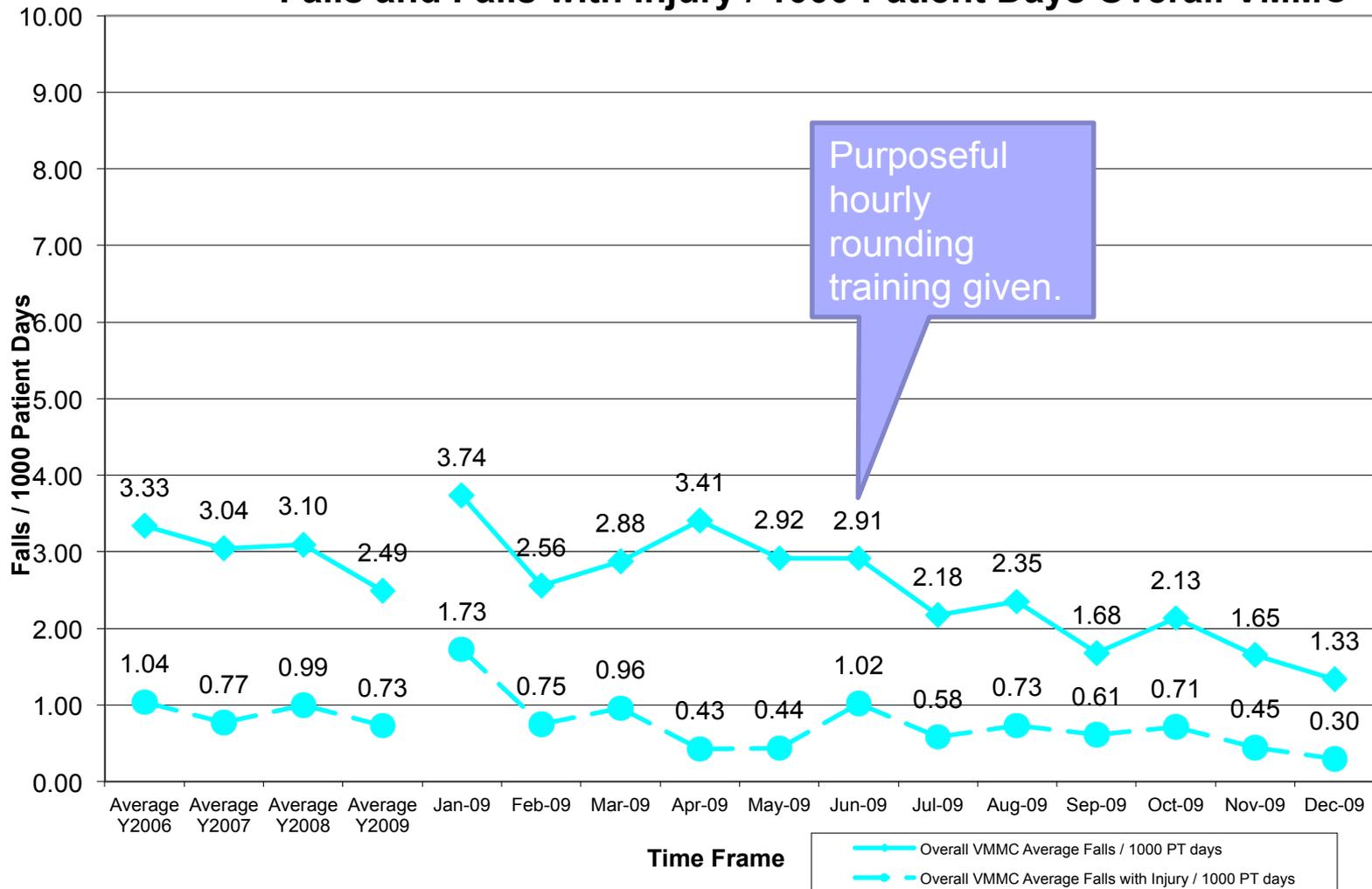
IMPORTANT STEPS	KEY POINTS	REASONS
A logical segment of the operation when something happens to advance the work.	Anything in a step that might— 1. Make or break the job 2. Injure the worker 3. Make the work easier to do, i.e. “knack”, “trick”, special timing, bit of special information	Reasons for the key points
1. Wet hands	Without soap	If soap is used, it rinses away
2. Apply soap	Cover all surfaces	Kill all germs
3. Rub hands	1. Palm to palm 2. Palm to backs	1. Clean entire surface 2. Clean entire surface
4. Rub fingers	1. Thumbs 2. Interlocking 3. Backs of fingers to palm 4. Tips of fingers to palm	1. Most active part of hands 2. Sides of fingers cleaned at one time 3. Cuticles and knuckles 4. Under finger nails
5. Rinse	Leave water on	Prevent recontamination of hands
6. Dry	Use towel to turn off water	Prevent recontamination of hands

Results of Hand Hygiene

- Before Pilot
 - 83.5% of VMMC staff were observed washing hands when needed
 - Worldwide, only 60% of healthcare workers clean their hands when they should (World Health Organization, 2010)
- After Pilot
 - In the areas where the JI pilot was run, reliability of Hand Hygiene went to above 98%.

Results of Rounding

Falls and Falls with Injury / 1000 Patient Days Overall VMMC



Feedback from Rounding Pilot

“For a long time now, I’ve taught my staff that the majority of patient falls occur during the toileting process. Knowing, however, wasn’t enough to hardwire actions to prevent patient falls. TWI provides the hardwiring and rigor ... toileting is planned for & built into my staff’s work flow. It’s really made a difference on Level 8.”

Rowena Ponischil,
Director, Levels 7/8

“ You know... you all must go through some kind of special training because EVERYONE asked me if I was comfortable, offered the bathroom, made sure that I had my call light and phone, and then asked if there was anything else I needed. I’ve never seen such great customer service while in a hospital.”

*Conversation between discharging patient
and his nurse on the Telemetry Unit*

Job Relations Training (JR)

Trains supervisors/team leaders on how to evaluate and take proper actions to solve and to prevent problems with people.

