

Emerging Markets and Industry Trends
Breakout Sessions
March 30, 2006

Lean Production

The Lean Production principles that have led the non-construction industries to higher profitability and lower cost that are easily applicable to the sheet metal and HVAC industry.

Dennis Sowards is now consulting to assist contractors achieve operational excellence. He recently left Kinetics where he was the manager of continuous improvement and communications. While at Kinetics, he led several successful projects that applied lean thinking techniques to construction. One of these, the 5S's was featured in *PM Magazine* in February 2003 and received MCAA's E. Robert Kent Award for Management Innovation.

Prior to coming to Kinetics, Dennis was the quality manager for J. B. Rodgers Mechanical Contractors. He has served as a judge for the Arizona State Quality Awards program. He has published articles in several national publications including *Contractor Magazine* and is the lead author of the SMACNA book – *Creating the High-Performing Contracting Company*. He recently completed a major research project for the New Horizons Foundation called *Lean Production Principles*. This shows how Lean principles used in production can be adapted to construction.

Lean Production

- Lean Works in Construction



SMWIA/SMACNA 2006 Partners in Progress Conference
 March 30, 2006
 By Dennis Sowards,
 Quality Support Services
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Workshop Objectives

- At the end of this session you will be able to:
- ❑ Explain the background, benefits and principles of Lean thinking
 - ❑ Understand the Lean techniques and how the tools work
 - ❑ Learn how Lean thinking has been used in construction
 - ❑ Identify which Lean techniques apply to your operations

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What's in your Company's Future?



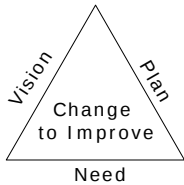
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"Good is the Enemy of Great"

***Nothing Improves Unless
Something Changes!***



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Is there a Need to Change?

- The Economy is going up/down/no where?
- Customers are more price driven
- Competition is increasing
- Why else?

Business is Not Business as Usual!

If you always do what you've always done – you'll always get
what you always got!

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**To do Lean is not
the question . . .**

It is an answer!

Is it your answer?

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Why Lean?

How do we bid a job today?

Estimate the Costs \$\$ + Profit margin = Bid Price

The *Lean* way to bid a job:

Market Price - Profit margin = Cost to do the Job

Is this Possible?

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Why Lean?

What would be the possibilities if you could reduce your Cost of Goods sold (Direct Operating Costs) by 15 %?

Where Would You Cut?

<u>Direct costs</u>		
Labor	60%	
Materials	25%	
Equipment	6%	
Sub Contractors	7%	
Indirect Costs	<u>2%</u>	

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Why Lean?

What has changed Manufacturing, and sharply pushed up productivity, are new concepts. Information and automation are less important than new theories of manufacturing, which are an advance comparable to the arrival of mass production 80 years ago. Indeed, some of these theories, such as Toyota's "lean manufacturing", do away with robots, computers and automation.

Peter Drucker, "The Economist", pg 12, November 3, 2001.

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Why Lean?

Design Performance in Auto Industry		Japan	USA
■ Avg. Engineering Hours (millions)		1.7	3.1
■ Avg. Development Time (months)		46.2	60.4
■ Prototype Lead Time (months)		6.2	12.4
■ Prod. Start to First Sale (months)		1	4

Assembly Plant Performance		Japan	USA
Output:			
Productivity (hrs/vehicle)		16.8	25.1
Quality (defects/100 vehicles)		60.0	82.3
Layout:			
Space (sq.ft./vehicle/year)		5.7	7.8
Repair Area - % of assembly space		4.1	12.9
Inventories (days)		0.2	2.9

Source: *The Machine that Changed the World*
by James P.Womack and Daniel T.Jones

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Why Lean?

Lean Companies have seen improvements:

- Manufacturing Lead Time - less than 1 day
- Delivered Quality – 3 PPM
- Delivery Performance – 99+ %
- Inventory Turns – Greater than 50 turns per year
- Manufacturing space - reduced 35 to 50%
- New product development – less than 6 months

Source: *Lean Transformation* by Bruce A.Henderson and George L.Larco,1999.

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Why Lean?

