Improving Construction Productivity

ESCIA & CSIA
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Publications

Books

Points to Implement and Seminar

1. Prioritize (Vital Few Versus Useful Many)
2. Problem solving
3. Plan and re-plan
4. Benchmark best practices
5. Focus on a defect to remove
6. Use variation to identify improvement
7. Be attentive to measurement
8. Better communicate
9. Record keeping for improvement
10. Emphasize pride and positives

How Important is the Construction Supervisor?

- The construction supervisor on average makes 60-100 decisions a day that affects time, cost, quality, or safety of the project.
- How much would your car cost or would it run if you built it on your driveway, it was hot or cold outside, six or more labor crafts were working on it, over 150 materials were being shipped to the driveway, 5 or more subcontractors were working the same area, and every car built was different. We have just described the CONSTRUCTION PROCESS!

Premise:
The construction industry is not a good industry; it is a great industry!
Effective Supervisor Skills

- Supervisors take responsibilities
- Supervisors are visionaries
- Supervisors plan and develop backup plans
- Supervisors focus on processes
- Supervisors are consistent

- Supervisors view subordinates as equals
- Supervisors promote learning and new ideas
- Supervisors are flexible
- Supervisors are team builders and find common ground
- Supervisors do not accept failure as an option

Definition of Productivity

Productivity = \$’s or Units of Work Output
Person Hours of Effort

Examples:
- Pounds of galvanized steel under 400lbs. Placed per man-hour
- Linear feet of 8” Diameter flexible non-insulated ductwork per man-hour
- Number of supply diffusers placed per man-hour

Example Sheet Metal Productivities

<table>
<thead>
<tr>
<th>Work Task</th>
<th>Phrs/Unit</th>
<th>Units/PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductwork: Galvanized Steel, Under 400lbs</td>
<td>0.102 lb.</td>
<td>9.80 lbs/ph</td>
</tr>
<tr>
<td>Ductwork: Galvanized Steel, 1,000 to 2,000 lbs.</td>
<td>0.090 lb.</td>
<td>10.99 lbs/ph</td>
</tr>
<tr>
<td>Ductwork: Stainless Steel, Type 304, Under 400lbs</td>
<td>0.145 lb.</td>
<td>6.90 lbs/ph</td>
</tr>
<tr>
<td>Ductwork: Flexible, Non-insulated, 8” diameter</td>
<td>0.080/linear ft.</td>
<td>12.3 lin ft/ph</td>
</tr>
<tr>
<td>Ductwork: Flexible, Non-insulated, 12” diameter</td>
<td>0.133/linear ft.</td>
<td>7.52 lin ft/ph</td>
</tr>
<tr>
<td>Ductwork: Insulated, 4” diameter</td>
<td>0.089/linear ft.</td>
<td>11.23 lin ft/ph</td>
</tr>
</tbody>
</table>

The Efficiency of Labor and Equipment Determine Productivity

Productivity Benchmarks

<table>
<thead>
<tr>
<th>% Annual Increase</th>
<th>Non-Productive Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>All USA Industries</td>
<td>Manufacturing 84 % Productive 16 % Non-Productive</td>
</tr>
<tr>
<td>Construction Industry</td>
<td>Construction Industry 50 % Productive 50 % Non-Productive</td>
</tr>
</tbody>
</table>

The Impact of Low Productivity and Increased Costs on Profits

- Annual Increase in Costs
- Annual Increase in Productivity
- Net Profit Margin of Firm
Example Construction Work Day

- Productive Time: 50%
- Non-Productive Time: 35%
- Support Time: 15%

Reasons for Non-Productivity Time:
- Industry related = 1/3
- Management related = 1/3
- Labor / equipment related = 1/3

Example Eight Hour Work Day

Productive time: 50%
Redo: 2%
Punch list: 3%
Accidents: 3%
Waiting on assignment: 7%
Substance abuse: 2%
Waiting on resource: 14%
Wastage and theft: 3%
Double(+) material handling: 6%
Late or inaccurate info: 5%
Waiting on instructions: 5%

