Adopting “Lean Construction” Principles

THE TOYOTA WAY

Continuous Quality Improvement (CQI)
Go & see for Yourself
Team Work
Challenge
Respect

TOYOTA PRODUCTION SYSTEM (TPS)

SEMINAR: “ADOPTING LEAN CONSTRUCTION PRINCIPLES”

THE 4-P’s

Corporate Level
Eric
Juan
Project Level
Chris
Kim
Alix
Team Level
Mike
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** Adopting “Lean Construction” Principles **

**THE LAUSD SEMINAR SPEAKERS ARE EXPRESSING THEIR PERSONAL EXPERIENCES AND VIEWS AND NOT THOSE OF THEIR EMPLOYER-LAUSD**

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**THE 4-P’s**

**THE TOYOTA WAY**

**TOYOTA PRODUCTION SYSTEM (TPS)**

**SEMINAR: “ADOPTING LEAN CONSTRUCTION PRINCIPLES”**

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**Eric Ahlstrom_Amgen, Lean Leader & Senior Manager Engineering Projects at Amgen:**
Mr. Ahlstrom has delivered projects throughout the Americas and Asia. He currently leads implementation of Lean Construction with several projects currently underway. Mr. Ahlstrom has a degree in Industrial Engineering and an MBA.

---

**Juan Penaherrera_LAUSD Resident Construction Engineer:**
Juan is a Certified Construction Manager (CCM) with 22 years of experience, while at Allied Signal Juan was on the Team that achieved ISO-9001 and QS-9000 Certification for the Allied Signal Co.
Adopting “Lean Construction” Principles

THE LAUSD SEMINAR SPEAKERS ARE EXPRESSING THEIR PERSONNEL EXPERIENCES AND VIEWS AND NOT THOSE OF THEIR EMPLOYER - LAUSD

THE 4-P’s

THE TOYOTA WAY

TOYOTA PRODUCTION SYSTEM (TPS)

SEMINAR: “ADOPTING LEAN CONSTRUCTION PRINCIPLES”

Chris Maslyk _Director of Planning & Lean Initiatives, Bernards:

Kim Altamirano_Project Executive S.J. Amoroso Construction Co, Inc:

Alix Walsh O'Brien, AIA_LAUSD, Facilities Asset Development Director:

Ms. O'Brien oversees more than two dozen professionals in the planning, design, and development of the District’s school construction and modernization projects, which are valued in excess of one and a half billion dollars. In her role, Ms. O'Brien also develops and administers pre-construction policies and procedures, and establishes department metrics, reporting protocols, and strategic long-term departmental plans and objectives. Ms. O'Brien is a registered architect with more than 35 years of experience.
Mike Vega PE, CPE_LAUSD, Senior Resident Construction Engineer: Mike has spent 1/3 of his career at Allied Signal Manufacturing Co. as a Registered Professional Manufacturing Engineer and 1/3 as a Plant Engineer and 1/3 in Project Controls. From 1988 to 1997 Mike was A Lean Champion in the Aerospace and Automotive Manufacturing Sector.

This Seminar can best be categorized as a “Sampler Plate” of Quality processes and tools available in the USA from 1925 to the present. Each of the presenters shares with you “Lean” from their own experience base, and since the audience comes from all sectors within the AEPC-CM there is something for everybody.
## A Survey of Registered Attendees

### Question 1

<table>
<thead>
<tr>
<th>&quot;GC&quot;, SUB-CONTRACTOR A&amp;E, CM, STUDENT OR OWNER?</th>
</tr>
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<tbody>
<tr>
<td><strong>CATAGORY</strong></td>
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<tr>
<td>GC</td>
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<td>SUB-CONTR</td>
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<td>A&amp;E</td>
</tr>
<tr>
<td>CM</td>
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<tr>
<td>STUDENT</td>
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<tr>
<td>OWNER</td>
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### Question 2

<table>
<thead>
<tr>
<th>HAS YOUR COMPANY JOINED (LCI) OR THE (ACG) LEAN FORUM?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CATAGORY</strong></td>
</tr>
<tr>
<td>LCI</td>
</tr>
<tr>
<td>AGC FORUM</td>
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### Question 3

<table>
<thead>
<tr>
<th>HAVE YOU, OR ANYONE IN YOUR COMPANY ATTENDED A &quot;PULL PLANNING&quot; SESSION</th>
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<tbody>
<tr>
<td><strong>CATAGORY</strong></td>
</tr>
<tr>
<td>YES</td>
</tr>
<tr>
<td>NO</td>
</tr>
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</table>
Introduction

The History of Quality & “Lean”

Dispelling the Myth

How does Continuous Quality Improvement (CQI) fit in to Construction?