Air Strut Assembly Process				
	Before	Event 1	Event 2	Event 3
Part Travel Distance (ft):	4300	2900	80	75
# of Tubs locations:	24	13	3	1
Dirt Shields Lead time	18 days	4 days	0.2 days	39 sec.
Work in Progress				
- Dirt Shields	9,078	2,000	100	10
- # of Process Steps	42	33	15	14
# of Forklift moves	16	9	2	1
Inventory Floor				
space (sq.ft.)	288	80	20	0

IndustryWeek, *Best Practices from American's Best Plants*,
Chicago, IL, Oct. 26-28 1998.

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FACT 1:

Lean Works

in

Manufacturing

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Does it Work in Construction?

It Works!!! PPC & Productivity

Crews with PPC	Performance Factor
> 50%	0.85 times budget
< 50%	1.15 times budget

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Does it Work in Construction?

It Works!!! TDIndustries

Studied 50 jobs all over \$300,000 in labor

	average
Jobs not using Last Planner	productivity ratio 0.97
Jobs using the new approach	0.88

Lean construction techniques saved 17% of their Projects' labor budget - a savings of \$1,511,544!

Source: Jim Teston's master thesis at Clemson University: Evaluating the Benefits of Lean Construction on Productivity, August 1998.

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Does it Work in Construction?

It Works!!!



A customer in the Southwest Region

Pilot Project - Using LPS on Two tools (Nov. 1999 - March 2000)

Results - The customer said:
" Durations have been reduced on major tools by 29%"

Actual Usage:
Wet Bench Tool Install – Beat standard by 200 hours!

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Does it Work in Construction?

It Works!!!

LPS on a Housing Project in Peru

(US Dollars in Millions)

	<u>Plan</u>	<u>Actual</u>
Revenue	\$ 9.75	\$ 10.40
Costs	7.70	7.10
Profit	2.05	3.30
Units	420	420
Time	2 years	10 months

Source: LCI 2003

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Does it Work in Construction?

It Works!!!

Contractors doing 5S's report:

- ❑ Freed up a space on both sides of the shop
- ❑ Returned \$5,000 in materials
- ❑ Saved 90 field man-hours on one job by reducing crew time getting ready for job
- ❑ An accounting department got rid of 18,000 duplicate copies of shop invoices freeing up file space and saving administrative time.
- ❑ Cleaned up the main yard - freeing up much needed space.

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Does it Work in Construction?

It Works!!!

Contractors doing Value Stream Analysis

- ▣ Saved \$40,000 in the tool room
- ▣ Gained 9 hours a week in technician tool repair time
- ▣ Reduced non-valued added steps in process by 4%

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FACT 2:

Lean works

in

Construction too!

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What is Lean?

Toyota's goal:

“Give customers what they want, deliver it instantly, with no waste.”

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What is Lean?

Lean Thinking is a concept of Quality Improvement (TQM)

Lean Thinking is a shift in management's focus to differentiate between Value and Waste

Lean Construction applies the principles and techniques of Lean Thinking to develop a better way to deliver the job.

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What is Value?

What the customer is actually willing to PAY for (USEFULNESS/COST)

Includes Functions, Features, Time & Price

Relates to the whole product or service received

Is the opposite of WASTE.

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What is Waste?



Types of Waste

- Defects in products
- Overproduction of goods not needed
- Inventories of goods awaiting processing or consumption
- Unnecessary processing
- Unnecessary movement of people
- Unnecessary transport of goods
- Waiting by employees for process; equipment to finish work or for an upstream activity to complete



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What does waste look like?



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What does waste look like?



Sheet Metal waiting to be processed

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What does waste look like?



Finished Duct waiting for the next process

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What does waste look like?



Finished duct waiting to be shipped

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What does waste look like?



Tools at job site

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What does waste look like?

