Critical Success Factors and Forecasting Project Performance

Edward J. Jaselskis, PhD, P.E.
E.I. Clancy Distinguished Professor
North Carolina State University
Dept. of Civil, Construction, and Environmental Eng.
Center for Nuclear Energy Facilities and Structures
• Defining Project Success*
• Current Project Performance Trends
• Reasons for Failure
• Critical Success Factors for Improving Project Performance
• Innovations in Project Planning and Control
• Conclusions

*Portfolio Success is not addressed
Wouldn’t it be great if every project was successful?

Q1: Experienced at least one very successful project?

Q2: How many would say that all of your projects turned out to be highly successful?
Defining Project Success

- Success is in the eyes of the beholder
- It’s subjective and dynamic
- Differs depending on perspective of each stakeholder (e.g., Owner, Designer, Contractor)
- Can differ depending on perspective of those within an organization
Measures of Project Success from Project Management Perspective*

Mainstream Measures

Budget (Cost), Schedule, Functionality, Safety, and Client Satisfaction

Other Measures

PM Team Satisfaction, Contractor Satisfaction (follow-on work and capabilities build-up), End User Satisfaction

*Modified from Clive Lurie and David Ashley, “Determinants of Construction Project Success” Pilot Study
The Reality for basket of ALL Projects

- Failure
- Average
- Outstanding

<table>
<thead>
<tr>
<th>%</th>
<th>Failure</th>
<th>Average</th>
<th>Outstanding</th>
</tr>
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<tbody>
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<td>100</td>
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</table>
The Reality for basket of ALL Projects

- Average: 72%
- Failure: 14%
- Outstanding: 14%

Improved Project Performance
Cost and Schedule Performance (118 Projects)

Cost Factor = Actual Cost/Planned Cost
Schedule Factor = Actual Duration/Planned Duration

Failed Projects (47):
Cost Factor = 1.47
Schedule Factor = 2.09

Outstanding Projects (39):
Cost Factor = 0.94
Schedule Factor = 0.99

Average Projects (32):
Cost Factor = 1.06
Schedule Factor = 1.12
How many Mega Projects* fail to meet authorized Cost and Schedule?

Original Contract

A. 65%
B. 75%
C. 85%
D. 95%
Most of them!

• Only about **one in twenty projects** meet both of these criteria. (CII 2012)

“As approximately **one out of ten** megaprojects is on budget, **one out of ten** is on schedule, and **one out of ten** delivers the promised benefits, then approximately **one in a thousand** projects is a success, defined as on target for all three.”

- Bent Flyvbjerg
Examples

<table>
<thead>
<tr>
<th>Project</th>
<th>Original Cost ($Bil)</th>
<th>Final Cost ($Bil)</th>
<th>Cost Increase (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston Big Dig</td>
<td>2.5</td>
<td>24.3</td>
<td>+872%</td>
</tr>
<tr>
<td>Channel Tunnel Project</td>
<td>10</td>
<td>18</td>
<td>80%</td>
</tr>
<tr>
<td>Trans Alaska Pipeline</td>
<td>0.9</td>
<td>9</td>
<td>900%</td>
</tr>
</tbody>
</table>

Legend:
- Original Cost ($Bil)
- Final Cost ($Bil)
Reasons for Failure (1)

• Over Optimism
  • “Optimism Bias” (Bent Flyvbjerg)
  • “Glandular Surge” (John Dalton)

Reasons for Failure (1)

• Over Complexity
  • “Difficult to define and even harder to quantify” (2)
  • “Many interrelated parts characterized in terms of the number of varied components in a project (e.g., tasks, specialists, sub-systems, and parts) (called differentiation) and the interdependencies between these components.” (3)
  • Caused in part by “uncertainties and risks” (4)

Reasons for Failure (1)

• Poor Execution
  • Incomplete Design
  • Lack of clear scope
  • Ill-advised short cuts
  • Mathematical errors in scheduling and risk assessment
  • Lack of adequate controls

Reasons for Failure*

• Weakness in Organizational Design and Capabilities
  • Right staffing levels?
  • Proper management and oversight of project?
  • Good clarity on roles, responsibilities, and authority?
  • Adequate alignment of the program and project organizational structures?