5-Case Studies completed for Construction Projects (within “Manufacturing & K-12”)

Michael Vega PE, CPE:
LAUSD Senior Resident Construction Engineer
The History of Quality & “Lean”

(from Walter Shewhart, 1925 to 2015)
THE HISTORY OF “QUALITY”

1950-JUSE establishes the Deming Prize.

1965-Toyota wins Deming Prize

1986-Motorola Invents Six-Sigma

1982- XEROX deploys BENCHMARKING


MASS PRODUCTION (TPS) BORN Just-in-Time MANUFACTURING LEAN MANUFACTURING

1992- “LEAN MANUFACTURING” term coined at NUMMI in FREMONT

1984 ISO-9001 FIRST ISSUED

In 1950 Toyota “Benchmarks” FORD’s production & visits

1925 Walter Shewhart

SPC FORD-MASS PRODUCTION PIGGLY WIGGLY JUST-IN-TIME
THE RECENT HISTORY OF THE DESIGN & CONSTRUCTION "QUALITY"

1986-Motorola Invents Six-Sigma

1988-1995 QUALITY IN PLANT ENGINEERING & MAINTENANCE DEPLOYED & DOCUMENTED

1992-LAURI KOSKELA ISSUES HIS GROUND BREAKING REPORT #72

1997 – PRESENT LEAN CONSTRUCTION INSTITUTE (LCI)

1982- XEROX deploys BENCHMARKING

1997-Lean Construction Institute founded

1991- 1st “Turnkey” project using Six-sigma

1993- XEROX Plant Build Benchmark

2014-AGC starts their Lean Construction Certificate

1988- 1995 QUALITY IN PLANT ENGINEERING & MAINTENANCE DEPLOYED & DOCUMENTED

CIFE CENTER FOR INTEGRATED FACILITY ENGINEERING
APPLICATION OF THE NEW PRODUCTION PHILOSOPHY TO CONSTRUCTION
THE NEAR TERM HISTORY

1988-1995
QUALITY IN PLANT ENGINEERING & MAINTENANCE DEPLOYED & DOCUMENTED

1992-LAURI KOSKELA ISSUES HIS GROUND BREAKING REPORT #72

The Toyota Production System (TPS)

1997 – PRESENT
LEAN CONSTRUCTION INSTITUTE (LCI)

Just-in-Time MANUFACTURING

LEAN MANUFACTURING


1994 - Ballard baselines “Last Planner”

The Golden Era of Quality” in Facility Mgmt

1998 - Howell “Last Planner”

2014 - AGC starts their Lean Construction Certificate

½ complete, 20 minutes remain
WHAT IS SIX-SIGMA?

IRS phone advice (2.3 sigma) 300,000 bad advice in a million phone calls

90%

99%

99.9%

AUTOMOTIVE HARDWARE 4.8 (sigma)

AIRCRAFT HARDWARE 5.0 (sigma)

SPACE HARDWARE 5.8 (sigma)

Domestic airline flight fatality rate - 1 per two million flights

MANUFACTURING IS “PRECISION”

VS

CONSTRUCTION IS “ACCURACY”
HOW DOES CONTINUOUS QUALITY IMPROVEMENT (CQI) FIT INTO CONSTRUCTION?
1st I need to dispel a myth

Manufacturing is "precision"  
Construction is "accuracy"

Car Door  
Bridge Girder

Laser alignment  
Drift pin alignment

The tolerances are different but the processes are the same!
WASTE IS OUR ENEMY!

1. Defects
2. Overproduction
3. Inventory
4. Unnecessary Transportation
5. Waiting
6. Unnecessary Motions
7. Over Processing

---

Toyota: "7 kinds of waste must be eliminated!"

