Mastering the Mega-Project

The Critical Role of Supply Chains

George Jergeas
Professor of Project Management
University of Calgary
Calgary Supply Chain
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References

Industry Support
Objectives

- Analysis of industry practices and challenges
- The Collaborative approach
Total to Take $1.65 Billion Loss on Canada Oil Sands Project
March 28 (Bloomberg) -- Total SA, Europe's third-biggest oil company, will book a $1.65 billion loss in the first quarter on the canceled Voyageur Upgrader project in Canada's oil sands after selling its stake to Suncor Energy.

ConocoPhillips Canada slab hundreds of jobs
Penn West Petroleum, ConocoPhillips Canada and Shell halts work on Pierre River oil sands mine in northern Alberta
CNRL cuts Calgary, Aberdeen staff salaries; cites low oil prices
Norway’s Statoil ASA has shelved a multibillion-dollar oil sands project blaming delays in new export pipelines that would boost the value of Canadian heavy crude oil.

Total Alberta oil sands mine
Statoil halts multibillion-dollar Alberta oil sands project
Cut Costs or Face Death Spiral

“The made in Fort McMurray” cost of doing business has risen too quickly and must end.

Oil sands producers were making three times the profit in 2004 when a barrel of oil cost about $40(US) than it did when price hit close to $100 in 2013.

The rising costs from suppliers, and not world oil prices, were the reason that CNRL and others could no longer produce the profits it once did.

.. Oil sands can only avoid collapse if the people in the room – contractors and service industry representative – begin to cut costs.

An opportunity for every part of industry to cut costs and eliminate inefficiencies that were allowed to creep in when business was booming.”

Steve Laut President of CNRL

Globe and Mail, February 19, 2015, by Peter Scowen
Mega Oil Sands Projects

- No major problems re quality and safety
- Projects running in excess of design capacity
- Hardworking people
- No unskilled or unprofessional conduct
- Proud of industry’s achievements
Mega Oil Sands Projects

- Size and interfaces
- Technological complexity
Thousands of Complex Interconnected Interfaces

**Engineering effort**
- 3.5 million man-hours
- 40 - 50,000 design drawings
- 10 - 20,000 vendor and shop drawings

**Construction effort**
- 15 million construction hours
- Labour force of 8,000 workers with a turnover of 200%
- Supported by 500 - 800 staff personnel
Thousands of Complex Interconnected Interfaces

- Organize, order, store and retrieve 80,000,000 material items.
- Managing a craft mix of 8,000 workers working in pairs doing at least two different activities per day results in a never ending 80,000 individual jobs in a 10 day shift.
- Each job requires a combination of the correct, materials, location, access, tools, equipment, scaffold, safety, quality, rigging, consumables, welding, x-ray and many other inputs to allow the worker to get his job done.

- **This task belongs to management which to date has not been able to plan, organize or execute.**
Five Warning Signs

1. Project delivery model
2. The four planes of decision process
3. Fast-tracking
4. Delays in engineering
5. Huge number of changes
1. Project Delivery Model

<table>
<thead>
<tr>
<th>PHASE 1</th>
<th>PHASE 2</th>
<th>PHASE 3</th>
<th>PHASE 4</th>
<th>PHASE 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDENTIFY &amp; Assess Opportunities</td>
<td>SELECT from Alternatives</td>
<td>DEVELOP Preferred Alternative</td>
<td>EXECUTE (Detail EPC)</td>
<td>OPERATE &amp; Evaluate</td>
</tr>
<tr>
<td>Determine Project Feasibility and Alignment with Business Strategy</td>
<td>Select the Preferred Project Development Option</td>
<td>Finalize Project Scope, Cost and Schedule and Get the Project Funded</td>
<td>Produce an Operating Asset Consistent with Scope, Cost and Schedule</td>
<td>Evaluate Asset to Ensure Performance to Specifications and Maximum Return to the Shareholders</td>
</tr>
</tbody>
</table>

AFE/FID

- Feasibility
- DBM
- Application
- FEED
- Long-Leads
- Reg. Approval
- Detailed Design
- Procurement
- Fabrication
- Construction
- Commissioning
- Start-Up
- Perf’m Testing
- De-bottleneck

25% engineering is not enough to provide the required accuracy in the AFE budget!!!
2. The Four Planes of Decision Process