How to Handle a Problem

DEFINE YOUR OBJECTIVE

Step 1 - Get The Facts

Get the whole story (opinions & feelings)

Step 2 - Weigh And Decide

Don't jump to conclusions

Step 3 - Take Action

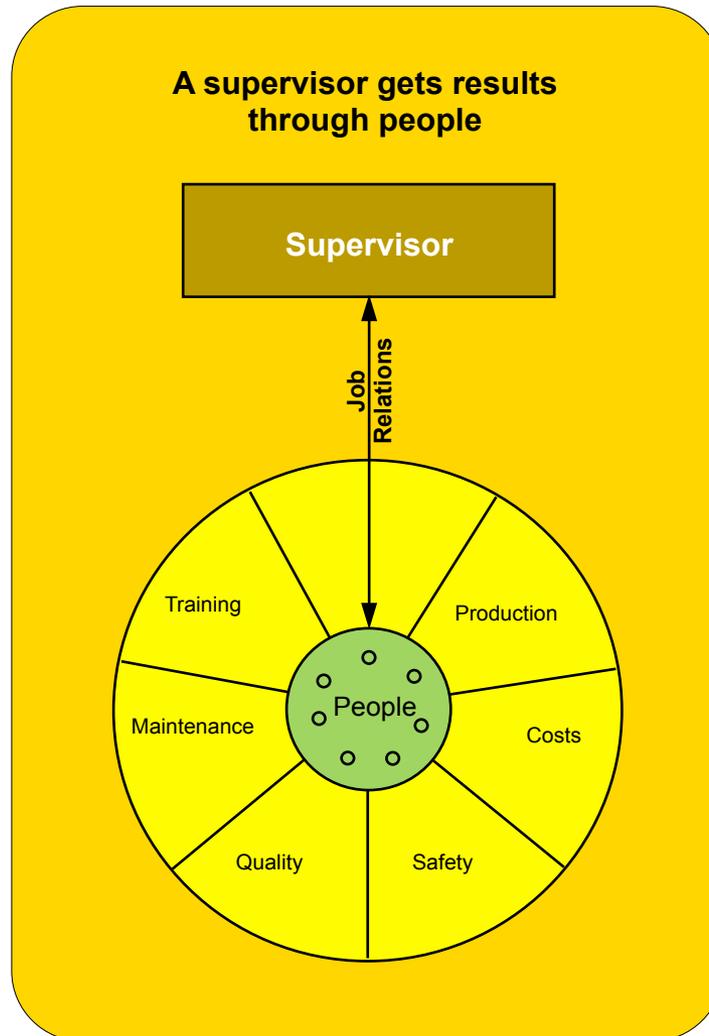
Don't pass the buck

Step 4 - Check Results

Did your action help production?

DID YOU ACCOMPLISH YOUR OBJECTIVE?

The Job Relations Model



How to Prevent Problems

- Let each worker know how he/she is doing
- Give credit when credit is due
- Tell people in advance about changes that will affect them
- Make the best use of each person's ability

Job Methods Training (JM)

Trains supervisors/team leaders on how to analyze jobs to make the best use of the *people, machines, and materials now available.*

Step 2 - Question Every Detail

Step 3 - Develop the New Method

Why?

What?



Eliminate

Where?

When?

Who?



***Combine
Rearrange***

How?



Simplify

JM Improvement Proposal

Improvement Proposal Sheet

Submitted to:
Made by:
Product/Part:
Operations:

Department:
Date:

The following are proposed improvements on the above operations.

1. Summary

--

2. Results

	Before Improvement	After Improvement
Production (one worker per day)		
Machine Use (one machine per day)		
Reject Rate		
Number of Operators		
Other		

3. Content

--

Step 4 - Apply the New Method

1. Sell the change to others
2. Obtain necessary approvals
3. Put the new method to use right away
4. Credit those involved

Job Methods - The Origin of “Kaizen”

- Indoctrinates people into an “improvement” frame of mind.
- Teaches people how to identify opportunities for improving their jobs.
- Trains people how to generate ideas to take advantage of these opportunities.
- Shows people how to get these ideas into practice right away.
- Creates ownership for people to maintain standard work.

How TWI Skills Work Together

	JI – JR	JI – JM	JR – JM
Relationship	Leadership skill (JR) is foundational to instruction skill (JI)	Good instruction (JI) both precedes and follows improvement efforts (JM)	Improvement activities (JM) enhance strong relations (JR) and vice versa
Principle	People will not “follow” our instructions if we do not “lead” them well	Work processes must be stabilized before they can be improved	Direct involvement in designing jobs inspires positive work ethic
Benefits	Standard Work is adhered to when people want to follow good instruction	Improved methods will “stick” when they are taught properly	<i>Kaizen</i> results multiply exponentially when people are actively involved

Why TWI, what is the need?

Fact ...

- Shingo researched Lean (Continuous Improvement) programs

... at least 85% of all Lean Projects fail in the initial implementation...



Why?

- Lacking **Work Standards**
- Insufficient **Respect & Trust** to and from employees
- Focused on **tools & methods**, not enough on employees

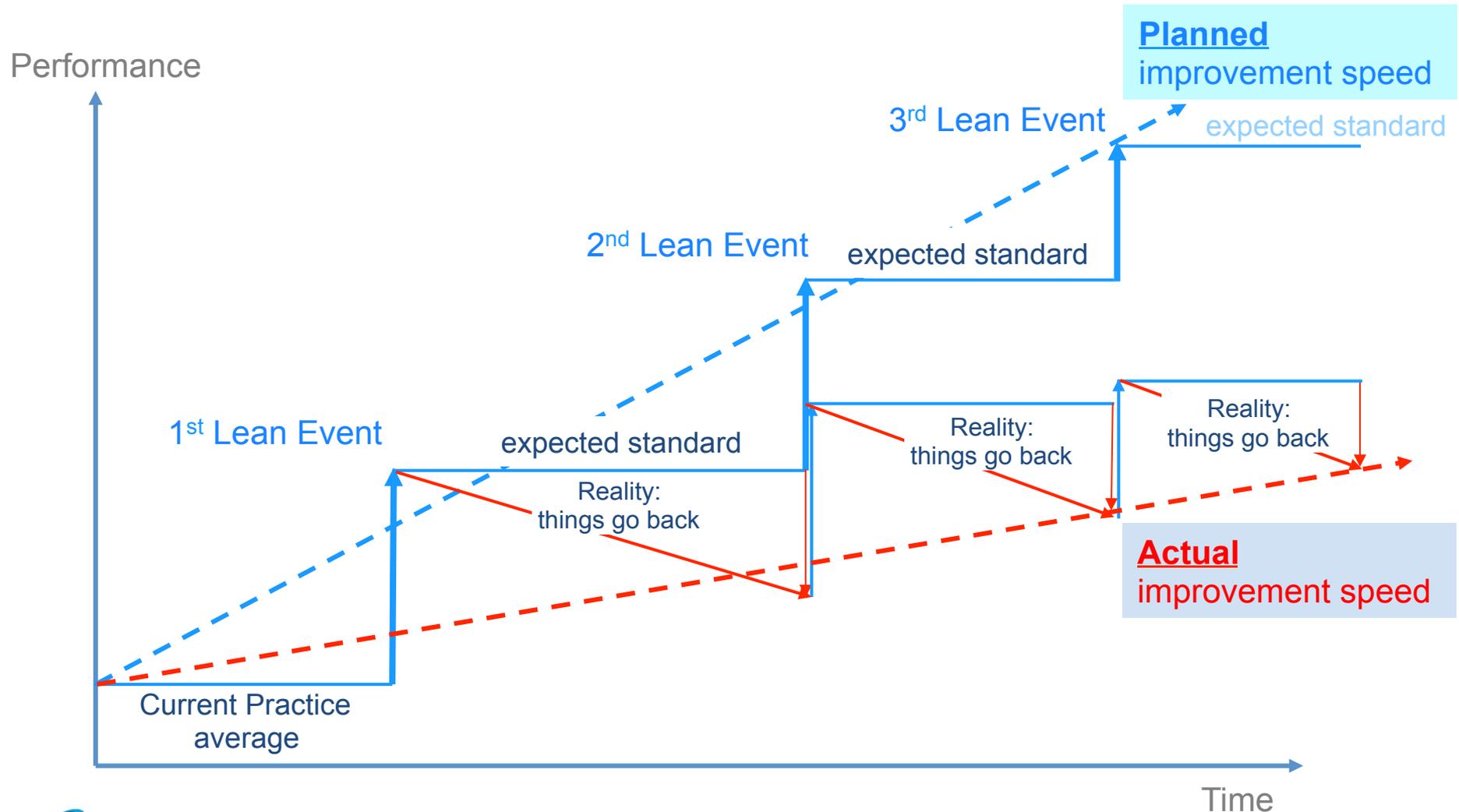
Toyota: since 1951 TWI-methods are fundamental in talent development!