1. Defects
2. Overproduction & early production
3. Inventory
4. Unnecessary transportation
5. Waiting
6. Unnecessary motions/ actions
7. Over-processing
Deming Cycle (Plan-Do-Check-Action)

1. Clarify the Problem
2. Breakdown the Problem
3. Target Setting
4. Root Cause Analysis
5. Develop Countermeasures
6. See Countermeasures Through
7. Monitor both Results and Processes
8. Standardize Successful Processes
Deming Cycle
(Plan-Do-Check-Action)

WHAT IS CONTINUOUS QUALITY IMPROVEMENT (CQI)? ITS SHORT FUSED SMALL CONTINUOUS IMPROVEMENTS

TIME

QUALITY IMPROVEMENT
HOW DO YOU EVALUATE WHAT TOOLS ARE AVAILABLE TO BECOME LEAN?
Health Care shares the SME “Lean” Certificate, soon “Six-Sigma” will enter the vocabulary of OSHPD Constructors.

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SME-Lean Bodies of Knowledge

MODULE 1 - Cultural Enablers
MODULE 2 - Continuous Process Improvement
MODULE 3 - Consistent Lean Enterprise Culture
MODULE 4 – Business Results

4.1. Principles Of Business
4.2 Measurement Systems
4.3. Key Lean Related Measures
AGC’s Lean Construction Education Program
Don’t get lost in the construction process. Take the direct route.

GO LEARN “LAST PLANNER”
THE Malcolm Baldrige National Quality Award
Winners creates “BD “Opportunities

The 96 Baldrige winners must share their “Best Practices” with whom ever calls

Take the opportunity to Benchmark and make a BD call!

Principle #14 Continuous Quality Improvement (CQI) is the home for Benchmarking
2-Case Studies completed for Construction Projects within a “Manufacturing Company”

3-Case Studies completed for Construction Projects within K-12

Five Case Studies where the Continuous Quality Improvement (CQI) tools & techniques were / are utilized
Five Case Studies where the Continuous Quality Improvement (CQI) Improvement tools & techniques were / are utilized:

1. Case Study #1-AE_CM XEROX nine month Plant Build Benchmarking Effort
2. Case Study #2-AE_CM.CG Turnkey Project utilizing JIT & Six-Sigma (All)
3. Case Study #3-GC Seamless, Continuous Flow Pay Application process (Office)
4. Case Study #4-GC Anchor Bolt Setting (Field)
5. Case Study #5-AE_CM.CG using QFD to fill a 4 month time void with the Site Utilities
WHERE DOES CASE STUDY #1 BENCHMARKING & SIX-SIGMA FIT IN!

IT WAS ALWAYS EASIER TO SELL A NEW IDEA OR PROCESS WHEN I SAID “HAMILTON STANDARD” DOES IT THIS WAY AND THEY BEAT US AT BID TIME”

Benchmarking will pay you back with Dividends
CASE STUDY #1
XEROX PLANT BUILD BENCHMARKING REPORT

XEROX PLANT BUILD BENCHMARKING REPORT
A SUMMARY OF XEROX NINE MONTH STUDY OF NEW PLANT CONSTRUCTION BEST PRACTICES

FINAL

Xerox would like to thank the following companies for participating in this benchmark effort:

- INTEL CORPORATION
- SHIN ETSU AMERICA, INC.
- TEXAS INSTRUMENTS
- SPRINT COMPANY
- WEYERHAEUSER PAPER COMPANY

Michael Vega PE
Lead Analyst

- XEROX NINE MONTH “PLANT BUILD BENCHMARKING STUDY LOOKING FOR “BEST PRACTICES” IN “PLANT BUILD”
  - IN 1993 MIKE WAS HIRED BY XEROX TO BENCHMARK – NEW PLANT CONSTRUCTION BEST PRACTICES.
  - BENCHMARKING CONCLUSIONS WERE PEER REVIEWED AT XEROX AND MADE A COMPANY STANDARD
CASE STUDY #2
“TURNKEY” PROJECT
NOW CALLED DESIGN & BUILD
JIT & SIGMA HAS & IS BEING USED IN MANUFACTURING “FACILITY CONSTRUCTION”