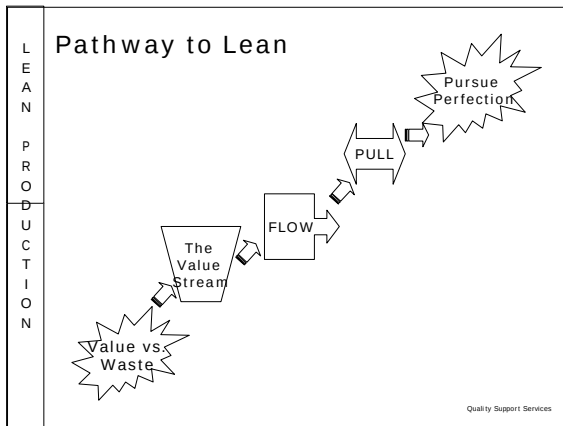
Treasure Hunts

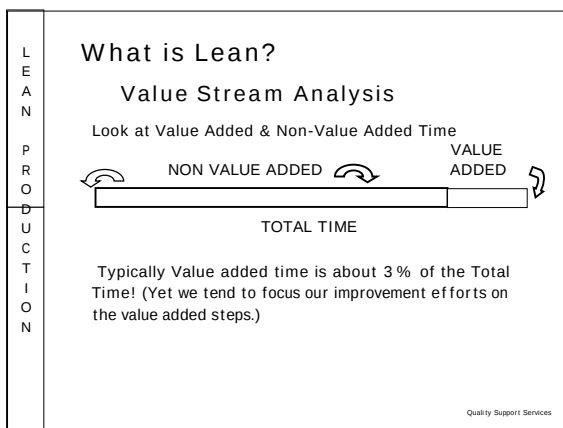
Workers looking for:

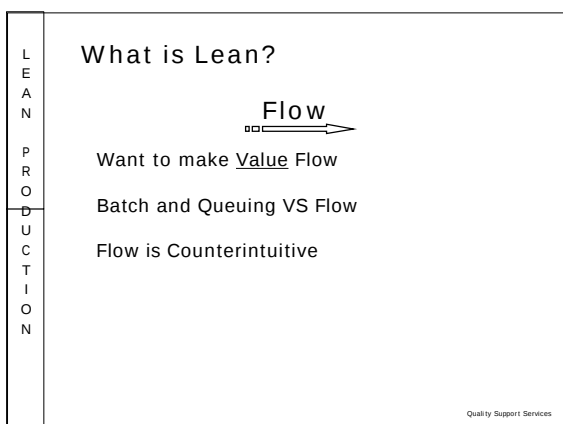
- ☐ Material
- ☐ Tools
- ☐ Equipment
- ☐ Information



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What is Lean?

PULL

Means no one upstream should produce a good or service until the customer downstream asks for it. Products and services are created only on demand.

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Pursue Perfection

Continuous Improvement



What if there were no WASTE at all?

The paradox is that perfection can never be achieved, but must be pursued.

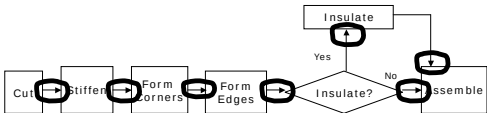
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Lean Principles

Operations vs. Processes



Lean focuses on the space between the steps

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Lean Principles

PDCA & Experimentation

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Basic Lean Tools & Techniques

- ❑ Five S's
- ❑ Last Planner System
- ❑ Kaizen Event
- ❑ Kanban
- ❑ Poka-Yoke
- ❑ Process Mapping / Analysis
- ❑ Rules of Release
- ❑ Spaghetti Chart
- ❑ Visual Control

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Lean Tools & Techniques

The 5 S's

- ❑ Sorting
- ❑ Simplifying
- ❑ Sweeping
- ❑ Standardizing
- ❑ Self-discipline

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The 5 S's

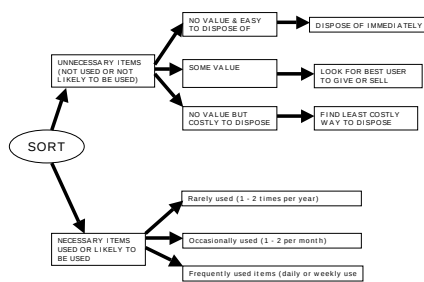
SORTING

Sort out the necessary from the unnecessary, discard the unnecessary. Work in progress, unnecessary tools, unused machinery, parts, and information, defective products, papers and documents



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How to Sort?

