Top 10 Areas for Productivity Improvement on Alberta Mega Oil Sands Construction Projects

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Defining Mega Projects

- Cost > $1 billion plus
- Significant interfaces / complexity
  - Many players with different interests and motives
- Most significant issues & risks must be managed at a level above the project team
- Fast tracked
Causes for Cost and Schedule Overruns

Unrealistic or overly optimistic original (AFE) cost estimate and schedules

- The under appreciation of project complexity, interfaces, interdependencies and risks.
  - Underestimating the cost to attract and maintain labour.
  - Underestimating the direct and indirect costs of overtime.
  - Craft wage increases to attract personnel to the location.
  - Regional and national demands on labour, including that from other mega projects.
  - Under estimation of the labour productivity loss associated with working in cold weather climates and locations with severely shorter daylight hours in northern.
  - Shortages of skilled labour.
  - Lower than anticipated labour productivity due to mismanagement of the construction phase.
  - High labour turnover mainly due to the harsh working environment and competition between employers attracting labour.
  - Underestimating transportation costs (including custom cost) for permanent materials, construction equipment, personal, staff, etc.
  - Environmental and regulatory compliance costs are not given sufficient consideration.
  - Material cost for both permanent facilities and temporary facilities are not sufficiently escalated during the project budget development phase.
Causes for Cost and Schedule Overruns

2. Incomplete scope definition or inadequate Front End Loading

- Mainly due to the fast-tracking nature of mega projects an
- Ongoing changing customer requirements.
  - Lack of understanding of the cumulative impact of scope changes on project cost and schedule.
Causes for Cost and Schedule Overruns

3. Inappropriate project strategies for the mega oil sands environment

- Some project strategies deployed do not properly consider the level of scope definition, the fast track nature of the mega project environment, market condition, owner participation, owner control and owner risk.
- Improper or late consideration of the following project strategies adds to cost overruns (ECI, 2002):
  - Project management strategies such as risk management, project control, change control, communications, organization and responsibilities.
  - Contract strategies relating to management, design, construction and commissioning services.
  - Design strategies such as contributions from client business, operation, project team, contractors and suppliers.
  - Procurement strategies including preferred suppliers, progressing, inspection and expediting, receipt, storage and management, spares and documentation.
  - Construction strategies including site management and organization, site layout, power, utilities and drainage, work breakdown structure, construction method, off-site prefabrication and assembly, schedule and milestones, industrial relations, and pre-commissioning.
  - Commissioning strategies including responsibilities, schedule and integration with construction, resources, training and validation, engineering and trade support, and provision of operating materials.
Causes for Cost and Schedule Overruns

4. Mismanagement of the construction phase:

- Later than anticipated engineering, vendor data, equipment and material deliveries.
- Poor project controls. Nobody on the project has single point responsibility except the client who does not control much of the work.
- Inadequate plan of execution and poorly defined tasks and division of responsibility.
- Lack of knowledgeable leadership in the engineering, procurement, construction and start-up of mega/major facilities.
- Inexperienced or poorly equipped project management personnel and supervisors coupled with the inability to understand, plan, adapt, implement project management procedures or systems.
- Lack of standardization and fit-for-purpose including inadequate use of shop fabrication, modularization strategy and constructability reviews.
- Poor communication, team work and alignment between the players leading to adversarial relationships and protracted disputes.
- Poor site organization and layout leading to excessive time wastage and productivity loss during construction.
- Joint venture (JV) of project partners, contractors and engineering firms that are not aligned or not set up to work effectively.
Reasons for Cost Overruns

- Changing customer requirements
- Lack of understanding the costs of changes
- Lack of standardization and fit-for-purpose
  - Inadequate use of shop fabrication/ modularization strategy
  - Little or no constructability reviews
- Poor communication and follow-up
- Poor site organization leading to excessive time wastage
- Inability to understand, plan, adapt, implement procedures or systems
- High labour turnover
Characteristics of Mega Projects

- Huge in size and requirement for financial resources
- Stretch available resources to the limit, people, materials, environment
- Built in areas with hostile climates
- Team members turnover
- Several functional areas with separate project managers, schedules, budgets and contracting strategies
- Fast tracked
- Cost plus arrangement
- Cost overruns
  - Consistently 50% to 100%
Project Phases or the Gated Process

**PHASE 1**
IDENTIFY & Assess Opportunities
- Determine Project Feasibility and Alignment with Business Strategy

**PHASE 2**
SELECT from Alternatives
- Select the Preferred Project Development Option

**PHASE 3**
DEVELOP Preferred Alternative
- Finalize Project Scope, Cost and Schedule and Get the Project Funded

**PHASE 4**
EXECUTE (Detail EPC)
- Produce an Operating Asset Consistent with Scope, Cost and Schedule

**PHASE 5**
OPERATE & Evaluate
- Evaluate Asset to Ensure Performance to Specification s and Maximum Return to the Shareholders