**THE CASE STUDY**

BENCHMARKING & SIX-SIGMA
FOR
ARCHITECT-ENGINEERING DESIGN SERVICES:
A CASE STUDY

by

Craig B. Smith
Facilities Systems Engineering Corporation

and

Michael F. Vega
AiResearch Los Angeles Division
Allied-Signal Aerospace Company

for Submission to
Motorola University
Six-Sigma Research Institute

November 1991

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**TEST CELLS PROJECT - 1991:**
- **DESIGN & BUILD COST $9.9 MILLION THEN ($39.5 M TODAY)**
- **TEST & ENERGIES EQUIPMENT $20.0 MILLION**
- **SCHEDULE-12 MONTHS CRITERIA & EQUIP’T, 24 MONTHS**

---

**This project attained 3.4 sigma**

---

**Turnkey (Design & Build) relationship**
JIT & SIGMA HAS & IS BEING USED IN MANUFACTURING “FACILITY CONSTRUCTION”
Candidate Design Measurements

• Measuring, using the Construction Specs:
  • 250 words/pages 1332 pages = 330,000

• Measuring, using the Drawings:
  • 1,200 symbols/valves, etc. X 80 drawings = 96,000
  • 250 word/information, etc. X 80 drawings = 20,000

STOP - I KNOW WHAT YOU ARE THINKING, COUNTING THE NUMBER OF WORDS?

• Measuring, using the Building Code:
  • Building Code = 800 pages
  • Electrical/Mechanical Code = 1,200 pages
  • Local Building Code = 800 pages
  • Total 2,800 pages x 250 words - = 700,000 words

• Compared to number of words on back check sheet
The SIX SIGMA Performance Measure

Vega-Turnkey Project 3.4 (sigma) or 98.2%

MANUFACTURING IS "PRECISION" vs CONSTRUCTION IS "ACCURACY"
**Budget**

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<tr>
<td>Total E&amp;O</td>
<td><em>270,000</em></td>
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<tr>
<td>E&amp;O per ($m)</td>
<td>27,245</td>
</tr>
<tr>
<td>E&amp;O (%)</td>
<td>2.72</td>
</tr>
<tr>
<td>YIELD (%)</td>
<td>97.28</td>
</tr>
<tr>
<td>PROCESS SIGMA</td>
<td>3.42</td>
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</table>
Immediately after completion a Customer Satisfaction Report Card was issued.
CASE STUDY #3
PINNER’s SEAMLESS –CONTINUOUS FLOW PAY APPLICATION
(FROM SOV TO P6 TO PAY APPLICATION)
Pinner Construction Seamless Continuous flow Pay Application (only 1 of 3 that I know tie SOV to P6 to the Billing)
What Sigma did Pinner hit?

Pinner billing accuracy 4 sigma or better than (99.6%)

Sigma Calculation:
$300,000 in $63,000,000
$300,000 / 63 = $4,762.00 E/O
per Million dollars of work

MANUFACTURING VS CONSTRUCTION
IS “ACCURACY”
NOW I’LL TURN THE PODIUM OVER TO JUAN PENAHERERA
ADOPTING LEAN CONSTRUCTION PRINCIPLES - PART 2

Juan Penaherrera: LAUSD Resident Construction Engineer
LEAN CHAMPION
INITIAL TASKS

• GATHER INFORMATION

• IDENTIFY, ELIMINATE/REDUCE WASTE

• STANDARDIZE PROCESSES (create a Quality Manual)
LEAN CHAMPION
INITIAL TASKS

• GATHER INFORMATION ABOUT YOUR PROCESSES
LEAN CHAMPION INITIAL TASKS

• IDENTIFY WASTE

1. Defects
2. Overproduction
3. Inventory
4. Unnecessary Transportation
5. Waiting
6. Unnecessary Motions
7. Over Processing
LEAN CHAMPION
INITIAL TASKS

• STANDARDIZE PROCESSES (create a Quality Manual)
8 MANAGEMENT PRINCIPLES

1. CUSTOMER FOCUS
2. LEADERSHIP
3. INVOLVEMENT OF PEOPLE
4. PROCESS APPROACH
5. SYSTEM APPROACH
6. CONTINUAL IMPROVEMENT
7. FACTUAL APPROACH
8. MUTUAL BENEFICIAL SUPPLIER RELATIONSHIPS
ISO-9001 “Type” Qualification Management System (QMS) is suitable for all kinds of interested Companies.
BE PROACTIVE, DEPLOY ISO-9001 BEFORE YOUR CUSTOMERS DEMAND IT!

