Panama Canal - Third Set of Locks Expansion Project

Project Controls in a multi-cultural environment
Agenda

• SIS Relationship to the Project
• SIS Scope of Work Summary
• Building the Canal – Then and Now
• Baseline Development & Challenges
• Project Scale vs. Complexity
• Complex Projects – Project Controls Issues
• Lessons Learned & Recommendations
SIS Relationship to the Project

• Provided scheduling services for Impregilo-Healy on the Portland Combined Sewer Overflow tunneling project in 2005/2006
• Provided scheduling services for Impregilo-Healy on the Las Vegas Lake Mead Intake Structure Project 2007/2008
• Retained by GUPC to develop the Baseline Schedule for the Locks Expansion Project in 2009
• Provide ongoing support for the Locks Expansion Project 2009 to present
SIS Panama Canal Project Involvement

- Phase 1: Baseline Schedule Development
- Phase 2: Ongoing Project Scheduling and Document Control Support
- Phase 3: Project Controls Assessment and Recommendations
SIS Panama Canal Project Involvement

- **Phase 1: Baseline Schedule Development**
  - Develop the Baseline Master Schedule from the bid schedule
  - Evaluate / Prove Production Rates
  - Establish Earned Value Systems Outline
  - Perform Schedule Risk Analysis
  - Facilitate Baseline Schedule Workshop (10 days long)
  - Baseline Submittal Package (565 pages when completed)
SIS Panama Canal Project Involvement

• Phase 2:
  • Provide on site scheduling support
  • Quarterly Risk Analysis
  • Train local staff in P6 scheduling techniques
  • Provide Document Control Manager
SIS Panama Canal Project Involvement

• Phase 3:
  • Evaluate Planning, Scheduling and Tracking processes
  • Assess ability of the processes to provide required information
  • Identify short comings and provide direction for improvement
Building the Original Canal

- First surveyed in 1534 by order of Charles V of the Holy Roman Empire
- Men behind the Suez Canal and Eiffel Tower failed at building the canal between 1880 and 1893
  - More than 20,000 workers died
- In 1903 US Congress authorized the purchase of French assets for $40 million and negotiated a treaty with Panama for $10 million for 500 square miles in which to build and operate the canal
  - Annual lease payment $250,000
- US spent $375 million to build the canal from 1904 to 1913 (about $9 billion adjusted for inflation)
  - More than 5,600 workers died
Building the Original Canal

- First ship passed through the Canal in September 1913
- Official opening August 1914
- US transferred control of the Canal to Panama on December 31, 1999
Building the Original Canal – Fun Facts

• More than four and half million cubic yards of concrete went in to the construction of the locks and dams.
• If material originally excavated to build the Canal were put on to a train of flat cars it would encircle the world four times.
• Excavation of the Canal was equal to digging a trench 10’ deep by 55’ wide from California to New York.
Building the Original Canal – Fun Facts

• More than 60,000,000 pounds of dynamite was used to excavate and construct the Panama Canal.

• In 1963 the Panama Canal started operating 24 hours per day, thanks to the introduction of high mass fluorescent lighting.

• Due to the reclining "S" shape of the Isthmus of Panama the sun rises from the Pacific and sets in the Atlantic Ocean and the Atlantic Entrance is 22 ½ miles West of the Pacific Entrance.
Expansion Project Summary

1. **Third Set of Locks**
   - The expansion will add a third lane of traffic to allow the transit of larger ships with more cargo capacity.
   - The expansion broke ground on September 3, 2007 and is moving forward in its goal of doubling the capacity of the Canal.

2. **Project Components**
   - Deepening of the Pacific and Atlantic Canal entrances.
   - Widening and deepening of the Gatun Lake navigational channel, and deepening of Culebra Cut.
   - Building of the new locks and water-reclamation basins on the Atlantic and the Pacific.
   - Raising of Gatun Lake maximum operational level.