Defects Causing Non-Productive Time at the Job Site

Reasons for Low Productivity Increase in the Construction Industry
- Low Investment in Education
- Focus on Results Instead of Process
- Lack of Focus on Measurement and Defect Analysis
- Lack of Knowing Project Status: Record keeping

Potential Impact of Productivity Increase

Example Sheet Metal Project

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>%</th>
<th>$1M Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor Cost</td>
<td>40%</td>
<td>$400,000</td>
</tr>
<tr>
<td>Material Cost</td>
<td>35%</td>
<td>$350,000</td>
</tr>
<tr>
<td>Equipment Cost</td>
<td>7%</td>
<td>$70,000</td>
</tr>
<tr>
<td>General Conditions</td>
<td>8%</td>
<td>$80,000</td>
</tr>
<tr>
<td>Company Overhead</td>
<td>8%</td>
<td>$80,000</td>
</tr>
<tr>
<td>Profit</td>
<td>2%</td>
<td>$20,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
<td>$1,000,000</td>
</tr>
</tbody>
</table>

Building Project Impact of Productivity Increase

- Assume a 5% Increase in Productivity

Initial Planned Profit: $20,000
Additional Benefits of 5% Increase in Productivity: $24,000

Note: A 5% Increase more than DOUBLES the initial planned profit

Themes for Effective Supervision
- Continuous Education
- Consistent Procedures and Practices
- Process versus Results Management
- Measurement / Benchmarking
- Defect Analysis
- Risk or Variation Analysis
- Vital Few versus Useful Many
- Proactive versus Reactive Management
- Challenging Versus Policing
- Focus on Quality and Safety
- Pride
A Twelve Point Program to Improve Construction Supervision

1. Using the Project Dormant Phase: Job Site Layout
2. Personnel Management: Making a Job Look Like a Firm
3. Material Management
4. Implement “MORE”
5. Defect Analysis
6. Using Quantitative Measurement Techniques
7. Planning and Scheduling
8. Equipment Management
9. Job Site Record keeping
10. Using New Technology to Increase Productivity
11. Emphasis on Quality and Safety
12. Pride in Work

1. Using the Project Dormant Phase: Preplanning

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MAKING PRODUCTIVE USE OF THE DORMANT PHASE

- Alternative job site layouts are prepared and appraised
- Superintendent reviews and inputs to the estimate
- As-planned schedule analyzed for resources
- Productivity program developed
- Contract documents reviewed for unusual requirements
- A program for job site record-keeping established
- Job site visit made to determine unusual conditions
- Organizational structure developed

2. Personnel Management: Making a Job Look Like a Firm

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Personnel Management: Making the JOB Look Like a FIRM
Personnel Management: Making a “Job” Look Like a “Firm”

Four Work Needs of an Individual
• Measured Results
• Communication
• Pride in Work
• Financial Reward

3. Material Management

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MATERIAL HANDLING

“The average material is handled 3.2 times at the job site”

Steps to Reduce Unnecessary Material Handling
• Prepare an effective job site layout
• Order material on a just in time basis when effective
• Place material near location of placement
• Fabricate off-site if possible
• Document all obstructions
• Hold individuals responsible for wastage and/or theft
• Make workers aware of the cost of materials
• Investigate causes of multiple handling

MEASURE: SIGN AT JOB SITE DOCUMENTING WEEKLY INCIDENCES OF REDO WORK

4. Implement “MORE”

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“MORE” Skills for Productivity Improvement
• MEASURE
• Challenge for OPPORTUNITY
• RISK Analysis
• EVALUATE Cost
Challenge vs. Watch

- What is the work method?
- What are we trying to achieve
- How are we currently doing the task?
- Why are we doing it this way?
- Who is best able to do this task?
- Where is the best place to do the task?
- When is the best time to do the task?

Best Practice Worksheet

[Table placeholders: Date, Work Method Analyzed, Recommendation for Improvement, Time, Cost, Quality, or Safety Benefit, Reviewed by, Recommendation]

VARIATION ANALYSIS AND IMPROVEMENT

Studying Productivity Variation and Causes as Means of Improving a Process and Productivity

Investigate days of good productivity; attempt to duplicate.
Investigate days of bad productivity; understand why and eliminate.