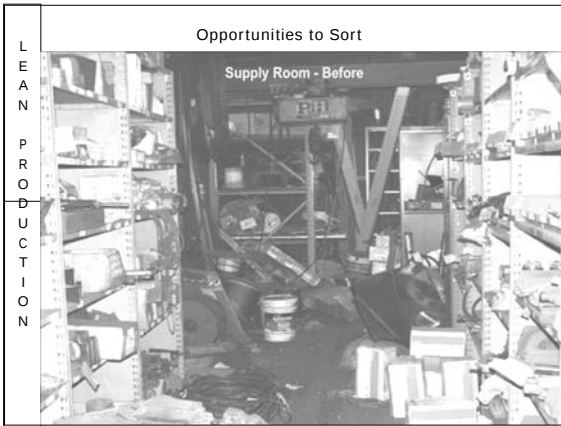


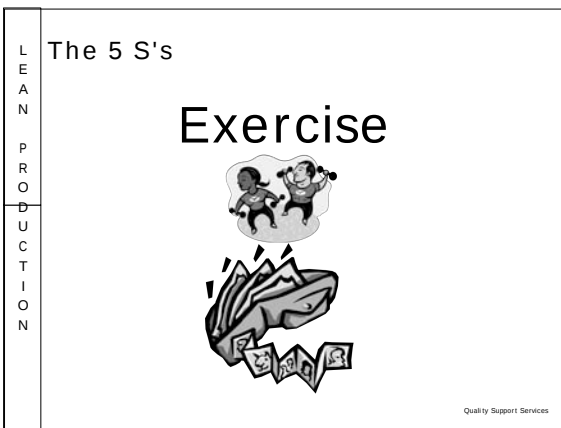
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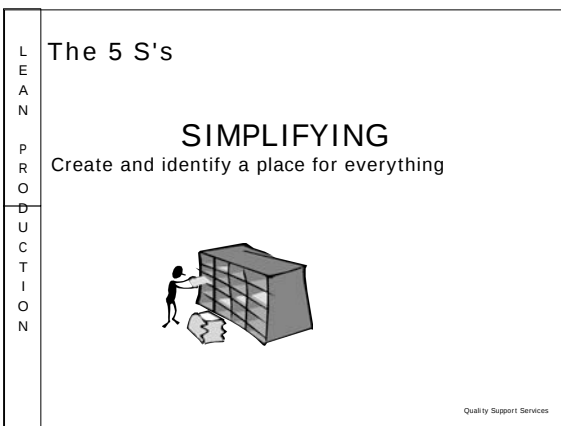
Some areas where Sorting can be done:



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The 5 S's

Simplifying
is creating a designated and marked place for everything according to frequency of use.
The goal is achieved when:

- 1) Items used most often are within easy access thus reducing the time to find something to almost zero.
- 2) Anyone, even someone who doesn't work in the area, could put everything back to where it belongs by the ways things are marked.

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The 5 S's

Simplifying Steps:

1. Review all frequently used items and determine where to put them. Put those used most often closest to the work area, those used less often, further away.
2. Develop a way to label or show where everything goes. Consider:
 - Shadow board
 - Marking the item and the location
 - Color-coding
 - Labels on drawers with list of contents inside
3. Develop ways to daily replace usable items
 - Establish lead times for replacement of daily usage supplies
 - Determine minimum and maximum supply levels and mark them

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The 5 S's

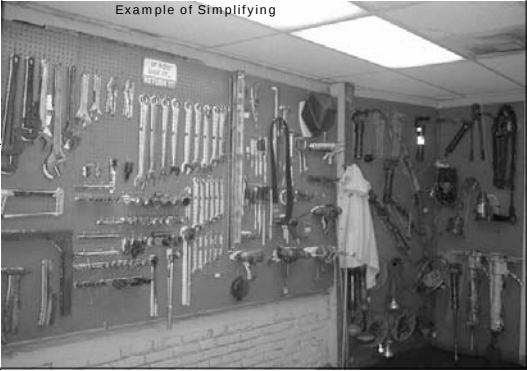


Examples of Simplifying

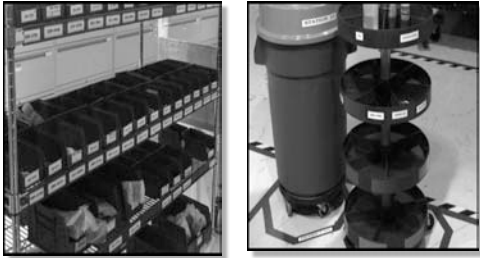


The 5 S's

Example of Simplifying



The 5 S's *Labeling*



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The 5 S's *More examples - a service cart*



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Floors should have visual marking to indicate when specific areas are to be used for a specific purpose.