Decisions made in one plane without consideration of the impact on the other plane.
Example: Unrealistic Cost Estimates
3. Project Fast-tracking
3. Project Fast-tracking

Time is Money

Schedule Compression

Shorter Project Duration  More Business Benefits

Photo: colourbox.com
3. Project Fast-tracking

Very costly!!
3. Project Fast-tracking

Fast tracking results in:

- Poor/incomplete scope definition
- Underestimation/under appreciation of project complexity
- Unrealistic expectations re cost and schedule
- Inadequate plan of execution
- Changing customer requirements
- Lack of understanding the costs of changes
- Little constructability input
- Cost reimbursable contracts
- Lower than anticipated labour productivity.
4. Delays in Engineering

- Delays in achieving early key engineering milestones such as:
  - Substantial Completion of Engineering
  - Freezing Process Flow Diagram’s (PFD’s)
  - P&ID issued for design

- What happens to the final completion date?
5. Project Changes

- Huge number of changes and extras
- Project re-estimates after AFE

- **What happens to the final completion date?**
Consequences: Fast Tracking the Fast Track!

Delays and changes do not seem to be reflected on final project completion date.

Maximum Overlaps
Consequences: Labour Productivity

30% of work day in direct work
... or 3 hrs / 10 are on real stuff

Blame unfairly placed on workers
The average schedule growth was 15.7% ranged from -12% (early finish) to 58% (late finish)
The average cost growth was 30.7%. Ranged from -18% (under budget) to 105% (over budget).
Construction Cost Growth and Percentage of Design Complete Before the Start of Construction
FILE
LESSONS LEARNED
REPORTS HERE
SO WE CAN CONTINUE
TO REPEAT FAILURE
More Consequences

1. Outsourcing engineering and fabrication
2. Owner’s don’t plan for the future but react to present cash flow
   - Stop or delay projects then speedup!
3. Owners requiring their contractors and suppliers to reduce costs!!!
   - Market Intervention
4. Myopic risk allocation and management
### Key Beliefs

<table>
<thead>
<tr>
<th><strong>Adversarial</strong></th>
<th><strong>Transactional</strong></th>
<th><strong>Collaborative</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Business is a &quot;Psychological War Game;&quot; Winning comes from Power</td>
<td>Trading, Bargaining, &amp; Differential Views on Value Produces Economic Exchange</td>
<td>Extreme Value is Generated when people work in teams to Push the Envelope on Performance</td>
</tr>
</tbody>
</table>

### Behaviours

<table>
<thead>
<tr>
<th><strong>Adversarial</strong></th>
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<th><strong>Collaborative</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Argumentative, Money Rules, Use Age, Experience, Position or Budget to get your way, “dog eat dog”</td>
<td>Squeezing &amp; Positioning enables you to get the best result in Negotiations, throw a bone to sweeten the deal.</td>
<td>Co-Creative, Teamwork, Trustworthiness, Highly Ethical &amp; Honest; Maximize what’s in the best interests of the whole</td>
</tr>
</tbody>
</table>

### Rules of the Game

<table>
<thead>
<tr>
<th><strong>Adversarial</strong></th>
<th><strong>Transactional</strong></th>
<th><strong>Collaborative</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure others; Winning is a result of Cunning &amp; Craftiness; Hype your importance; Protect your backside; Don’t Trust Others or you will get screwed; Everything is Win – Lose.</td>
<td>Take advantage of every opportunity, Exploit weaknesses; Timing is critical; Perception is everything; Trust but verify; Use lawyers to ensure protection; Everything is in the “deal;”</td>
<td>Create value &amp; competitive advantage by using Teamwork (internally) &amp; Alliances (externally). Close integration between operating units, suppliers &amp; Close attention to customers/client; Strive for Win-Win.</td>
</tr>
</tbody>
</table>

### Information

<table>
<thead>
<tr>
<th><strong>Adversarial</strong></th>
<th><strong>Transactional</strong></th>
<th><strong>Collaborative</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Horde Information – It is Power</td>
<td>Contractor responsible for interpretation of information</td>
<td>Share Information to create more new ideas</td>
</tr>
</tbody>
</table>