US ARMY CORPS OF ENGINEERS

Quality in Construction Works

An Introduction to QA/QC Concept and Quality Management System Based on ISO 9001:2008
Example of an ISO -9001 Compliant Quality Manual

122 S. Wilson Avenue
Fremont, Ohio 43420

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1</td>
<td>4.1 MANAGEMENT RESPONSIBILITY</td>
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<tr>
<td>2</td>
<td>4.2 QUALITY SYSTEM</td>
</tr>
<tr>
<td>3</td>
<td>4.3 CONTRACT REVIEW</td>
</tr>
<tr>
<td>4</td>
<td>4.4 DESIGN CONTROL</td>
</tr>
<tr>
<td>5</td>
<td>4.5 DOCUMENT &amp; DATA CONTROL</td>
</tr>
<tr>
<td>6</td>
<td>4.6 PURCHASING</td>
</tr>
<tr>
<td>7</td>
<td>4.7 CONTROL of CUSTOMER-SUPPLIED PRODUCT</td>
</tr>
<tr>
<td>8</td>
<td>4.8 PRODUCT IDENTIFICATION &amp; TRACEABILITY</td>
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<td>9</td>
<td>4.9 PROCESS CONTROL</td>
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<tr>
<td>10</td>
<td>4.10 INSPECTION &amp; TESTING</td>
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<td>11</td>
<td>4.11 CONTROL of INSPECTION, MEASURING &amp; TEST EQUIPMENT</td>
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<td>12</td>
<td>4.12 INSPECTION &amp; TEST STATUS</td>
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<td>13</td>
<td>4.13 CONTROL of NONCONFORMING PRODUCT</td>
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<td>14</td>
<td>4.14 CORRECTIVE &amp; PREVENTIVE ACTION</td>
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<td>15</td>
<td>4.15 HANDLING, STORAGE, PACKAGING, PRESERVATION &amp; DELIVERY</td>
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<td>16</td>
<td>4.16 CONTROL of QUALITY RECORDS</td>
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<td>4.17 INTERNAL QUALITY AUDITS</td>
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<td>18</td>
<td>4.18 TRAINING</td>
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<tr>
<td>19</td>
<td>4.19 SERVICING</td>
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<tr>
<td>20</td>
<td>4.20 STATISTICAL TECHNIQUES</td>
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</table>
LEAN CHAMPION
ON-GOING TASKS

• GATHER INFORMATION
• IDENTIFY WASTE
• STANDARDIZE PROCESSES (create a Quality Manual – living document)
• TRAINING IN PROCESSES & PROBLEM SOLVING
• ANALYZE AND IMPROVE PERFORMANCE
• FACILITATE PULL PLANNING SESSIONS
ANALYZE AND IMPROVE PERFORMANCE

COLUMN BASE PLATE

2-1/4 BASE PL HOLE
1-3/4” AB
UCL 3/16”
LCL - 3/16”
ELIMINATES WASTE
REMOVE VARIABILITY

RUN CHART

ERROR PROOFING

Example c Chart: 3 signal limits. No Standards Given

USE SIX-SIGMA TO CONTROL “VARIATION”
CASE STUDY #4
AMOROSO ZEROED OUT THE VARIATION IN SETTING THE 2,600 ANCHOR BOLTS!

THE STEEL WENT UP IN RECORD TIME
Amoroso used 8 of 14 (TPS) Principles to successfully set the Anchor Bolts.
What Sigma did Amoroso hit?