Defect	Classification
Red	Reduction in the number of defects
	Reduction in the number of defects
	Reduction in the number of defects
	Reduction in the number of defects
Yellow	Reduction in the number of defects
	Reduction in the number of defects
Green	Reduction in the number of defects
Blue	Reduction in the number of defects
White	Reduction in the number of defects
Black	Reduction in the number of defects
Grey	Reduction in the number of defects
Light Grey	Reduction in the number of defects
Dark Grey	Reduction in the number of defects

How could Sammy Soza and the Cubs have benefited from the 5S's?



The 5 S's

SWEEPING

Physical and visual control of the work area



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Sweeping Actions

Sweeping is done when regular sweeping processes occur and areas are clean, safe and neat.

Actions:

- Determine regular schedule for cleaning the yard, work & break areas.
- Orient everyone including new employees with daily 5S's activity responsibilities and expectations.
- Post area cleaning guidelines and schedules.
- Keep tools, machinery and office equipment clean and in good repair.
- Keep yard, work/break areas and trailers clean and orderly.
- Establish a dependable, documented method in place to reduce hazardous waste and minimize chemical products usage.
- Perform safety inspections on a regularly schedule.

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The 5 S's

STANDARDIZING

is creating standard ways to keep the work areas organized, clean and orderly and documenting agreements made during the 5S's. *For standardization to be successful, employees must understand the value of using and maintaining standard methods.*



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How to Standardize?

- Use a 5S's assignment map to help everyone know exactly what they are responsible for doing, when it is to be done, where and how it is to be done to maintain the first 3S's agreements.
- Have clear instructions for people who deliver goods or materials to the site. Clearly mark and post where the material, tools & equipment are to be placed. Educate the supplier on what is expected of him/her.
- Use a standard 5S's format for communication boards/binders so they are similar in appearance.
- Install standard visual controls for the area (signboards, shadow boards, outlining, etc.)
- Develop standard labeling and outlining methods for the area or department so that anyone can see when something is out of place.
- Document all 5S's agreements and implement any changes.

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The 5 S's

SELF-DISCIPLINE

Follow through with the 5Ss agreements



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The 5 S's

How to create self-discipline:

Self-discipline is done when:

- The 5S's rules for Sorting, Simplifying, Sweeping and Standardizing are being followed.
- All changes have been documented.
- A daily 5S's activity checklist is posted and used.
- The 5S's communication board/binder is being updated regularly by personnel listed as responsible.
- The work area is being kept neat and clean.

Self-discipline is easier when anyone can visually see what is right. Use color-codes, striped areas (open and close lines, signs, maps, pictures, posted Checksheets, etc

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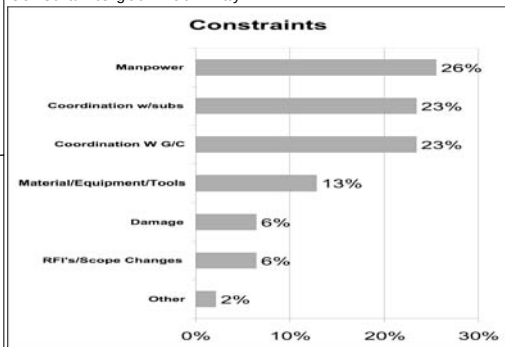




Recent study by FMI -
 81% of contractors feel that they can save 5% or more of their field productivity through better project management practices.
 BUT
 Only 37% said they have a formal plan to do it!
 Only 47% do formal & consistent pre-planning
 44% plan less than 3 days ahead!
 (Those reporting high field productivity said they plan 5 or more days in advance!)