### Trust Level

<table>
<thead>
<tr>
<th><strong>Adversarial</strong></th>
<th><strong>Transactional</strong></th>
<th><strong>Collaborative</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distrust, Deception, Aggression, &amp; Manipulation Prevalent</td>
<td>Caveat Emptor (buyer beware)Trust is elusive and unsustainable</td>
<td>Trust is essential to generating a continuous stream of new value</td>
</tr>
</tbody>
</table>
No Damage for Delay

“... the contractor shall not have any claim for compensation for damages against the owner for any stoppage or delay from any cause whatsoever.”
Examination of Work

“The bidder is required to investigate and satisfy himself of everything and every condition affecting the work to be performed and the labour and material to be provided, and it is mutually agreed that submission of tender shall be conclusive evidence that the bidder has made such an investigation.”
Any Connection

Insanity: doing the same thing over and over again and expecting different results. ~Albert Einstein
Fresh Thinking is Required
Multiple Primes

- Owner exerts governance over 1st tier contractors
- Interfaces between contractors managed by Owner
- Need for Management Contractor

Multiple prime contractors

Contractual governance
• Managing contractor to create an alliance
• Vertical tie between Owner and Alliance management
• Horizontal ties between suppliers
Project Owner

Strategic Alliance Partners
(Owner, EPC, Prime Contractors, etc)

Systems Integrator

Contractual Governance

Alliance Partner Agreement

VALUE NETWORK

Sub-Suppliers & Subcontractors
Collaborative “Chains” become “Networks”

“Aligned Value Network”

INNOVATIVE, RELIABLE, INTEGRATED, SPEEDY
(CAN ONLY MANIFEST IN COLLABORATIVE SYSTEMS)
Systems Integrator

- Forge alignment on common goals and objectives between the alliance partners,
- Develop plans for their achievement,
- Establish/improve working relationships
- Create an environment where open and honest communication, trust and teamwork foster a cooperative bond, promote innovation and prevent breakdowns at interfaces.
Systems Integrator

Functions:

- Plug the gaps in missing competencies and capabilities to create a whole system.
- Establish cross-functional leadership teams for managing ever-changing alignments.
- Discuss and resolve any conflicts or adversarial relationships that may emerge.
- Provide facilitation, team training and conduct regular organizational "health checks."
**Systems Integrator**

**Ownership:**

- The Integrator could be an independent project management firm
  - Jointly-owned and controlled by the stakeholders (owners, contractors, EPCs, employees, suppliers, labour unions, and the public)
  - Put up the money for its staffing in proportion to the amount of reward they share in the venture.
Collaborative Construction Model

- Try the very Canadian way of life!
- None of us is as smart as all of us.
  - Ken Blanchard
Collaborative Construction Model

- Establish collaborative relationships between Owners, Engineering Contractors, Construction Contractors, Labour, Governments.....
  - Input from stakeholders from procurement, engineering, projects, supply chain, construction, and operations.
Collaborative Construction Model

- Engage major supply chain stakeholders early.
- Utilize supplier expertise in all phases of the project life cycle by developing an advance procurement strategy and reaching agreement with suppliers on strategic procurement items and/or systems prior to the associated project engineering activities.
Collaborative Construction Model

- Require TRUST
  - Stakeholders to be motivated to share expertise and deliver value
  - TRUST will deliver value
  - Traditional EPC does not lever expertise of supply chain and construction contractors.
Collaborative Construction Model

A structured management approach to build a cohesive, co-operative relationship with common goals and established procedures for open and honest communication and issue resolution in a timely manner.
Collaborative Construction Model

- Reverse backward trend by:
  - Changing mind sets
  - Focus on real issues

- Start early!
Prerequisites

- Equality
- Commitment
- Trust
- Open and honest communication
- Mutual goals and objectives
- Ongoing project performance evaluation
- Timely issue resolution
Collaborative Construction Model

- Team building Workshop for Team members
- Problem Resolution
- Monitoring Success / Health
- Completion

On Going Support and Leadership
Collaborative Construction Model

1. Project Charter/Common Vision
2. Health Check
3. Issue Resolution Mechanism
4. Ground Rules
5. Roles and Responsibilities
We, the NE LRT Extension Team, recognize the complexity of the overall program and the individual project responsibilities, commit to a collaborative process through mutual respect, effective communication and trust to achieve a successful opening of the LRT to Saddle Towne by September 2012.
Our Vision