Critical Success Factors for Improving Project Performance

**Hypothesis:** One can achieve better construction project performance by knowing and implementing factors linked to project success.
Critical Success Factors*

• What are the Critical Factors related to Project Success
• 2,000 potential factors reduced to 46

*Rory Salimbene and David Ashley, Determinants of Construction Project Success
Top 10 Project Success Factors*

1. Project Manager Goal Commitment
2. Project Manager Capabilities/Experience
3. Planning Efforts
4. Project Team Motivation/Goal Orientation
5. Scope and Work Definition
6. Project Manager Involvement
7. Commitment Mtg Project Objectives
8. Control Systems
9. Safety
10. Project Manager Authority/Influence

*Clive Lurie and David Ashley, “Determinants of Construction Project Success” Pilot Study
Project Manager Goal Commitment*

- Use of Monetary Incentives for Contractor PM
- Owner’s perception of Contractor’s PM ...
  - Support by senior company management
  - Visibility and recognition
  - Growth potential

*Statistically significant factors
1. Project Manager Technical Experience (# projects)
   • 5.7 (better budget performance)
   • 1.8 (worse budget performance)

2. Project Managers* with management-related education produced projects with better budget performance

*Mix of both owner and contractor project managers
Planning Efforts

• Front End Planning
  1. Implementing a **Formal Risk Identification program** produced projects with better budget performance
  2. Implementing a **Constructability program** produced projects with better budget performance
Planning Efforts

• Modularization (% total project cost)
  1. 7.3% [outstanding]
  2. 1.3% [average]

• Design Complete at Start of Construction (%)
  1. 69.9% [better budget performance]
  2. 51.0% [worse budget performance]
Project Team Motivation/Goal Orientation

1. Lower project team turnover for better projects (%)
   • 7% (Outstanding)
   • 14% (Average)
   • 25% (Failure)

2. Higher Levels of:
   1. Designer contract incentives and penalties translated to projects with better budget performance
   2. Owner and Designer Technical Experience translated to projects with better budget performance
   3. Designer, Constructor, and Owner Technical Experience translated to projects with better schedule performance

3. Co-locating teams improves schedule performance
1. Early Contractor Project Manager Involvement (%)
   - 15% (Nonfailed Projects)
   - 5% (Failed Projects)

2. Project Manager located at the site improved schedule performance
1. Cost Monitoring Performed by both Contractor **AND** Owner

2. Control System Cost (% total project cost)
   - 2.1% (better budget performance)
   - 0.9% (worse budget performance)

3. Projects that used Liaison Personnel experienced better budget performance

4. Projects with more control meetings (~5/wk) had a better chance of achieving outstanding project performance

5. Projects with more budget updates had better schedule performance (# updates per year)
   - 16.3 (better)
   - 10.7 (worse)
Importance of Cost Monitoring by Owner*

*Jeffrey S. Russell and Edward J. Jaselskis, “Predicting Construction Contractor Failure Prior to Contract Award”

- Cost Monitoring not performed: 94% probability of failure
- Cost Monitoring performed: 63% probability of failure

Cost Monitoring Status

Project Outcome

- Not Performed
- Performed
Use Core Project Control Metrics*

<table>
<thead>
<tr>
<th>Category</th>
<th>Forecasting</th>
<th>Diagnostic</th>
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</thead>
<tbody>
<tr>
<td>Performance Forecasting</td>
<td>Variance at Completion</td>
<td>Baseline Execution Index for Critical Path</td>
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<tr>
<td>Performance Forecasting</td>
<td>Estimate at Completion (CPI)</td>
<td>Number of Critical (or Near Critical) Paths</td>
</tr>
<tr>
<td>Performance Assessment</td>
<td>Estimate to Complete (CPI)</td>
<td>Schedule Variance</td>
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<tr>
<td>Performance Assessment</td>
<td>To Complete Performance Index (EAC-CPI)</td>
<td>Unit Rate</td>
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<td>Budget at Completion</td>
<td>Cost Variance</td>
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<td>Cost Performance Index</td>
<td>Procurement Cost Variance</td>
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<tr>
<td></td>
<td>Schedule Performance Index</td>
<td>Efficiency or Productivity Index</td>
</tr>
<tr>
<td>Progress Measurement / Data Collection</td>
<td>Physical Percent Complete</td>
<td>Ratio of Actual to Planned Progress</td>
</tr>
<tr>
<td></td>
<td>Earned Value</td>
<td>Percent Key Deliverables Completed on Time</td>
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<tr>
<td></td>
<td>Planned Value</td>
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<tr>
<td></td>
<td>Actual Cost</td>
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</tbody>
</table>

* Construction Industry Institute Research Team 322, Improving Project Progress and Performance
Safety