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Constraints get in our way!



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The Last Planner System *

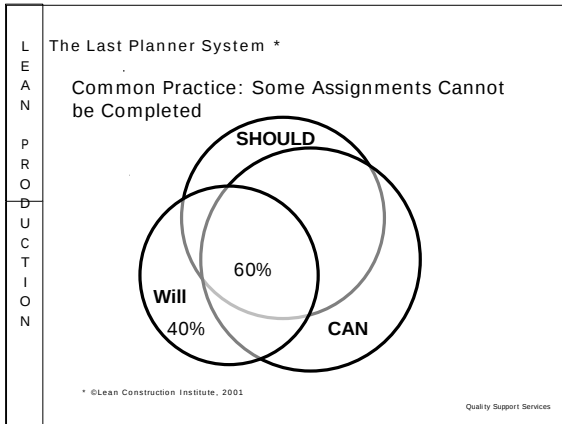
Key Terms

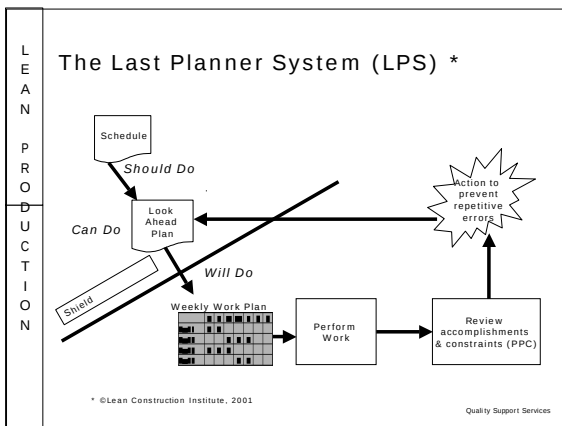
- ❑ Last Planner –the person that gives assignments to production units (construction crews).
- ❑ Commitment – What a person is really willing to do or make happen.
- ❑ Release of work - making work available to the next crew.
- ❑ Dependence - waiting on release of work.
- ❑ Variation - the range of work completed each day or week.



* ©Lean Construction Institute, 2001

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The Last Planner System (LPS) *

Project Management is all about Communications!

How does *LPS* do it?

The Weekly Coordinating Meeting

* ©Lean Construction Institute, 2001

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The Last Planner System * **BOLDT**

It Works!!!
 Fourth Generation, Family Owned Construction Services Company in Business Since 1889.
 - \$450-500 Million Project Completed Annually
 - Largest Constructor in Wisconsin and operate 7 regional offices throughout the Midwest and Southeast.

Using Last Planner on 200 Projects over past 5 years

- Shorter schedules, up to 20% reduction on some projects that really commit to the process
- Improved concrete productivity - up to 30%
- Improved profitability due to shortened schedules(reduced general conditions) and improved productivity – *"a good amount of our work is negotiated GMP so we also see savings going back to the customer in the form of growing contingencies."*

Source : Annual Lean Construction Congress (August 2000/2001)
 * ©Lean Construction Institute, 2001

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The Last Planner System *

		2000 all years	2000 1. Half-year
Highway	Schedule Range	100000	100000
	Schedule meeting schedule	0	0
	Range of release time to schedule	-	0.0
	Released into production per MONTH in hours	-	0.0
Building	Schedule Range	100000	100000
	Schedule meeting schedule	0	0
	Range of release time to schedule	-	10.0
	Released into production per MONTH in hours	-	10.0

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Basic Lean Tools & Techniques

- ❑ Five S's
- ❑ Muda Walk - "Chalk Watch"
- ❑ Last Planner System
- ❑ Kaizen Event
- ❑ Kanban
- ❑ Poka-Yoke
- ❑ Process Mapping / Analysis
- ❑ Rules of Release
- ❑ Spaghetti Chart
- ❑ Visual Control