We, the YYC Runway Development Program – City of Calgary Airport Trail Tunnel teams will meet the following milestone dates:

- Zone 1 under runway – Aug 31, 2012
- Zone 2/3 under Taxiways – October 31, 2012
- Structure completion – October 31, 2012
- Zone 4/5 under perimeter roads – June 30, 2013
- Runway in service – May 2014
2. Health Check

- List the criteria that will be used to:
  - Evaluate our performance and effectiveness
    - Both soft and hard issues
# Health Check: Monitoring Performance

<table>
<thead>
<tr>
<th>Date:</th>
<th>Name:</th>
<th>Firm:</th>
</tr>
</thead>
</table>

## COMMUNICATION

1. Communications are... | difficult, guarded | 1 2 3 4 5 | open, up-front |
2. Information flow is... | restricted | 1 2 3 4 5 | free, open |
3. Timeliness of information is... | late | 1 2 3 4 5 | on-time |

## WORKING RELATIONSHIPS

4. Cooperation between parties is... | poor, detached | 1 2 3 4 5 | good, unreserved |
5. Issues and concerns are... | ignored | 1 2 3 4 5 | dealt with quickly |
6. Responses to issues become... | personal | 1 2 3 4 5 | project problems |
7. Disputes are addressed... | ineffectively | 1 2 3 4 5 | efficiently |
8. Problems are resolved by... | senior management | 1 2 3 4 5 | lowest level |

## TECHNICAL REQUIREMENTS

9. Safety performance is... | not acceptable | 1 2 3 4 5 | acceptable |
10. Overall quality is... | not acceptable | 1 2 3 4 5 | acceptable |
11. Value for money is | not acceptable | 1 2 3 4 5 | acceptable |

## STAKEHOLDER & EXTERNAL ISSUES

12. Public complaints are... | frequent | 1 2 3 4 5 | infrequent |

Please list examples for point 1 – 12 above that you rated 1 or 2

______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________
Team Alignment Overall

Team Self-Evaluation Results (Combined)
04-Dec-09

1. Communications
2. The flow of information
3. The timeliness of information
4. Cooperation
5. Problems, issues or concerns
6. Responses to problems
7. Disputes/problems
8. Problems are resolved
9. Construction safety performance
10. Design and construction quality
11. Value for money
12. Public Complaints
Team Alignment by Company

Team Self-Evaluation Results (By Company) 04-Dec-09

1. Communications
2. The flow of information
3. The timeliness of information
4. Cooperation
5. Problems, issues or concerns
6. Responses to problems
7. Disputes/problems
8. Problems are resolved
9. Construction safety performance
10. Design and construction quality
11. Value for money
12. Public Complaints
3. Issue Resolution Mechanism

- Lowest level with time limit

- Escalated to the next level of management

- No action is **not** an option
Issue Resolution Mechanism

Stage One
Within 2 days
Names:
1. _________
2. _________

Problem becomes apparent
Solution to problem offered by those who are directly involved with it.
If problem not resolved, go to stage two.
If solution agreed, do not go to stage two. If changes affect other project parties, record them onto a form for circulation.

Stage Two
Within 3 days
Names:
1. _________
2. _________

Problem discussed at progress meeting.
Solution to problem offered by project team.
If solution to problem cannot be agreed at progress meeting, go to stage three.
If solution agreed, do not go to stage three. Solution to problem recorded in meeting minutes.

Stage Three
Within 5 days
Names:
1. _________
2. _________

A resolution committee comprising a representative from each of the project parties is formed.
Problem resolution meeting called for committee.
Mutual way forward for project agreed by resolution committee.
Statement of way forward recorded and issued.

If any project party is not content with the way forward agreed by the resolution committee then they may take normal recourse through the contract.

Resources Available
1. 
2. 