The Reality of Tactical Lean

- Companies rely on “scheduled events” to make even small changes.
- People resist change making it difficult to get them to participate in the improvement process.
- People tend to rely on others for improvements.
- Even when people want to improve they don't have the improvement skills and/or support.
- Supervisors and operators end up leaving improvement until after “making the numbers.”

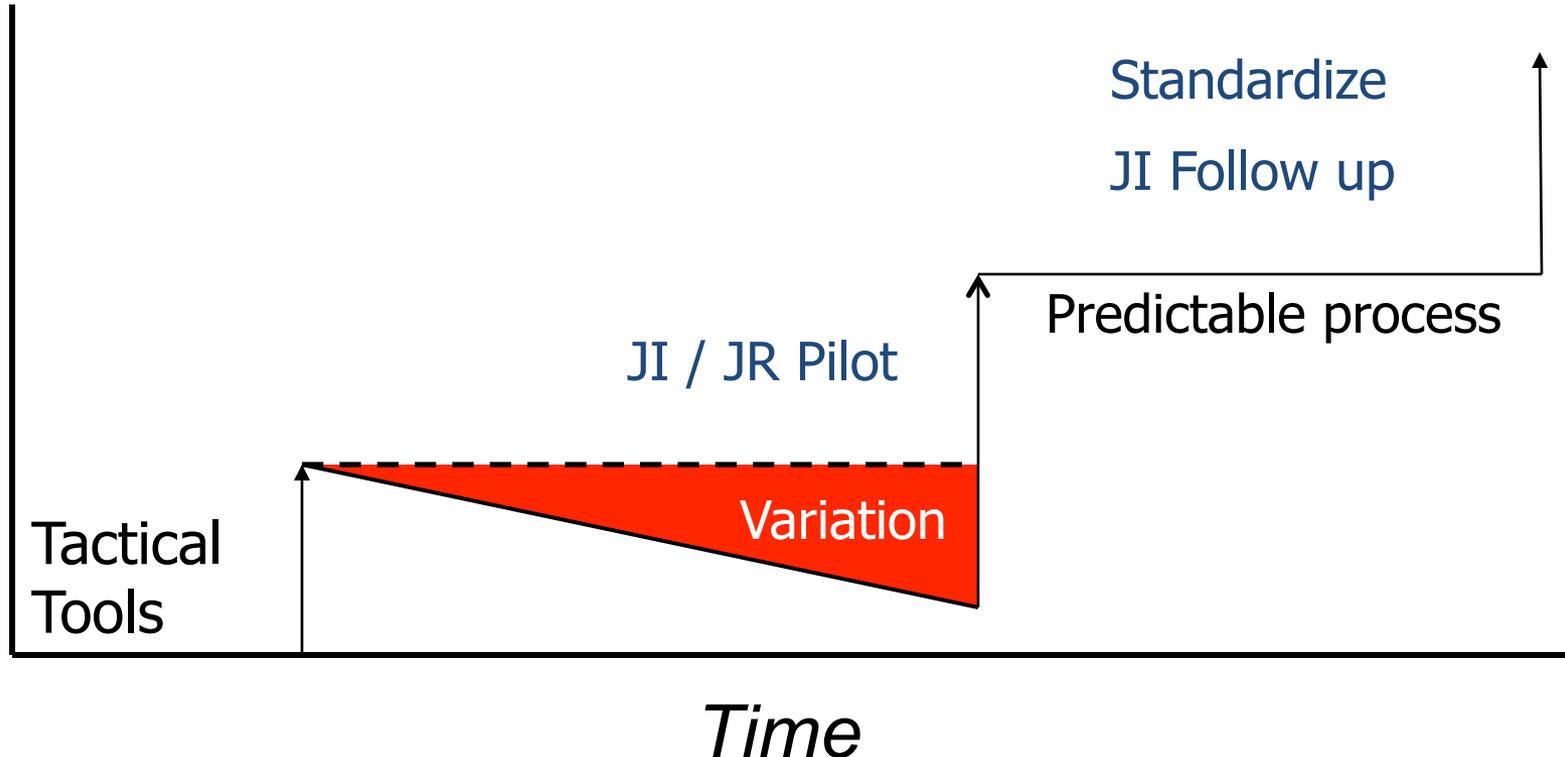


Does Lean Deliver Your Planned Results?