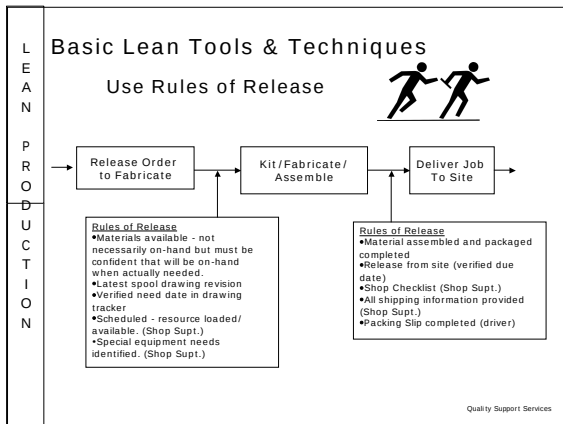
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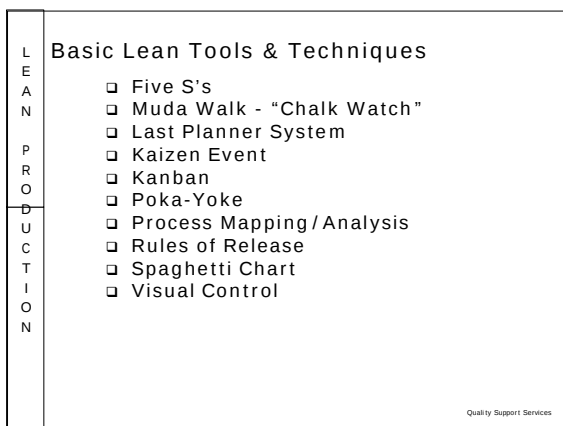
Process Mapping / Analysis

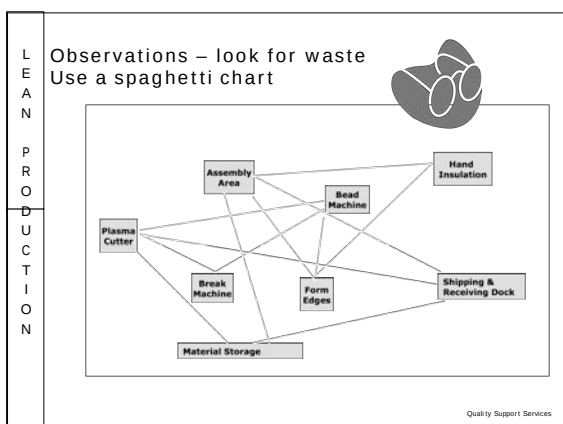
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Lean Tools & Techniques

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Where to start?

Basic Rules to improve Construction

Focus -

1. Keep the Crew Installing
2. Reduce Inventory
3. Reduce Costs

Define the Process - Value Stream

- ❑ Steps - value added/non value added
- ❑ Who Touches
- ❑ Requirements
- ❑ Process Owner

Educate senior management in process thinking to complement strategic & financial thinking

Try something



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Where to start?

Pick a Key Process

- ❑ Define/verify VALUE as seen by the customer
 - > Improve Quality
 - Where do we not meet the customer's requirements?
 - Where do we have defects & rework?
 - DON'T GET IT > DON'T MAKE IT > DON'T

SEND IT

- ❑ Does Value Flow - so one step leads immediately to the next with no batches?
 - > Look at handoffs - Define Rules of Release



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Where to start?

- ❑ Eliminate Treasure Hunts - Organize the Workplace
 - > Use 5S's, Spaghetti Chart & Kanban
- ❑ No Muda - attack waste with a passion like Ohno
 - > Use the 'chalk watch' & Reduce inventory
- ❑ Standardize process step, tools & equipment
- ❑ Eliminate Defects
 - > Do Root Cause Analysis, do Poka Yoke




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Where to start?

Improve Project Management

- ❑ Learn & Apply Last Planner System *
 - ❑ Schedule
 - ❑ Look Ahead Plan
 - ❑ Weekly Work Plan
 - ❑ Measure PPC
 - ❑ Do Constraints Analysis



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Where to start?

Ten Basic Rules for Practicing Kaizen

1. Discard conventional rigid thinking about production.
2. Think of *how to do it*, not why it cannot be done.
3. Do not make excuses. Start by questioning current practices.
4. Do not seek perfection. Do it right away even if for only 50% of the target.
5. Correct mistakes at once.
6. Do not spend money for Kaizen.
7. Wisdom is brought out when faced with hardship.
8. Ask "why?" five times and seek the root cause.
9. Seek the wisdom of ten people rather than the knowledge of one.
10. Remember that opportunities for Kaizen are infinite.