Finish
Finish
Finish
### Issue Resolution Mechanism

<table>
<thead>
<tr>
<th>Group</th>
<th>A Immediate</th>
<th>B 5 days</th>
<th>C 5+ days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Level</td>
<td>Site Level</td>
<td>12 HR</td>
<td>1 day</td>
</tr>
<tr>
<td>PM Level</td>
<td>PM level</td>
<td>24 HR</td>
<td>2 days</td>
</tr>
<tr>
<td>Director</td>
<td>Director</td>
<td>24 HR</td>
<td>2 days</td>
</tr>
<tr>
<td>General Manager</td>
<td>CEO</td>
<td>24 HR</td>
<td></td>
</tr>
</tbody>
</table>

A: Issue requires immediate or quick resolution.

B: Issue can be resolved within 5 days with minimal impact

C: Issue can be resolved in greater than 5 days with minimal impact
4. Ground Rules

- Mutually agreed standards of conduct and behaviour
- What is expected of everyone
- What is important to the team
- What is appropriate behaviour
- Express the values of the team
- To help the team evaluate its performance
- To help the team resolve conflicts
5. Roles and Responsibilities

- Understand the roles and responsibilities of each player.
- Read and understand your contract
- RTFC
The Most Important Thing for Leaders to Know

- Leadership means doing something different, something better – not the same thing that had failed before.
- Making the shift to collaboration may be difficult.
- Senior leaders must be united in their resolve to stay on course.
- Dedication by leaders at the top, middle, and bottom of the organization.
The Most Important Thing for Leaders to Know

- Leadership must make a decision as to the type of culture to be deployed: *adversarial* or *collaborative*.

- Senior executives must:
  1. Build a unified vision around the three principles of:
     - High performance,
     - High profitability, and
     - High sustainability
  2. Remove any leaders committed to *adversarial* thinking
  3. Develop a set of high performance values, metrics & rewards that support a *collaborative* culture, then live by these.
Key Message

- Our future is at stake
- We have no option but to shift to a Collaborative Construction Model
  - Reduce costs, get the projects back on track, and prevent litigation in the future.
- The movement to make this happen must start with senior management of the energy companies.
Key Message

- We all have a role to play
  - Owners
  - Engineering Contractors (EPC)
  - Construction Contractors
  - Labour
  - Governments
  - Stakeholders
COAA/CII/U of C Findings

Findings of a New Study

Table 9: Factors that affect Project Performance (references)

<table>
<thead>
<tr>
<th>Factors that affect project performance</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Insufficient/incomplete front end planning, cutting corners</td>
<td>1, 2, 5, 19, 28, 33, 50, 52, 57, 59, 61</td>
</tr>
<tr>
<td>2. Inaccurate/unreal estimates/economics, optimistic bias, aggressive targets</td>
<td>2, 16, 19, 25, 39, 50, 55, 57, 61, 79, 86</td>
</tr>
<tr>
<td>3. Poor risk assessment/management, uncertainty, poor risk sharing</td>
<td>2, 6, 25, 42, 50, 52, 57, 61, 78, 79</td>
</tr>
<tr>
<td>4. Poor governance, oversight, support, business/project/strategy management</td>
<td>2, 5, 9, 28, 36, 37, 55, 57, 86</td>
</tr>
<tr>
<td>5. Team conflict, turnover, lack of integration, lack of continuity, poor interface management</td>
<td></td>
</tr>
<tr>
<td>6. Unclear scope/objectives, late scope changes, scope creep</td>
<td></td>
</tr>
<tr>
<td>7. Changes, slow/poor decision making</td>
<td></td>
</tr>
<tr>
<td>8. Contract strategy, responsibilities, slow payment, lump sum barriers</td>
<td></td>
</tr>
<tr>
<td>9. Unmet stakeholder requirements, poor stakeholder/user engagement</td>
<td></td>
</tr>
<tr>
<td>10. Poor monitoring/control, lack of control</td>
<td></td>
</tr>
<tr>
<td>11. Incomplete contingency plan, low contingencies</td>
<td></td>
</tr>
<tr>
<td>12. Inexperienced, lack of project management skills</td>
<td></td>
</tr>
<tr>
<td>13. Underestimating complexity and magnitude of the project</td>
<td></td>
</tr>
<tr>
<td>14. Incomplete engineering design before construction start</td>
<td></td>
</tr>
<tr>
<td>15. Compressed and aggressive schedule, fast tracking</td>
<td></td>
</tr>
<tr>
<td>16. Poor communication</td>
<td></td>
</tr>
<tr>
<td>17. Procurement strategy (global/local), late material/equipment delivery</td>
<td></td>
</tr>
<tr>
<td>18. People (limited resources), labour, engineering, construction management</td>
<td></td>
</tr>
<tr>
<td>19. Engineering/construction productivity</td>
<td></td>
</tr>
<tr>
<td>20. Technology</td>
<td></td>
</tr>
<tr>
<td>21. Insufficient modularization, prefabrication</td>
<td></td>
</tr>
</tbody>
</table>