Supervisor Focus on Vital Work

<table>
<thead>
<tr>
<th>Work Tasks</th>
<th>Cost/Unit</th>
<th>Critical to Schedule</th>
<th>Productivity Risk</th>
<th>New Type of Work</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1=highest 5=lowest</td>
</tr>
</tbody>
</table>

Viewing “things” as Cost

<table>
<thead>
<tr>
<th>Resource / Material</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpenter (h)</td>
<td>$25.00 / hour</td>
</tr>
<tr>
<td>Backhoe (cubic yard)</td>
<td>$64.00 / hour</td>
</tr>
<tr>
<td>Crane</td>
<td>$95.00 / hour</td>
</tr>
<tr>
<td>Concrete</td>
<td>$65.00 / cubic yard</td>
</tr>
<tr>
<td>Steel</td>
<td>$500 / ton</td>
</tr>
</tbody>
</table>

5. Defect Analysis

Twelve Point Program to Increase Construction Productivity
DEFECT ANALYSIS

Example: Eight Hour Work Day

<table>
<thead>
<tr>
<th>Defect</th>
<th>Role as a Cause of Non-Productive Time</th>
<th>Ease of Getting Information/Data</th>
<th>Expect Benefit and Able to Measure Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redo work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Punch list work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting on Resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Starts, Early Quits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting on Instructions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastage and Theft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accidents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting on Assignment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unnecessary Material Handling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Substance Abuse</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SELECTED DEFECT

6. Quantitative Measurement Methods

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Use of Quantitative Methods: The Need to Benchmark Productivity

- Labor Rating Models
- MPDM Model
- Time Study
- Work Sampling
- Queuing Model

You can’t improve something we don’t measure. Measurement is done to focus on causation, not blame.

DEFECT ANALYSIS: The Process

- Select a Defect
- Identify a “Work Team” to Analyze
- Measure the Defect
- Analyze the Variation and Causations
- Brainstorm for Improvement
- Implement Improvement
- Measure Again; Continue the Process; i.e. Continuous Improvement

Accounting versus Analysis for Improving Productivity

1. Accounting Process
2. Analysis
3. Process
4. Planning
5. Analysis

Use of Quantitative Methods: The Need to Benchmark Productivity

- Labor Rating Models
- MPDM Model
- Time Study
- Work Sampling
- Queuing Model

You can’t improve something we don’t measure. Measurement is done to focus on causation, not blame.
7. Planning and Scheduling

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PLANNING AND SCHEDULING AND PRODUCTIVITY

- Short Interval Scheduling
- Revolving Three to Four Week Look Ahead Schedule
- Master Schedule (Initial and Updates)

Planning and Scheduling and Productivity

Daily Short Interval Scheduling - A Foreman Tool for Increasing Productivity

The One to Four Week Look Ahead Schedule - A Superintendent Tool for Increasing Productivity

The Critical Path Method Schedule – The Project Master Schedule
8. Equipment Management

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9. Job Site Record Keeping and Control and Productivity

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JOB SITE RECORD KEEPING AND CONTROL

Ideas for Improving Record Keeping

- Develop a program of recognition and awards for those individuals that submit timely and accurate records
- Explain all record keeping requirements to job site personnel
- Demonstrate the importance of accurate record keeping by means of an example
- Be innovative in designing record keeping input forms.
- Give field personnel feedback
- Don’t require input data that serves no purpose
- Never ask for the same data twice
Supervisor Compliance with “Procedures”

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Score (10 full compliance, 1 no compliance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Late Starts and Early Quit Policy</td>
<td></td>
</tr>
<tr>
<td>2 Daily Short Interval Schedule</td>
<td></td>
</tr>
<tr>
<td>3 Weekly One to Four Week Look Ahead Plan</td>
<td></td>
</tr>
<tr>
<td>4 Identification of Best Practice</td>
<td></td>
</tr>
<tr>
<td>5 Schedule Updates</td>
<td></td>
</tr>
<tr>
<td>6 Change Order Administration Program</td>
<td></td>
</tr>
<tr>
<td>7 Performance of Personnel Management Program</td>
<td></td>
</tr>
<tr>
<td>8 Safety Compliance</td>
<td></td>
</tr>
<tr>
<td>9 Defect Analysis Program</td>
<td></td>
</tr>
</tbody>
</table>