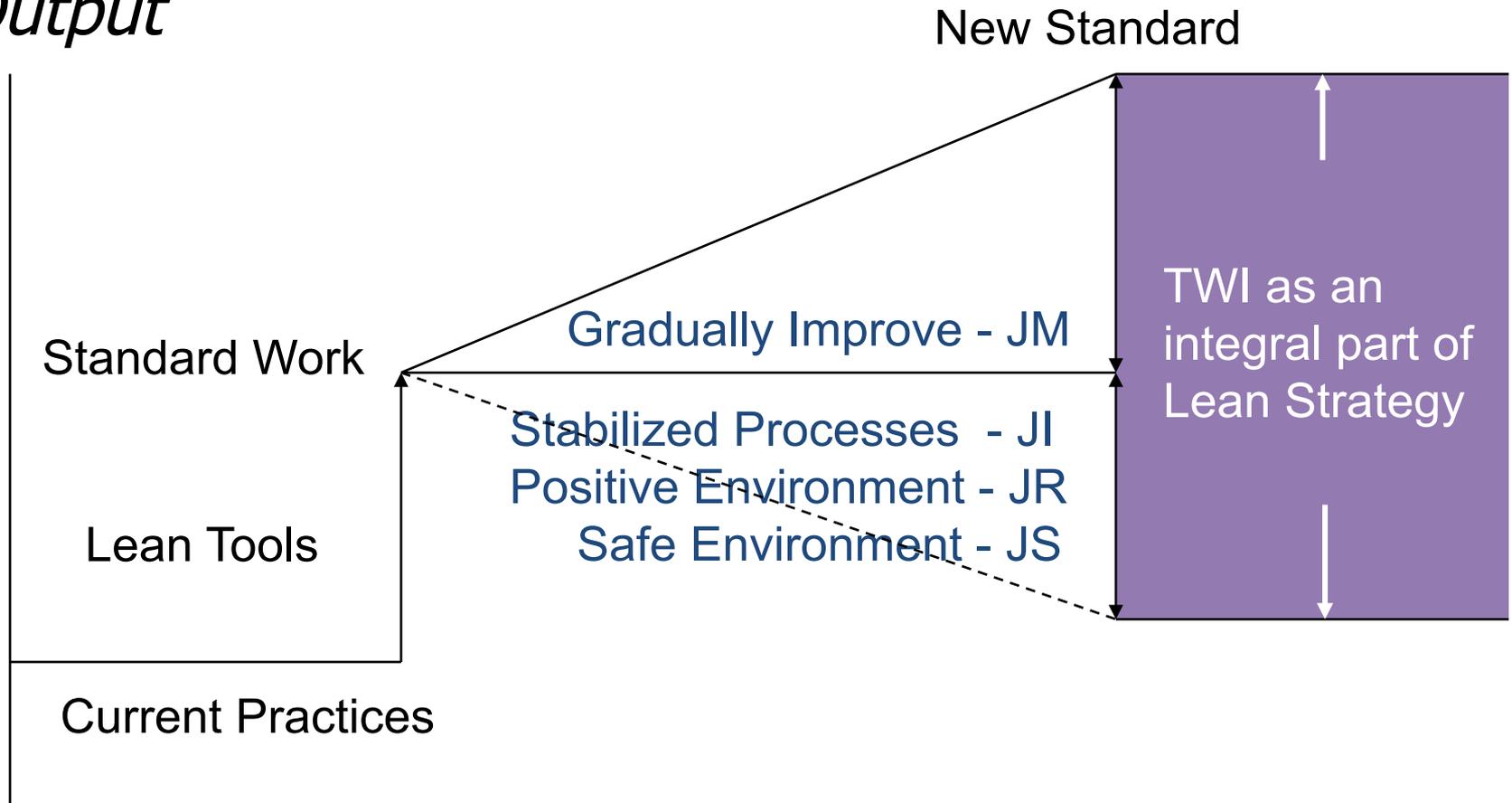
Achieving Basic Stability

- JI - Document current best methods to retrain people to a standard.
Audit operators to achieve and sustain predictable processes.
- JR - Engage people to improve by breaking down barriers to change.



Stabilize, Standardize, Sustain

Output



Time

Standardize – (*What to Do*)

“...the best possible work method, with the least amount of waste, producing the best quality product at the lowest cost.”

The Toyota Way Fieldbook, Jeffrey Liker & David Meier, 2006, p111-114

STANDARDIZED WORK CHART		PROCESS		Cycle Time	TAKT Time	SAFETY	QUALITY	IN PROCESS
Glost Kiln Operator Cycle				30-minutes	1-cycle / 90-minutes	+	◆	●
Element Number	Description	Work Time	Walk Time	WORK AREA LAYOUT				
1	Walk to GK #3 Exit		1.0					
2+	Discharge Car from GK#3	5.0						
3+	Discharge Car from GK#4	5.0	1.2					
4	Record GK#4 car numbers and temps	1.0	0.7					
5◆	Charge GK#4	5.0	0.3					
6◆	Charge GK#3	5.0	1.0					
7	Record GK#3 car numbers and temps	1.0	0.6					
8	Return to loading		0.6					
Total (min):		22	5.4					
COMMENTS: Safety: Use high temp gloves, pusher to move cars and be mindful for oily/slick surfaces Quality: Inspect kiln cars and repair downed ware and refractory. Use care not to damage glaze of unfired ware								

STANDARDIZED WORK CHART		PROCESS		Cycle Time	TAKT Time	SAFETY	QUALITY	IN PROCESS
Rail Loading Process				430	440	+	◆	●
Element Number	Description	Work Time	Walk Time	ELEMENTS OF PROCESS				
1	Exit van at loadline, proceed to car	5	5					
2	Verification Prior to Exiting Loadline	20	0					
3	Follow Driving Pattern in Yard	75	0					
4	Pull up to terminal, Load car in NPPS	25	0					
5	Drive up ramp and enter railcar	18	0					
6	Drive through railcars at a maximum speed of 15 km/h <i>Environmental, Significant Noise Impact</i>	40	0					
7	Park car to CP/AA/RTLS audit specifications	5	0					
7a	Car in "home position", transmission in neutral, parking brake on (AAR standard)	5	0					
7b	Exit car with door under control	5	4					
8	Chock down front tire of vehicle	45	2					
8a	Chock down rear tire of vehicle	45	8					
9	Spot following T.M. before exiting railcar	5	0					
9a	If required, lower hingedecks (loading A-deck)	10	0					
9b	If required, remove bridgplates from C-deck (loading B-deck)							
9c	If required, remove bridgplates/close up railcar (loading B-deck)							
10	Exit Railcar	5						
10a	Get ride from shuttle	115						
• During inactivity or downtime, SS or do jobs as assigned • Repeat procedure until break, take-down or shift end								
		411	19					