Table 10: Categories of Factors that affect Project Performance

<table>
<thead>
<tr>
<th>Project Planning</th>
<th>AFE</th>
<th>Project Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Large project size</td>
<td>- Poor project management skills</td>
<td></td>
</tr>
<tr>
<td>- Lessons learned ignored</td>
<td>- Slow decision making</td>
<td></td>
</tr>
<tr>
<td>- Unclear scope/objectives</td>
<td>- Uncontrolled scope creep</td>
<td></td>
</tr>
<tr>
<td>- Poor scope management</td>
<td>- Incomplete engineering design</td>
<td></td>
</tr>
<tr>
<td>- Incomplete front end planning</td>
<td>- Complex new technology</td>
<td></td>
</tr>
<tr>
<td>- Inaccurate/unreal estimates</td>
<td>- Low contingencies</td>
<td></td>
</tr>
<tr>
<td>- Compressed/aggressive schedule</td>
<td>- Rework and changes</td>
<td></td>
</tr>
<tr>
<td>- Incomplete contracting strategy</td>
<td>- Risk averse behaviour</td>
<td></td>
</tr>
<tr>
<td>- Inadequate procurement strategy</td>
<td>- Lack of innovation</td>
<td></td>
</tr>
<tr>
<td>- Inadequate risk assessment</td>
<td>- Poor monitoring and control</td>
<td></td>
</tr>
<tr>
<td>- Incomplete project execution plan</td>
<td>- Mishandled claims and disputes</td>
<td></td>
</tr>
<tr>
<td>- Poor governance, oversight, support</td>
<td>- Team conflict</td>
<td></td>
</tr>
<tr>
<td>- Inadequate staffing</td>
<td>- Insufficient modularization</td>
<td></td>
</tr>
<tr>
<td>- Unsatisfactory contractor selection</td>
<td>- Unsatisfactory productivity</td>
<td></td>
</tr>
<tr>
<td>- Onerous legal contracts</td>
<td>- Unmet stakeholder requirements</td>
<td></td>
</tr>
<tr>
<td>- Poor communication</td>
<td>- Poor communication</td>
<td></td>
</tr>
<tr>
<td>- Deceptive low bidding</td>
<td>- Poor construction management</td>
<td></td>
</tr>
<tr>
<td>- Biased risk management</td>
<td>- Late material delivery</td>
<td></td>
</tr>
<tr>
<td>- Incomplete contingency plan</td>
<td>- High worker turnover</td>
<td></td>
</tr>
<tr>
<td>- Distrustful project culture</td>
<td>- Poor monitoring and control</td>
<td></td>
</tr>
<tr>
<td>- Incomplete transfer of information</td>
<td>- Undefined lines of authority</td>
<td></td>
</tr>
<tr>
<td>- Poor stakeholder engagement</td>
<td>- Poor interface management</td>
<td></td>
</tr>
</tbody>
</table>
3) What can we do tomorrow?

The researchers and professional organizations offered many ideas as to what we could do to improve our capital projects including: (a) actions to improve project performance, (b) executive oversight, (c) systems thinking, (d) leading indicators (early warnings) and (e) benchmarking programs.

(a) Actions to Improve Project Performance

Table 11: Actions to improve Project Performance (reference below)