Amoroso Construction Co. Anchor Bolt Setting 4.52 Sigma (or better than 99.9%)

CONSTRUCTION IS "ACCURACY"
THE RESULTS
MAKE READY THE
SITE & SHORING

Feb 20, 2015
March 12, 2015
April 3, 2015
Looking North April 26, 2015

POURING THE 6’X6’ PEDESTALS WITH 20 ANCHOR BOLTS

June 17, 2015

Looking South May 4, 2015
ERECTING THE STRUCTURAL STEEL & ENCLOSURE

August 4, 2015

August 26, 2015

Sept 25, 2015

3-MONTHS TO DO (C bridge)=1, 500 tone

Start 5/28/15
Complete 8/31/15

Structural Steel
FACILITATE PULL PLANNING SESSIONS

LEAN CONSTRUCTION: CURRENT GC PHILOSOPHY USE “PULL PLANNING”
A project that utilized QFD & Pull Planning

“Respect for People”
a Owners point of view

Alix Walsh O'Brien, AIA, LAUSD, Facilities Asset Development Director
We used PULL PLANNING on my project, Chris will discuss PULL PLANNING via a mock exercise, just after the Break.

Commitment, Cooperation & Passing the Baton

Continuous Quality Improvement (CQI)

Problem Solving

Continuous Improvement

The Toyota Way

Go & see for Yourself

Team Work

Respect for People

Challenge

Respect

Quality Function Deployment (QFD)
planning, weekly work planning, Percentage of Promises Completed on time or Percent of Planned Completed “PPC
CASE STUDY #5

Quality Function Deployment (QFD) used to convince Contractor to fill the 4 month time void with site utilities.
We used PULL PLANNING on my project, Chris will discuss PULL PLANNING via a mock exercise, just after the Break.
QFD & THE HOUSE OF QUALITY
(another TPS quality tool that was used)

QFD was used on my project to decide on moving up site utility installation to period when steel sub went under
What’s going on around us!

CSU
Now to turn the podium over to Eric Ahlstrom - Amgen, Senior Manager/Lean Leader
Driving the future of Lean/IPD – $50B Annual Capital Spend
Lean Construction Study 2015

Prepared by:
Dodge Data & Analytics
September 2015
Project Teams – Integration & Engagement

Integration of Project Team Members

- 4-Key stakeholders worked cohesively together to optimize the whole, to create workflow, and to deliver value to the end user
  - Typical: 9%
  - Best Performing: 59%

- 3-Key stakeholders often acted in the interest of the project to optimize the whole
  - Typical: 34%
  - Best Performing: 44%

- 2-Key stakeholders sometimes acted in the interest of the project to optimize the whole
  - Typical: 6%
  - Best Performing: 38%

- 1-Key stakeholders acted primarily/solely for their own benefit on project deliverables
  - Typical: 9%
  - Best Performing: 0%

Engagement of Key Stakeholders

- Pre-business case
  - Typical: 6%
  - Best Performing: 9%

- Business case validation (pre-design)
  - Typical: 6%
  - Best Performing: 19%

- During conceptualization (0-15% design)
  - Typical: 10%
  - Best Performing: 16%

- During schematic design (15-30%)
  - Typical: 9%
  - Best Performing: 16%

- During design development (30-60%)
  - Typical: 9%
  - Best Performing: 31%

- During construction documents (60-90%)
  - Typical: 0%
  - Best Performing: 19%

- End of construction documents or later (100% CD)
  - Typical: 6%
  - Best Performing: 6%
Project Teams – Chemistry & Decision Making

Perception of Team Chemistry

- **4-Excellent**: Typical 9%, Best Performing 72%
- **3-Good**: Typical 25%, Best Performing 59%
- **2-Fair**: Typical 31%, Best Performing 3%
- **1-Poor**: Typical 0%, Best Performing 0%

Timeliness of Decision Making Related to Issue Resolution

- **4-Always on time**: Typical 9%, Best Performing 34%
- **3-Frequently on time**: Typical 41%, Best Performing 59%
- **2-Occasionally on time**: Typical 6%, Best Performing 50%
- **1-Never on time**: Typical 0%, Best Performing 0%