KEYPOINTS:
 *Do not spin tires *Radios are not to be on while loading *Do not lean or place hands on vehicle *Place door edge protector at top of door frame when loading C deck (Corolla) *Drive at 35 km/h in yard *Keep 2 car lengths away from vehicle in front *No stopping on bridgplates *Keep vehicle positioned in railcar 1" to 2" from tie-down rail. If unsure of positioning STOP vehicle and check. *Tail loading at high speeds may cause a high noise impact *Make sure chock strap is centered on tire and not touching the strut behind tire (check with hand) *Ensure straps are not twisted *Ratchet chocks firmly but do not bulge tire *Visually check to see if pin is locked in *Use the 3 point contact rule when climbing down the ladder *Carry ratchet in hand away from vehicle, put in pocket when climbing down ladders *Make sure hinge decks are locked in when lowered
 *Be aware of other crew, know what they are loading and drive with caution when approaching loadline or terminal scanners
 *Repeat procedure until break, take-down or shift end

NOTE PLACE: i ● ◆ + A ENVIRONMENTAL "SIGNIFICANT NOISE IMPACT"

JI Breakdown teaches *How to Do It*

No. _____

JOB INSTRUCTION BREAKDOWN SHEET

Operation: Glost Kiln Operator Cycle

—

Parts: None

—

Tools & Materials: Kiln Gloves

IMPORTANT STEPS	KEY POINTS	REASONS
A logical segment of the operation when something happens to advance the work.	Anything in a step that might— 1. Make or break the job 2. Injure the worker 3. Make the work easier to do, i.e. "knack", "trick", special timing, bit of special information	Reasons for the key points
1. Discharge GK #3	1. Use kiln gloves 2. Pull at correct time	1. Burn hazard 2. Kiln control
2. Charge GK #3	1. Fix downed ware 2. Do not slam transfer	1. Defect prevention 2. Defect prevention
3. Record car data		
4. Check kiln temperatures	1. Call Ceramic Tech if 50°F delta in zones	1. Proper kiln control
5. Charge GK #3	1. Fix downed ware 2. Do not slam transfer	1. Defect prevention 2. Defect prevention
6. Discharge GK #3	1. Use kiln gloves 2. Pull at correct time	1. Burn hazard 2. Kiln control
7. Record car data		
8. Check kiln temperatures	1. Call Ceramic Tech if 50°F delta in zones	1. Proper kiln control

- Train all operators to the standard
- Monitor to maintain standards to eliminate variation in the process
- Focus operators on takt time and quality at the source vs. just keeping up
- Teach people how to solve problems on their own to continuously improve

Group Leader Qualifications

To be considered for the Group Leader (Supervisor) position at Toyota a person must be able to interpret high level needs and to transfer that knowledge so the team can accomplish daily objectives.

Characteristics needed for the job:

1. Willingness and Desire to Lead
2. Job Knowledge
3. Job Responsibilities
4. Continuous Improvement Ability
5. Leadership Ability
6. Teaching Ability

The Toyota Way Fieldbook, Jeffrey K. Liker and David Meier, McGraw-Hill, 2006, Chapter 10

What is Good Front Line Supervision?

“Good supervision gets the people in the department to do **what** the supervisor needs done, **when** it should be done, and the **way** the supervisor needs it done, **because they want to do it.**”

- **What & When:** dictated by the Customer
- **The Way:** Standardized Work
- **Because they want to do it:** Engagement

Source: *Training Within Industry Program*

Benchmarking with Toyota

“If people want to succeed with lean or TPS they have to emphasize people development and making leaders capable of delivering improvements. TWI is a great starting point even today and a hidden strength of Toyota’s production system.”



Source: “Why in your opinion is TWI critical?” Summary Notes from Art Smalley Interview with Mr. Isao Kato, TWI Influence on TPS & Kaizen, Feb. 8, 2006, www.ArtofLean.com

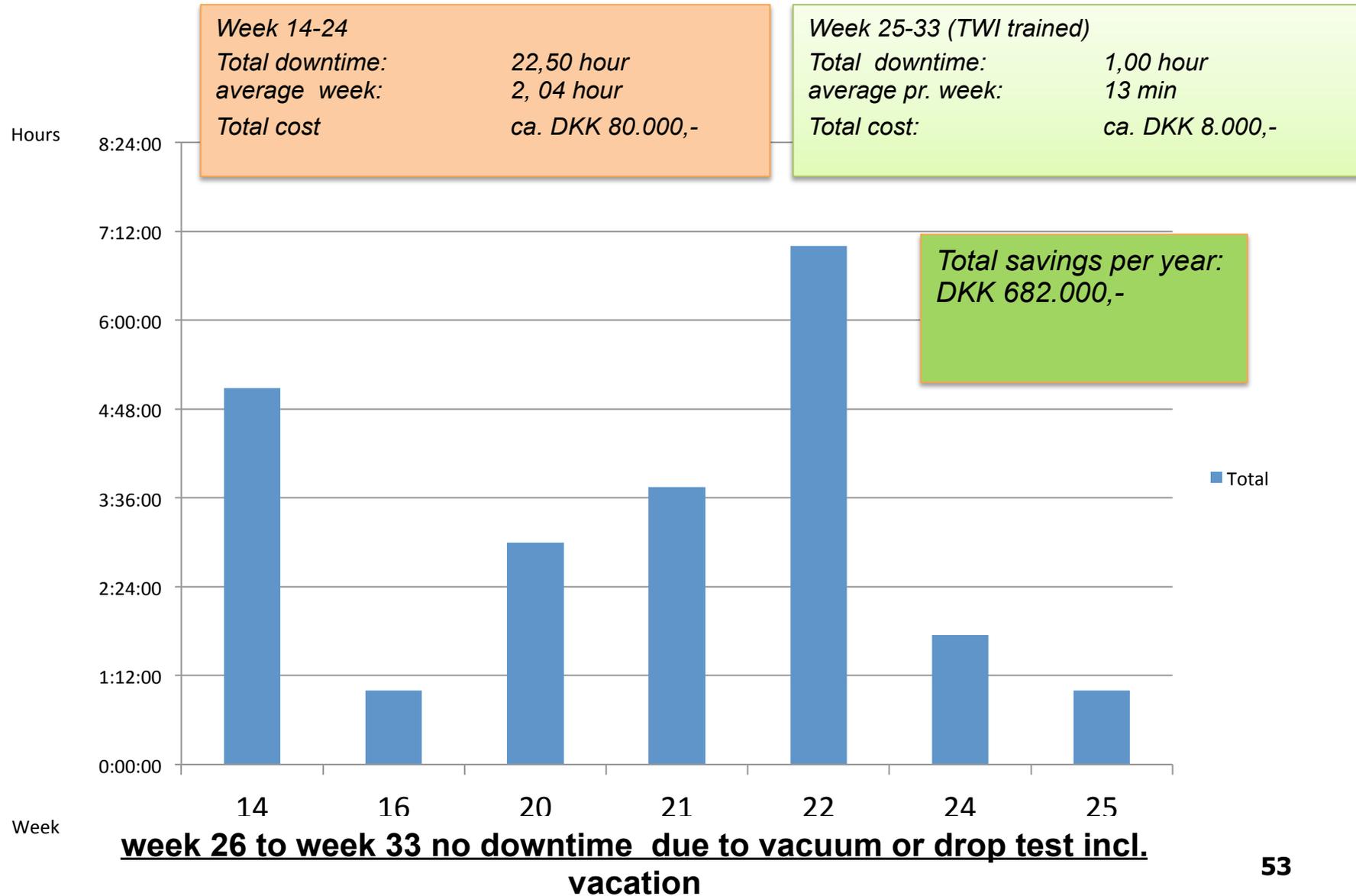
7-Step Implementation Model

1. Form TWI Steering Team
2. Identify pilot project(s)
3. Schedule Initial TWI training
4. Carry out pilot project
5. Publicize results of the pilot
6. Develop in-house trainers
7. Roll out TWI on a larger scale/Introduce JM