<table>
<thead>
<tr>
<th>Actions to improve Project Performance</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Leadership, governance (see Executive Oversight questions below)</td>
<td>16, 33, 36, 38, 39, 42, 57, 68</td>
</tr>
<tr>
<td>2. Stakeholder input/communication/alignment</td>
<td>17, 21, 30, 38, 43, 57, 68</td>
</tr>
<tr>
<td>3. Strong risk management program (share risks)</td>
<td>14, 18, 42, 43, 52, 54, 68</td>
</tr>
<tr>
<td>4. Comprehensive front end planning (get it right)</td>
<td>15, 33, 45, 46, 57, 58</td>
</tr>
<tr>
<td>5. Clear roles and responsibilities</td>
<td>18, 21, 41, 42, 52, 54</td>
</tr>
<tr>
<td>6. Strong cost and schedule monitoring and control (stick to the plan)</td>
<td>41, 43, 46, 49, 52, 68</td>
</tr>
<tr>
<td>7. Interface management</td>
<td>18, 19, 21, 40, 80</td>
</tr>
<tr>
<td>8. Manage engineering (do not fast track engineering)</td>
<td>16, 33, 49, 52, 57</td>
</tr>
<tr>
<td>9. Clear scope definition</td>
<td>21, 55, 57, 72</td>
</tr>
<tr>
<td>10. Assign project team early (adequate staffing)</td>
<td>42, 55, 57, 58</td>
</tr>
<tr>
<td>11. Restrict changes (e.g. after constructability review)</td>
<td>4, 7, 9, 72</td>
</tr>
<tr>
<td>12. Manage changes</td>
<td>21, 41, 43, 52</td>
</tr>
<tr>
<td>13. Higher modularization and offsite fabrication</td>
<td>7, 19, 33, 49</td>
</tr>
<tr>
<td>14. Develop contracting strategy early</td>
<td>9, 21, 33, 52</td>
</tr>
<tr>
<td>15. Realistic cost and schedule estimates</td>
<td>14, 42, 43, 66</td>
</tr>
<tr>
<td>16. Strong construction contract management</td>
<td>15, 19, 33, 52</td>
</tr>
<tr>
<td>17. Standardize designs and work processes</td>
<td>18, 55, 57, 78</td>
</tr>
<tr>
<td>18. Integrated project team</td>
<td>46, 58, 63</td>
</tr>
<tr>
<td>19. Reduce project complexity/size</td>
<td>41, 49, 61</td>
</tr>
<tr>
<td>20. Manage key suppliers/logistics</td>
<td>18, 19, 41</td>
</tr>
<tr>
<td>21. Align expectations/team</td>
<td>28, 57, 72</td>
</tr>
<tr>
<td>22. Strong construction labour relations (incentives, schedules, site, size)</td>
<td>33, 49, 52</td>
</tr>
</tbody>
</table>

23. Board of Directors oversight (see Executive Oversight questions below) | 57, 86 |
24. Cost driven not schedule driven | 55, 66 |
25. Risk assessment before estimates | 27, 66 |
26. Use Best Practices (CII and others) | 7, 72 |
27. Develop dispute avoidance/resolution model | 13, 52 |
28. Focus on Project Management best practices (skills training) | 14, 52 |
29. Apply lessons learned | 14, 72 |
30. Early focus on supply and contract optimization | 18, 52 |
31. Clear communications | 18, 33 |
32. Complete constructability reviews | 20, 33 |
33. Develop long term relationships | 52, 78 |
34. Optimize scarce talent | 52, 82 |
35. Select appropriate project delivery system | 42 |
36. Less fast tracking | 66 |
37. Near term thinking | 36 |
38. Early contractor involvement | 4 |
39. 10-4 construction site work schedule | 7 |
40. High quality FEED | 9 |
41. Complete the project execution plan | 9 |
42. Incremental design optimization | 78 |
43. Develop construction plan early | 9 |
44. Local versus global sourcing | 49 |
45. Monitor and control global sourcing | 11 |
46. Select better projects | 14 |
47. Manage cash flow | 14 |
48. Trim project portfolio (less projects simultaneously) | 16 |
49. Independent peer reviews | 17 |
50. Benchmark projects | 17 |
51. Capture risk history | 27 |
52. Review risks at 30% review | 27 |
53. Manage political influence | 33 |
54. Continuous improvement culture | 72 |
55. Accelerate operational readiness | 82 |
3) What can we do tomorrow?

The researchers and professional organizations offered many ideas as to what we could do to improve our capital projects including: (a) actions to improve project performance, (b) executive oversight, (c) systems thinking, (d) leading indicators (early warnings) and (e) benchmarking programs.

(a) Actions to Improve Project Performance

Table 11: Actions to improve Project Performance


Authorization for Expenditure (AFE). These categories of suggested actions allow us to focus our resources to achieve the best results for the two parts of a project.