Legend: Typical, Best Performing
### Project Approach & Methods

#### Construction Management at Risk
- Typical: 25%
- Best Performing: 44%

#### Design-bid-build
- Typical: 16%
- Best Performing: 34%

#### Design-build based on initial design
- Typical: 9%
- Best Performing: 9%

#### Design-build/EPC/Turnkey based on program/requirements
- Typical: 6%
- Best Performing: 3%

#### Integrated project delivery (multi-party agreement)
- Typical: 0%
- Best Performing: 34%

#### Other
- Typical: 9%
- Best Performing: 9%

### Project Management and Operating Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Typical (all)</th>
<th>Best Performing (all)</th>
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</thead>
<tbody>
<tr>
<td>BIM 3D coordination</td>
<td>44%</td>
<td>66%</td>
</tr>
<tr>
<td>Value Engineering</td>
<td>66%</td>
<td>59%</td>
</tr>
<tr>
<td>CPM Scheduling</td>
<td>69%</td>
<td>56%</td>
</tr>
<tr>
<td>Co-location Big Room</td>
<td>93%</td>
<td>93%</td>
</tr>
<tr>
<td>Design to Budget</td>
<td>38%</td>
<td>53%</td>
</tr>
<tr>
<td>Conceptual/Continuous Estimating</td>
<td>22%</td>
<td>53%</td>
</tr>
<tr>
<td>Prefab/Modularization</td>
<td>25%</td>
<td>50%</td>
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<tr>
<td>Last Planner System</td>
<td>13%</td>
<td>47%</td>
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<tr>
<td>Visual Management</td>
<td>13%</td>
<td>47%</td>
</tr>
<tr>
<td>Target Value Design</td>
<td>3%</td>
<td>47%</td>
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<tr>
<td>Full-team On-boarding</td>
<td>16%</td>
<td>44%</td>
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<tr>
<td>Root cause analysis</td>
<td>16%</td>
<td>41%</td>
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<tr>
<td>Electronic information exchange (paperless project)</td>
<td>38%</td>
<td>38%</td>
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<tr>
<td>BIM Design authoring</td>
<td>13%</td>
<td>38%</td>
</tr>
<tr>
<td>BIM Execution Plan</td>
<td>8%</td>
<td>38%</td>
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<tr>
<td>A3 Thinking</td>
<td>38%</td>
<td>38%</td>
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<tr>
<td>PDCA</td>
<td>28%</td>
<td>28%</td>
</tr>
<tr>
<td>5 Whys</td>
<td>3%</td>
<td>28%</td>
</tr>
<tr>
<td>OAC Report-out Mtgs</td>
<td>34%</td>
<td>25%</td>
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<tr>
<td>BIM model based estimating</td>
<td>13%</td>
<td>22%</td>
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<td>10%</td>
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<tr>
<td>BIM 4D &amp; site logistic planning</td>
<td>16%</td>
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<td>9%</td>
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<td>6%</td>
<td>3%</td>
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</table>

**Note:** The data is based on a survey conducted by Dodge Data & Analytics.
Let's take a 10 minute Break, then Chris will facilitate his mock “Pull Planning” exercise.
The Last Planner® (sometimes referred to as the Last Planner® System) is a production planning system designed to produce predictable work flow and rapid learning in programming, design, construction and commissioning of projects. Last Planner® was developed by Glenn Ballard and Greg Howell.
What Is The Last Planner® System?

A Planning Method Based on These Key Concepts:

- The People Who Are Doing the Work Will Plan the Work
- Tracking and Measuring the Performance of the Work
- Improving the Performance of the Work
Pull Plan

Weekly Work Plan

Status and Review

Promises
Traditional Pull Plan

Foremen Hand Write Sticky Notes

Post Sticky Notes and Arrange Sequencing

PE Inputs Plan Into Excel for Look Ahead

Excel Plan is Updated For Weekly Meetings
# Traditional Weekly Work Plan

## Sunrise Torrance
25335 Hawthorne Blvd, Torrance CA

### Level One Completion Early Units

<table>
<thead>
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</table>

- Painting prime, 1st, and 2nd
- Public Bathroom Tile
- Doors
- Electrical Rough Finish
- All Cabinets and pics Wood Trim
- Bathroom Fixtures
- Wall Coverings
- Finishes Electrical
- Finishes Plumbing
- Finishes HVAC
- Finishes Fire sprinkler
- Flooring
- Install Appliances
- Sunrise Moves in Furniture