TWI Lem pilot training effect

- Job instruction (JI) vacuum and drop test V 110. Training started week 24

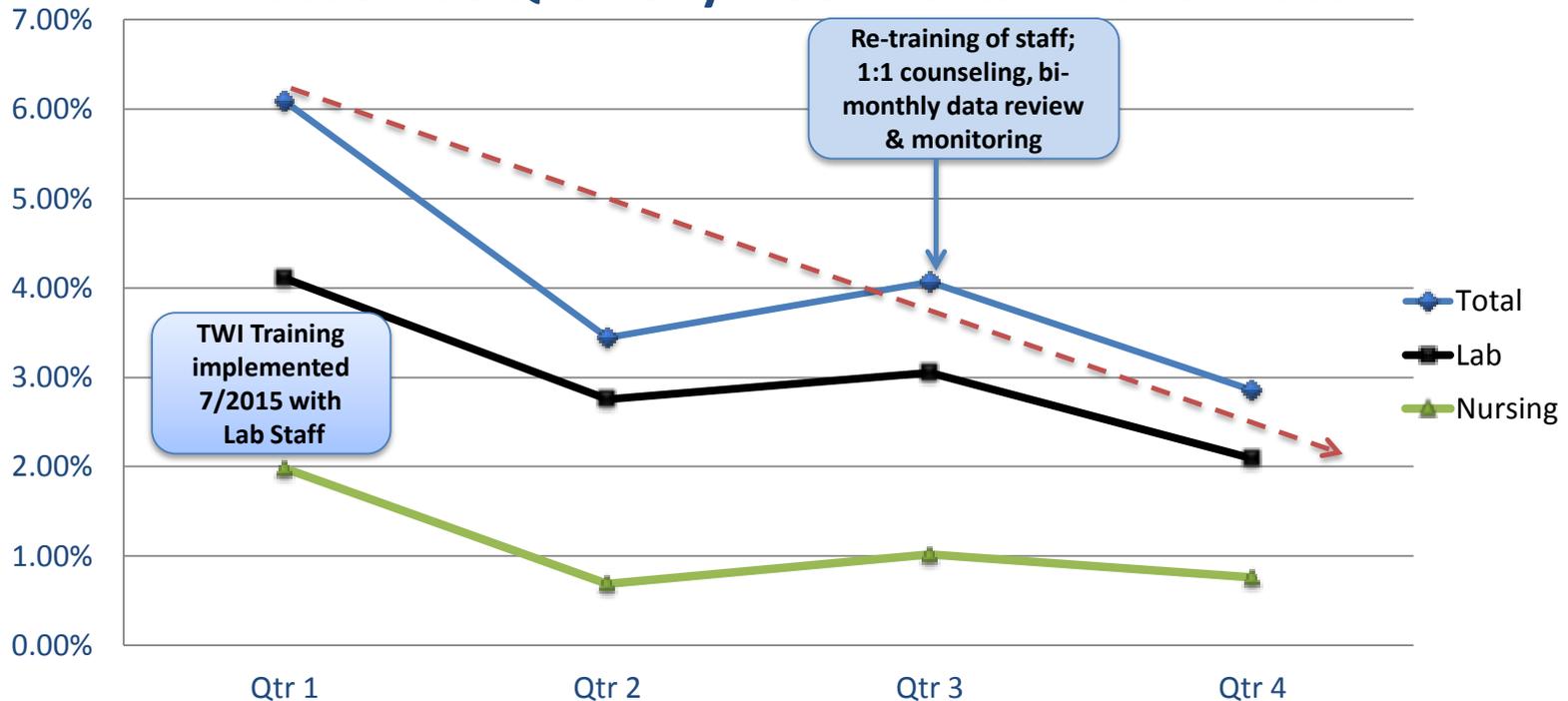


Journey #1

Analysis: FY 2016



Housewide Quarterly Blood Contamination Rate



National Benchmark 2.5% BMHGT Goal 3%

NASSCO 2010 Pilot Project Results

Training Method Comparisons

Legacy

TWI

SAFETY

At Risk Behaviors Observed

8

2

FIRST TIME QUALITY

Defects Observed

53

3

WORK PERFORMANCE OUTPUT

Ability to Meet Installation Rates

71%

124%

KNOWLEDGE RETENTION

Important Steps, Key Points, Reasons

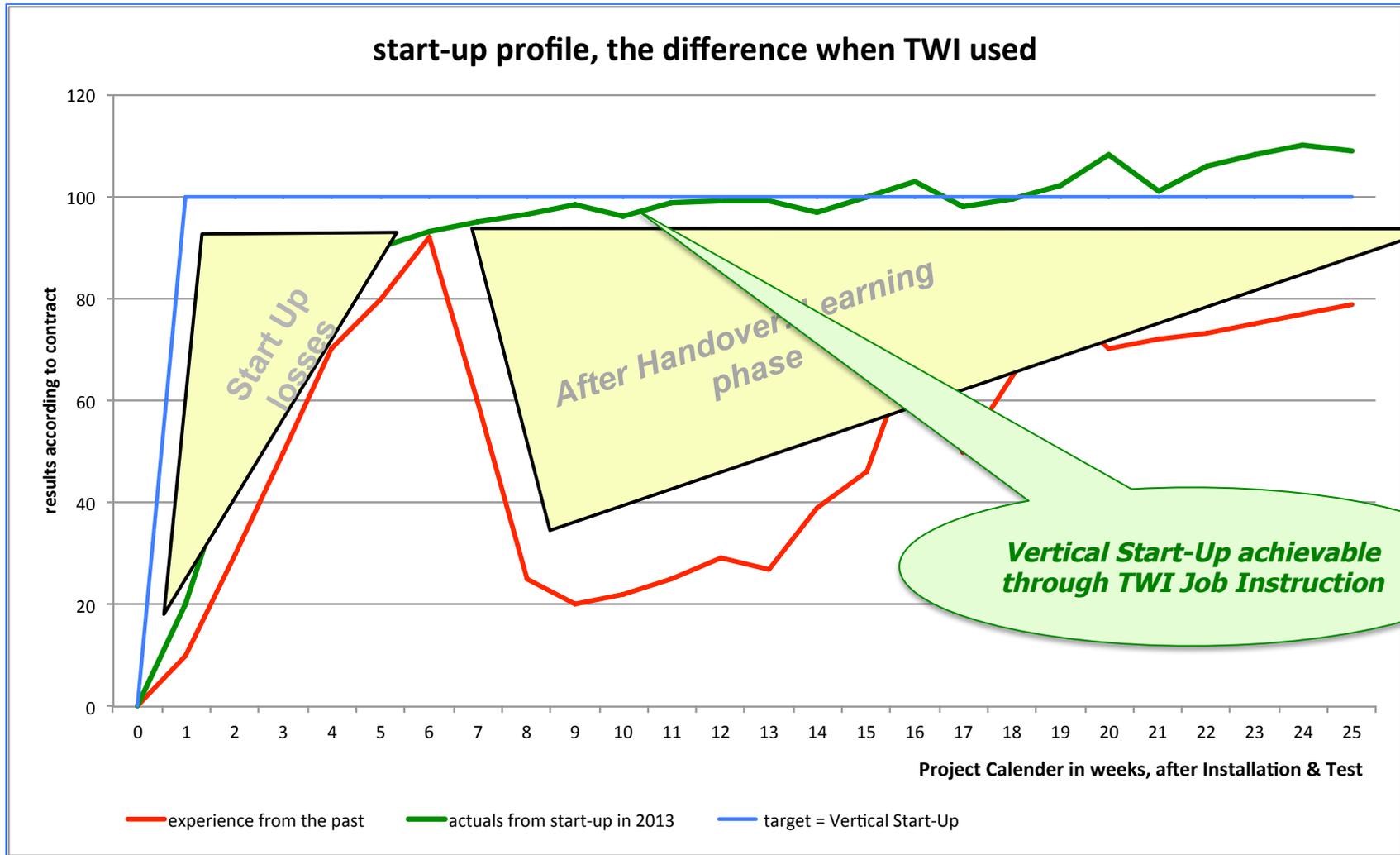
61%

92%

TWI-JI DELIVERS ROI (for Gemalto)

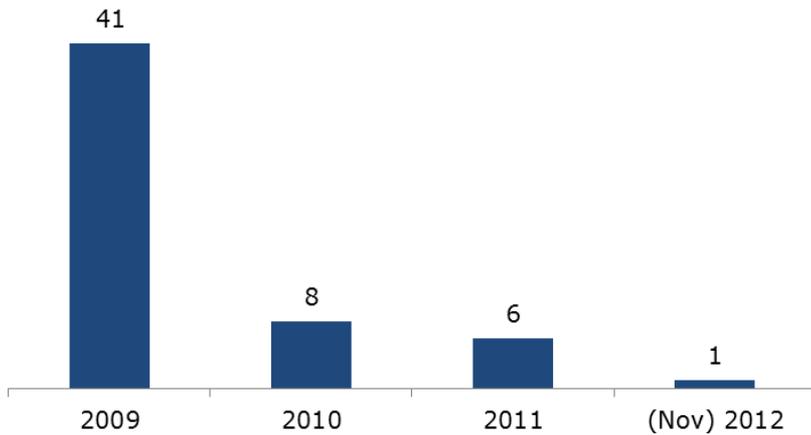
- New operator **training time** – from 4 weeks to 1 week
- **Rework** caused by complex manual setup – 42% to 15%