Four Rules for Collecting Accurate and Timely Information

- Never require someone to fill out a form without explaining where the data goes and how it is used
- By example, show individual that the data was used
- Show the individual how bad data created a problem, or good data enabled solving a problem
- Given feedback

10. Using New Technology to Increase Productivity

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11. Emphasis on Quality and Safety

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SAFETY AND PRODUCTIVITY

A Safe Job Is Also a Productive Job

- Many accidents occur when a worker is in a non-productive work state
- Improve safety by investigating the cause of each accident
- Improve safety by studying accident variation
- The cost of accidents include:
  - Added workmen comp.
  - Cost of accident
  - Low worker morale
  - Disruption in work process
  - Intangible cost of injured worker
The “Four” Variables of the Construction Process

• Time
• Cost
• Quality
• SAFETY

Quality: Do It Right the First Time

• Zero Punch List
• Zero Redo Work

12. Be Proud to be a Constructor

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Ten Reasons Why You Should Encourage Your Daughter or Son to be a Construction Supervisor

The construction supervisor will always be able to make the following claim: “I make things!”

10. If you want a challenge, choose a career as a construction supervisor!

Think about what your car would cost if built under the following conditions: It is a unique design. It is built on your driveway, subject to extremes of temperature as well as rain and snow and snow. It is
Changes and Claims

Measurement of Lost Productivity for Labor and Equipment

Example Factors that Negatively Impact Productivity

- Weather (Cold, Hot, Wind, Wet Conditions)
- Overtime / Shift Work
- Sequencing
- Crowding (Stacking)
- Loss of Learning
- Changes
- Work Difficulty

Example of Research Available for Quantifying Lost Productivity

Measuring Lost Productivity

- Discrete Method
- Measured Mile Method
- Earned Value Method
- Total Cost Method
- Modified Total Cost Method
- But For Method
- Reconstruction of Daily/Weekly Impact
- Expert Analysis

The Effective Supervisor

<table>
<thead>
<tr>
<th>SKILL</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technically Competent</td>
<td>1 to 10</td>
</tr>
<tr>
<td>Challenges Work, Not Just Policies</td>
<td></td>
</tr>
<tr>
<td>Focuses on Production State, Risk, Cost</td>
<td></td>
</tr>
<tr>
<td>Focuses on Planning, Not Just Reacting</td>
<td></td>
</tr>
<tr>
<td>Manages Subordinates as Equals</td>
<td></td>
</tr>
<tr>
<td>Is a Team Player</td>
<td></td>
</tr>
<tr>
<td>Does Timely and Accurate Recordkeeping</td>
<td></td>
</tr>
<tr>
<td>Makes Quality and Safety a Top Priority</td>
<td></td>
</tr>
<tr>
<td>Seeks Continuous Improvement and Education</td>
<td></td>
</tr>
<tr>
<td>Is Proud of Being a Supervisor</td>
<td></td>
</tr>
<tr>
<td>TOTAL (Out of 100)</td>
<td></td>
</tr>
</tbody>
</table>

Points to Implement and Seminar

1. Prioritize (Vital Few Versus Useful Many)
2. Problem solving
3. Plan and re-plan
4. Benchmark best practices
5. Focus on a defect to remove
6. Use variation to identify improvement
7. Be attentive to measurement
8. Better communicate
9. Record keeping for improvement
10. Emphasize pride and positives
Implementing a Best Practice Initiative for Productivity Improvement

Several of my construction industry clients have increased construction productivity by implementing what I refer to as a "Best Practices" initiative. Implementations of such programs should yield long-term cost and time savings as well as improve project quality and safety. The individual steps in the implementation of such a Best Practice initiative are described in this issue.

Questions / Contact

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