1. Outstanding projects had better safety performance
2. Contractors with lower EMR (0.66) had higher profitability
3. Stronger upper management attitude toward safety (9.2/10 vs 7.4/10)
4. More safety meetings between upper management and field safety representatives (13.4 vs 5.9 per year)
5. Better safety training and orientation for new foremen (4 hrs vs 1.4 hrs)
6. More GC safety coordinator meetings with subcontractors (3.5 vs 1.8 per month)
7. Lower project team turnover (3.8% vs 9.6% per year)
8. Informal site safety inspections (16.3 vs 7.4 per month)
1. Higher PM Design Authority resulted in better budget performance

2. Higher PM Budget and Control Authority resulted in better schedule performance
Innovative Project Control Metric: Earned Schedule--SPI(t)

• Limitations using EVM for Schedule Performance Measurement
  • Schedule indicators (SPI and SV) are flawed for late projects
  • EVM uses cost as a proxy for assessing schedule performance

• Earned Schedule
  • Earned Schedule uses time for assessing schedule performance
  • Provides more accurate indication of schedule performance even on late projects

Earned Value Management

\[
\begin{align*}
SV &= EV - PV \\
SPI &= \frac{EV}{PV}
\end{align*}
\]

\[\text{EV} = \text{Earned Value (\$)}\]
\[\text{PV} = \text{Planned Value (\$)}\]

\[\text{ES} = \text{Earned Schedule (months)}\]
\[\text{AT} = \text{Actual Time (months)}\]
Earned Schedule vs Earned Value Management

![Graph showing Earned Schedule vs Earned Value Management](image-url)
Advanced (“Enhanced”) Work Packaging (AWP)

“AWP guides the dissection of project scope so that it supports the execution of Workface Planning in the field. ... starts with the processes upstream of the Construction Work Packages and aligns Engineering Work Packages with Procurement Work Packages” (1)

“Better integration of E-P-C”

Information Management is key

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Research Reports and Books

- *Validating Advanced Work Packaging as a Best Practice: A Game Changer* (RT-319), 2015. Construction Industry Institute
- *Even more Schedule for Sale*, Geoff Ryan

Advanced Work Packaging Software

- *ConstructSim* (Bentley Systems)
- *Smart Construction* (Hexagon)
- *iConstruct* (Autodesk)
Integration of DOE and Construction Industry Institute (CII) Best Practices*

• **Front-End Planning**
  - DOE G 413.3-12 Chg 1 (PDRI)
  - DOE G 413.3-4A Chg 1 (TRA)
  - DOE P 451.1 (NEPA)

• **Team Building**
  - DOE G 413.3-18A Chg 1 (IPT)

• **Partnering**

• **Constructability**

• **Planning for Startup**
  - DOE O 425.1D Chg 1
  - DOE G 413.3-16A Chg 1

• **Material Management**
• **Dispute Resolution**
• **Quality Management**
  - DOE G 414.1-2B (Admin Chg 2)
• **Lessons Learned**
• **Project Risk Assessment**
  - DOE G 413.3-7A Chg 1
• **Planning for Modularization**
• **Alignment**

• **Change Management**
  - DOE G 413.3-19 Chg 2

• **Zero Accident Techniques**
  - DOE G 440.1-1B Chg 1
  - DOE G 440.1-7A
  - DOE O 450.2 Chg 1

• **Benchmarking and Metrics**

• **Advanced Work Packaging**

U.S. DOE Root Cause Analysis and Corrective Action Plan Closure Report
February 2011

Refer to CII Knowledge Base: https://kb.construction-institute.org/Best-Practices
Benefits of Best Practice Implementation*

• $1 spent on Front End Planning led to a $3-7 ROI
• Use of CII’s PDRI tool has a $24/1 benefit to cost ratio
• Use of Constructability programs
  • Reduces total project cost 1 to 11 percent
  • Reduces total project schedule 5 to 10 percent
  • Consistent, documented, quantified benefit/cost ratios of 10:1
• Use of Zero Accident Techniques reduces the Total Recordable Incident Rate for Contractors by 54% and Owners by 64%
• Improved Supply Chain Management can provide savings of 4-8%
• Use of Advanced Work Packages can improve field productivity by up to 25% and reduce Total Installed Cost by 10%.

*Research performed by the construction academics for the Construction Industry Institute
Conclusions

• If we know so much about achieving project success then why is it so difficult?!

• Develop appropriate strategies for addressing reasons for poor performance (overly optimistic, complexity, poor execution, and weaknesses in organizational design and capability)

• Implement Best Practices

• Having a little luck doesn’t hurt either!

[Image: On the Right Things!]
Questions