- Operators now do tricky engineering **setups** – faster than engineers
- Long-standing **manual errors** on complex operations eliminated
- **Customer complaints** turned into customer praise for fast and effective elimination of long-standing quality issue
- \$500k USD **cost-saving** from eliminating over-production
- **Capacity increase** on constraint operations by standardized 'best way known' of performing change-overs (**capital expenditure avoidance**)

TWI Applied on Line Start Up

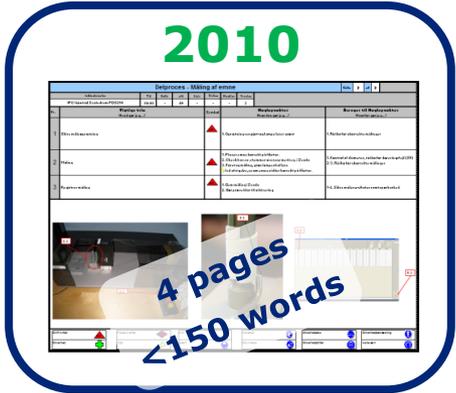


Novo Nordisk JI

QUALITY



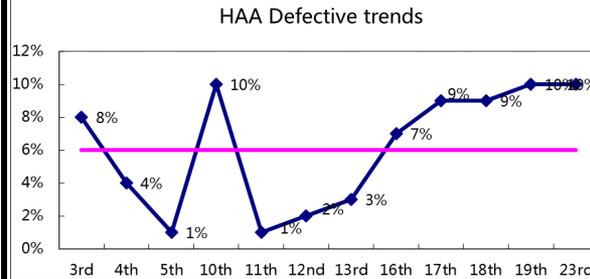
Errors in documentation leading to re-work



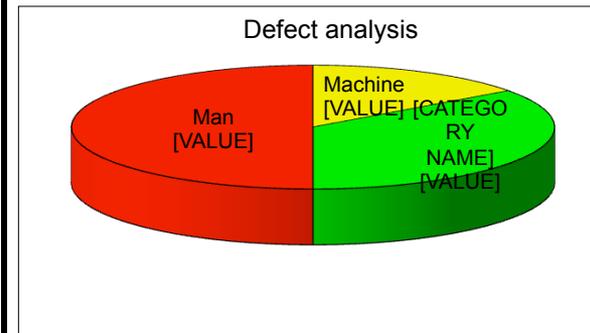
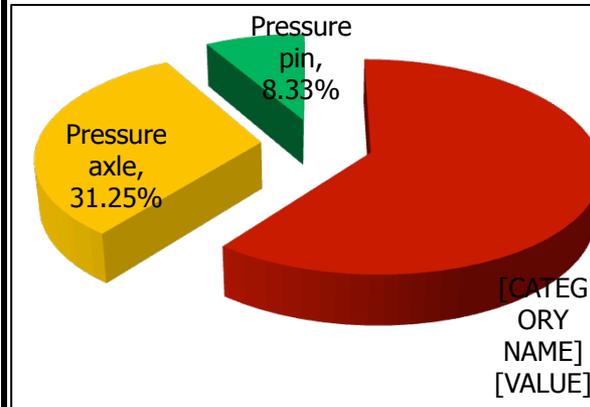
Target Condition
Achieve by: 7/31/14