### Level One Completion Interior

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</table>

- HVAC shafts walls and ceilings/inst
- Drywall Ceilings
- Taping
- Painting prime, and Post
- Doors
- Electrical Rough Finish
- All Cabinets and pics
- Flooring
- Finishes Electrical
- Finishes Plumbing
- Finishes HVAC
- Finishes Fire sprinkler
Last Planner® System with Cloud Based Tools

- Web Based Application
- Real time
- Multiple Users
- Access from Any Device
Last Planner® System
Last Planner System

Weekly Work Planning

Plan the Next Two or Three Weeks

Foremen Commit Labor and Material
**Last Planner System**

**P** Promise Period

→ **Lock the Commitments**

→ **Foremen leave the meeting with the look ahead in Hand**
Last Planner® System

S
Status and Review

Weekly Foreman’s Meeting

Address and remove hurdles

Plan the next period
# Last Planner® System

## Gantt Project Report

**Project:** RCC-SSA  | **Start Date:** Sunday September 27 2015  
**Plans:** All Plans Selected  | **End Date:** Saturday October 17 2015  
**Roles:** All Roles Selected  | **Data as of:** October 06, 2015 07:40:39 PM EDT

<table>
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<th>Task Description</th>
<th>Days</th>
<th>Crew Size</th>
<th>Start</th>
<th>End</th>
<th>Responsible Party</th>
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<th>Week of 10-04</th>
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## Weekly Work Plan

**Project:** RCC-SSA  
**Week Commencing:** Tuesday October 06 2015  
**Plans:** All Plans Selected  
**Data as of:** October 06, 2015 07:10:47 PM EDT  
**Roles:** All Roles Selected

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<th>On Time</th>
<th>Reason For Varia #</th>
<th>Notes</th>
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<td>Frame curtainwall at south elevation</td>
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**Daily Crew Size Table:**
- T: Tuesday, W: Wednesday, T: Thursday, F: Friday, S: Saturday, S: Sunday, M: Monday

**Reason For Variations:**
- # indicates the reason for the variation in the plan.
We still develop and maintain the Master Schedule for our projects in P6.

LPS is most effective for planning the next milestone or phase.
CASE STUDY #4
HOW AMOROSO ZEROED OUT THE VARIATION
“SINGLE PIECE FLOW”

Kim Altamirano Project Executive S.J. Amoroso
Construction Co, Inc:
All concrete parking deck

6-Structural steel bldgs

• DATA SHEET: HIGH SCHOOL
• 298,000 SF
• 13,000 CY CONCRETE
• 1,500 TONS OF STEEL
• 730 TONS REBAR
• UTILIZED ONE CREW OF 15 CRAFTSMAN TO SET THE FOOTINGS
BACKUP ONLY
Noteworthy web pages

http://www.nist.gov/baldrige/

https://www.freese.com/baldrige

http://asq.org/cert/SME-AME-Shingo-Institute-Lean-Certification-Alliance

http://www.qimacros.com/qi-macros/six-sigma-software/?gclid=CO-csM7gocgCFRBrgod4osE8g

http://www.ghafari.com/content.cfm/ghafari-announces-launch-of-vplanner


http://www.leanconstruction.org/media/docs/Pages_from_LCI_Poster.pdf
A brief history of ISO-9001


The ISO 9001 quality management standard applies to areas such as manufacturing, processing, servicing, printing, forestry, electronics, steel, food processing, legal services, financial services, trucking, banking, retailing, drilling, recycling, aerospace, construction, exploration, textiles, pharmaceuticals, oil and gas, pulp and paper, publishing, petrochemicals, shipping, mining, energy, telecommunications, plastics, metals, research, health care, hospitality, utilities, aviation, machine tools, agriculture, government, education, recreation, tourism, fabrication, sanitation, software development, consumer products, transportation, instrumentation, computing, biotechnology, chemicals, consulting, insurance etc.

ISO has two kinds of quality management standards: requirements and guidelines. Together these two kinds of quality standards make up what is known as the ISO portfolio of quality management standards.

Requirements are the formal expectations that you must meet if you wish to be officially certified or registered. They are compulsory. Guidelines, on the other hand, are suggestions and recommendations only. They are voluntary.