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

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Early Warning Signs

1. Delays in Engineering

- Early delays in achieving key milestones such as:
  - Substantial Completion of Engineering
  - Freezing Process Flow Diagram’s (PFD’s)
  - P&ID issued for design
- Delays do not seem to be reflected on final project completion date
  - Fast-tracking the fast-track!
Early Warning Signs

2. Huge number of Trends/scope changes and project re-estimates

3. Contingencies and Allowances consumed quickly.
   - Warning signal to the PM that events are not evolving as expected
Industry Survey

- Survey question
  - What do you suggest to improve construction productivity in the delivery of the oil and gas capital projects?

- 77 highly experienced people
  - Owner, EPC and Constructors

- 309 recommendations
Top 10 Areas

1. Labour Management, Conditions and Relations
2. Proper Project Planning and Workface Planning
3. Construction Management and Support
4. Engineering Management
5. Effective Supervision and Leadership
6. Communication
7. Contractual Strategy and Contractor Selection
8. Constructability in Engineering Design
9. Government Influence
10. Modularization, Prefabrication, Pre-build in Shops
1. Labour Management, Conditions and Relations

- Incentive programs
- Remote locations
- Access to job-site
- Labour management and relations
- Resource scheduling (shift and overtime)
- Training and certification of workforce
2. Project Front-end Planning and Work Face Planning

- Proper amount of FEL complete before execution (Design and Construction)
- Implement Workface planning
3. Management of Construction and Support

- Tools
- Equipment
- Access to site and site layout
- Camp facilities
- Travel
- Health programs
- Scaffolding
- Safety
- Management of change and rework minimization
- Material management and supply chain management
- Quality
- Contract administration
- Progress measurement
4. Engineering Management

- 80 -100 rule
  - 80% of engineering complete before mobilizing to site
  - 100% of IFC drawings before construction
- Enhance quality of engineering organizations
- No fast tracking
- Design review by construction and operation
5. Effective Supervision and Leadership

- Supervision to labour ratio 1 – 8 to 1 – 20
- Accountability of scope, time and cost
- Organized management
- Decision making and follow-up
- Empowerment
6. Communication

- Recognize challenges of communication on mega projects
- Daily communication
- Clarity of roles
- Clear lines of communications
- Minimize levels of communications
- Well coordinated team
7. Contractual Strategy and Contractor Selection

- Select appropriate contracting strategies
  - EP, CM, C
  - Lump sum
  - Make procurement/material handling the responsibility of a single company
- Break the project into smaller projects
- Use liquidated damages
- Contracts with incentives
- Avoid fast tracking
- Proper risk allocation
Advantages of Lump Sum – Engineering Contractor Opinion

- Cost certainty for owner.
- Profits for engineering contractor are higher if the risks are well managed.
- All parties focused on same goal of delivering project on cost and schedule.
- The project scope is forced to be more clearly defined and agreed upon.
- Forces proper project planning at all project stages.
Disadvantages Lump Sum – Engineering Contractor Opinion

- Must apply a larger risk premium increasing owner’s cost.
- Too risky because of Alberta labour market challenges.
- Too risky because of desire for involvement of Alberta clients.
- Can not fast track (overlap phases) of project.
- Poor scope: Contractor unable to predict the schedule and resources.
- Owner must relinquish control of project planning and execution to contractor at contract award.
Advantages and Disadvantages of
Lump Sum – Operating Company

Advantages:
- Cost certainty/control
- Transfer of risk
- Decrease cost

Disadvantages:
- Potential for too many unknown risks
- Potential for too many scope changes
8. Constructability in Engineering

- Involve operation and construction in detailed engineering
- Timely constructability inputs
- Seek lessons learned, best practices
- Standardize design
- Fit for purpose
- Simplify owner processes, procedures
9. Government Influence

- Pace the startup of mega projects
- Look at other countries experience
- Withhold regulatory approval until a target FEL is reached
- Remove cross provincial and trade barriers
- Increase royalties during boom times and use it during bust times
- Improve infrastructure in and around Fort McMurray
- Ensure sustainable development
10. Modularization, Prefabrication, Pre-build in Shop

- Use standardization in plant design and construction
- Do as much work in vendor’s shop
- Standardize drawings, vendors
- Modularize
- Use prefabricated units
Conclusions

- We can improve our performance
  - It is not impossible
  - Commitment
- We all have a role to play
  - Owner
  - EPC
  - Contractor and labour
- Lessons re-learned
  - Barriers to implementation