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Barriers to Implementing Lean

- ❑ *No sense of urgency*
- ❑ *Lack of leadership*
- ❑ *Not communicating with employees*
- ❑ *Not creating short-term wins and celebrating*
- ❑ *Seeing this as a Quick Fix*
- ❑ *Not anchoring the Lean changes with the rest of the culture & systems*



The Real Barrier is thinking Lean can't work
in Construction!

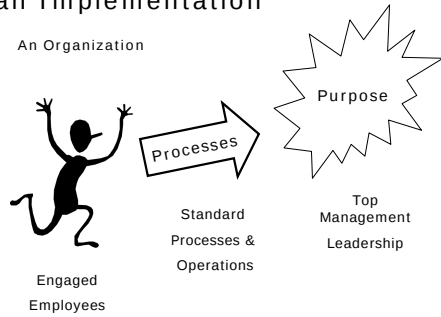
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Lean Implementation

An Organization



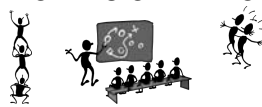
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Change Management

20 - 60 - 20 Rule



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[illegible]

Top 10 Ways to Engage Employees

- Invest in Training & Development
- Participate on Teams
- Have a Best Ideas/Problems to Solve Program
- Empower Employees - Decision Making
- Hold 5S's Competitions
- Safety as a Value
- Let them have Contact with the Customers
- Give Special Assignments
- Celebrate Victories & Milestones (big & small)
- Have an Open Book

Quality Support Services

[illegible]

Thoughts & Tips

Lean came out of trial & hands-on tests - an ever evolving set of techniques & tools to apply the basic principles. Need to involve the workers.

It took 30 + Years for U.S. Manufacturing to see its value

Once a company uses it successfully - they become the leaders in the market & they start sharing it with suppliers

There are Lean diet fads and false starts

Quality Support Services

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Thoughts & Tips

In Construction:

Not (yet)embraced by the some of the leading companies (Good is the enemy of Great!)

Not high tech - it is hands-on

Some tools fit better but others may work if really tested

Some customers are already taking it to their suppliers (Ford & Boldt)

SMACNA's High-Performing Contractors Assessment does not require Lean *but Lean will help one become a HPC*

Quality Support Services

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Toyota's goal:

“Give customers what they want, deliver it instantly, with no waste.”

What do you what to do?

Quality Support Services

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Where to Learn more?

Web sites:

- Lean Construction: www.leanconstruction.com
- Lean Thinking: www.lean.org
- Learning about Lean: www.joelylean.blogspot.com
- Lean Ideas on the Web: www.productivityinc.com
- Poka Yoke - www.Shingoprize.org

Books & Articles:

- The Gold Mine by Freddy Valle and Michael Balle, Lean Enterprise Institute, 2005
- Lean Production Principles, by Dennis Sowards, New Horizons Foundation, 2004
- Sheet Metal Made Lean and Clean, by David Skinner, SMACNA Publication, Dec. 1999
- Lean Thinking by James P. Womack and Daniel T. Jones, Simon & Schuster, New York, NY 1996.
- 5 Pillars of the Visual Workplace by Hiroyuki Hirano, Productivity, Inc. Portland, OR, (1-800-394-6868) www.productivityinc.com
- Gemba Kaizen, by Masaaki Imai, McGraw-Hill, New York, NY, 1997
- All I need to Know about Manufacturing I Learned in Joe's Garage by William B. Miller and Vicki L. Schenk, Bayrock Press, 2000. (208-376-2266)
- Lean Transformation by Bruce A. Henderson & Jorge L. Larco, The Oaklea Press, Richmond, VA, 1999. www.OakleaPres@aol.com
- "5S's that would make any CEO Happy," By Dennis Sowards. Contractor Magazine, May 2004.
- "A Place for Everything and Everything In Its Place," by Katie Rotella, PM Magazine, February 2003, page 48.

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