Table 12: Categories of Actions to Improve Project Performance

<table>
<thead>
<tr>
<th>Project Planning</th>
<th>AFE</th>
<th>Project Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce project size/complexity</td>
<td>Clear roles and responsibilities</td>
<td></td>
</tr>
<tr>
<td>Clear scope definition</td>
<td>Strong cost/schedule monitoring and control</td>
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<tr>
<td>Apply lessons learned</td>
<td>Manage engineering</td>
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<tr>
<td>Comprehensive front end planning</td>
<td>Manage/restrict changes</td>
<td></td>
</tr>
<tr>
<td>Strong risk management plan</td>
<td>Standardize designs</td>
<td></td>
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<tr>
<td>Early contracting strategy</td>
<td>Local versus global sourcing</td>
<td></td>
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<tr>
<td>Realistic estimates</td>
<td>Integrated project team</td>
<td></td>
</tr>
<tr>
<td>High quality FEED</td>
<td>Strong construction management</td>
<td></td>
</tr>
<tr>
<td>Complete project execution plan</td>
<td>Manage key suppliers</td>
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<tr>
<td>Strong leadership/governance</td>
<td>Strong interface management</td>
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<tr>
<td>Stakeholder input</td>
<td>Ongoing dispute avoidance and resolution</td>
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<tr>
<td>Assign project team early</td>
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<tr>
<td>Clear communications</td>
<td></td>
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<tr>
<td>Early contractor involvement</td>
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<tr>
<td>Optimize scarce talent</td>
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</table>
1) Recommendations from Industry Survey Group

The industry executives that participated in the survey identified a number of actions that they recommend be taken to improve project performance. These recommended actions include the following:

- Complete front-end planning including the Project Execution Plan (PEP)
- Align all project teams to follow the Project Execution Plan (PEP) and remove those who are not aligned
- Get the project scope right and don’t make changes
- Provide sufficient time to complete the engineering design
- Spend more time with key Suppliers and Fabricators – expedite well and continually - since they can make or break a project
- Increase standardization and modularization
- Develop a workable contracting strategy
- Conduct a serious analysis of all types of risks including global risks that are outside the control of the Project Manager and the Executives
- Include the right levels of contingencies in the budget
- Exhibit leadership that is empowered to make decisions without fear of blame
- Assign project leaders and project teams early and maintain continuity
- Develop strong teamwork and collaborative relationships
- Be open about your capabilities - do not be afraid to ask for help
- Assign experienced and competent professionals to all project teams
- Maintain the continuity of all project teams

Table 14: Categories of Leading Indicators as Early Warnings

<table>
<thead>
<tr>
<th>Project Planning</th>
<th>AFE</th>
<th>Project Implementation</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td>Changes to scope during FEED</td>
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<tr>
<td>Delays in engineering</td>
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<tr>
<td>Contingencies used quickly</td>
<td></td>
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<tr>
<td>Late permits</td>
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<tr>
<td>Late decision making</td>
<td></td>
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<tr>
<td>Pilot facility not completed</td>
<td></td>
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<tr>
<td>Long lead items not ordered</td>
<td></td>
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<tr>
<td>Low staffing levels</td>
<td></td>
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<tr>
<td>Contractor not accepting contract</td>
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<tr>
<td>Changes from stakeholders</td>
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<tr>
<td>Onerous local content requirements</td>
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<td></td>
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<tr>
<td>Environmental, political, social interruptions</td>
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<tr>
<td>Vendor information late</td>
<td></td>
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<tr>
<td>Changes in approved construction and engineering plans</td>
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<td></td>
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<tr>
<td>Material delays</td>
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<tr>
<td>Multiple change orders</td>
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<td></td>
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<tr>
<td>Changes to long lead items after orders placed</td>
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<td></td>
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<tr>
<td>Delays without schedule change</td>
<td></td>
<td></td>
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<tr>
<td>Vendors provide target dates only</td>
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<tr>
<td>Late mobilization</td>
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<tr>
<td>Disputes between contractors</td>
<td></td>
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<tr>
<td>Low engineering and construction productivity</td>
<td></td>
<td></td>
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<tr>
<td>Incomplete design before construction</td>
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</tbody>
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