Reduce End of Line Defect rate by 3% points

Current Condition



HAA average defect rate is 6%, of which 60% were poor endoleak



PDCA Cycles Record

1. Train Team leaders on proper collection of defect rate on HAA pilot line
2. Audit Standard Work adherence for Operators
3. Train Operators using JI on revised SWS

Obstacles Parking Lot

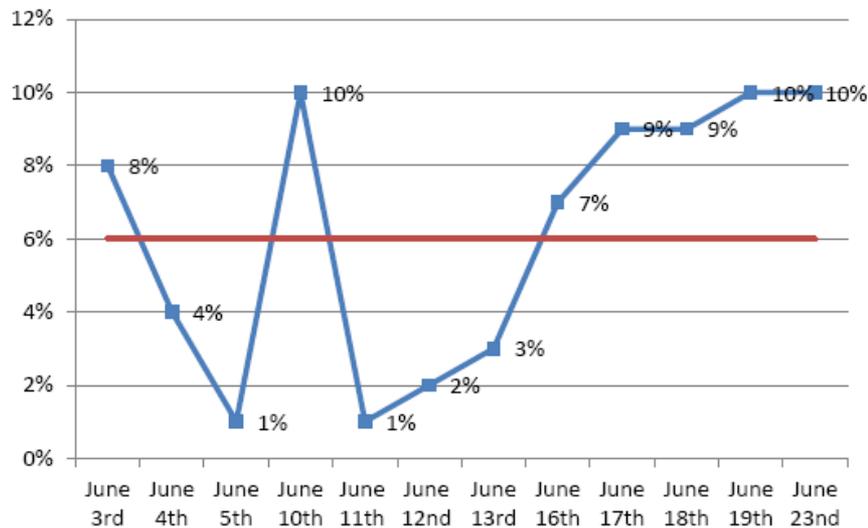
- Afternoon and night shifts have different staffing levels and work assignments
- Rework is shifted to day shift from off shifts

Defects Drop at Magna

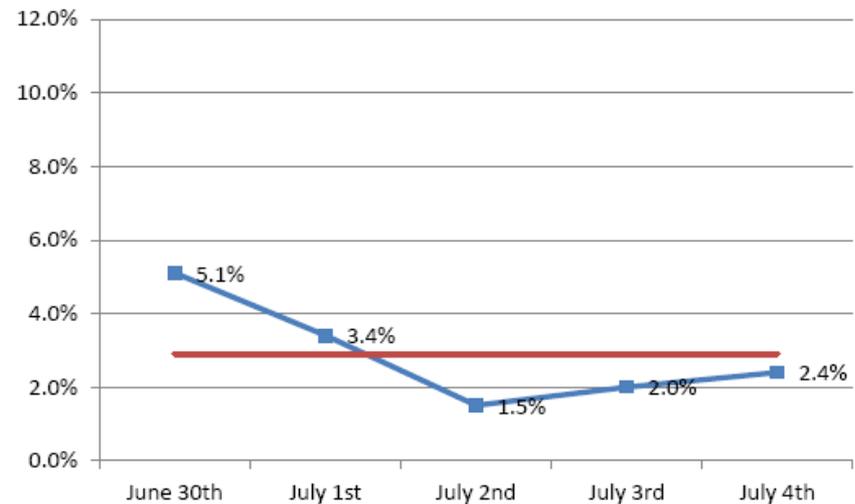
Phase Results - HAA defect rate



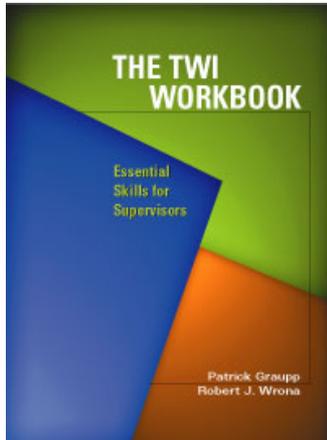
HAA Defective trends –before training



HAA Defective trends –after training

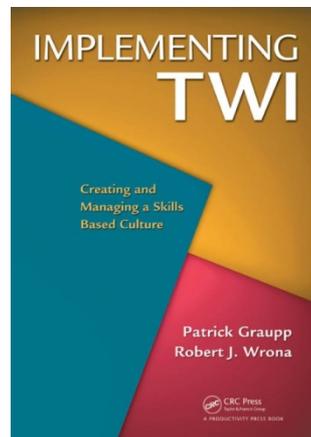


Publications



The TWI Workbook: Essential Skills for Supervisors

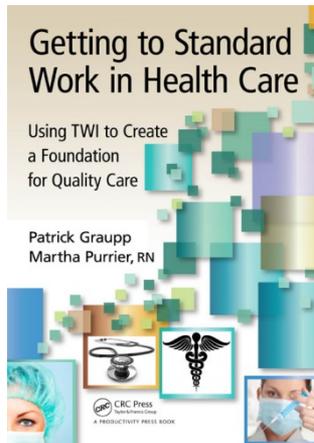
Productivity Press, Patrick Graupp and Robert
J. Wrona
Shingo Prize 2007



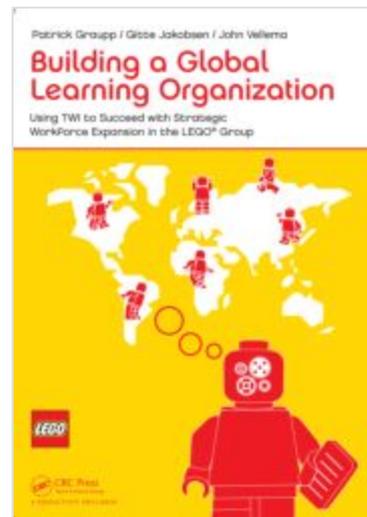
Implementing TWI: Creating and Managing a Skills Based Culture

CRC Press, October 2010
Patrick Graupp and Robert J. Wrona

Publications



Getting to Standard Work in Health Care: Using TWI to Create a Foundation for Quality Care
CRC Press, October 2012
Patrick Graupp and Martha Purrier



Building a Global Learning Organization: Using TWI to Succeed with Strategic Workforce Expansion in the LEGO Group
CRC Press, June 2014
Patrick Graupp, Gitte Jakobsen & John Vellema
Shingo Prize 2015