3. **Diagram of Water-Saving Basins**
   - The use of more efficient cycling gates will facilitate the maintenance.
Canal Operations

**Current System**
- Lock Size: 1000’ x 110’ x 42’
- Max ship size: 965’ x 106’ x 39 ½’
- Max Cargo: 4,400 TEU’s
- Fresh water used per transit: 52 million gallons
- Transports 4% of world trade

**Post Panamax**
- Lock Size: 1400’ x 180’ x 60’
- Max ship size: 1200’ x 160’ x 50’
- Max Cargo: 12,600 TEU’s
- Fresh water used per transit: 21 million gallons
SIS Panama Canal Project Involvement

- Phase 1: Baseline Schedule Development
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Expansion Project Major Parties

- ACP: Panama Canal Authority
- CH2M Hill: Program Manager
Expansion Project Challenges

• Multi-national Participants
  • Language barriers
  • Cultural differences
  • Execution differences
  • Internal systems differences
  • Expectations
  • Financial Considerations
Project Controls Systems in use by GUPC

- Scheduling
  - Master
  - Detailed
- Earned Value
  - Design
  - Construction Quantities / Commodities
- Procurement
- Document Control
- Financial
Schedule Development Considerations

• Structure
  • Coding
  • WBS
  • Naming Conventions
  • Area Designations
Schedule Development Considerations

- Consistency
- Settings / Rules
- Methods for adding details
- Methods for tracking impacts
Schedule Development Considerations

- Calendars
- Resources
- Reporting
- Communicating the Plan
Baseline Schedule Assumptions

• Schedule development considerations:
  • Production Rates / Limits
    • Dredging       ~600,000 cm/mth
    • Excavation     ~900,000 cm/mth
    • Backfill       ~600,000 cm/mth
    • Concrete       ~110,000 cm/mth
    • Re-Steel       ~6,000 mt/mth
Baseline Schedule Sample
Baseline Schedule Samples

The image shows a graph titled "Reinforcing steel procure - install balance." The x-axis represents months from November 2010 to May 2014, while the y-axis measures the quantity of reinforcing steel procure and prepare (cumulative). The graph compares different phases of the project:

- Re-steel - Pacific - Stock balance (monthly)
- Re-steel installation - Pacific - (cumulative)
- Re-steel - Pacific - procure and prepare (cumulative)
Crushing plants and Barges system
Monthly number of working days necessary to fulfill requirements

- Aggregates & filters - Pacific Primary and Secondary crushing plants
- Aggregates & filters - Pacific Tertiary and Quaternary crushing plants
- Barge system
- Aggregates & filters - Atlantic Tertiary and Quaternary crushing plants
Baseline Schedule Sample
Baseline Schedule Sample – Temp Facilities

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Baseline Schedule Sample
Baseline Schedule Samples
### Risk Rating Matrix

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**Baseline Schedule Sample**

![Diagram of risk management process]

- **Risk Identification**: Risk is identified and risk input sheet is determined.
- **Risk Assessment**: Risk score and present in risk review panel.
- **Risk Review**: Risk review process.
- **Risk Mitigation**: Mitigation plan implemented and risk reviewed.
- **Risk Monitoring**: Monitor mitigation plan and risk level.
- **Risk Control**: Approve mitigation plan and budget.
### Canal Basin Average Rain (mm)

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<th></th>
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<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
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### Graph

- **Legend:**
  - **Canal Basin Average Rain (mm)**
  - **Concrete Revised % non working**
  - **Earthwork Revised % non working**

The graph shows the average rainfall in the canal basin for each month, with additional data points indicating concrete and earthwork revisions.
Baseline Workshop

• 10 day workshop over three week time period
• Joint review of the planning and scheduling process by all parties
  • Structure
  • Rules
  • Production Rates
  • Sequencing
  • Earned Value Measurement
  • Cost Loading
  • Risk Analysis Review
Project Scale vs. Complexity

• 10,000 Cubic Yards over a 10 month time frame is not as complex as 10,000 Cubic Yards over a 10 week time frame
• $10,000,000 project is not just 10x larger than a $1,000,000 project it is also more complex (but not 10x more complex)
• As project scale increases project controls needs increase
• As project complexity increases project controls needs increase
Project Scale vs. Complexity

- Project Size tends to drive Project Controls expectations, usage & funding
  - Foreman and a pick-up truck: ~$50,000
  - GF and a Conex: ~$100,000
  - Superintendent and a single wide: ~$1,000,000
  - Construction Manager and a double wide: ~$5,000,000
  - Project Manager and a trailer complex: ~$50,000,000
  - Project Director and a compound: ~$200,000,000 & up
As projects get larger and more complex the basics often get overlooked in favor of fancier charts and graphs.

In its simplest form project controls is about knowing the following:

- What needs to be done
- How much needs to be done
- When does it need to be done
- What resources are required to do it
- What has been done

Short changing any of these areas will decrease project performance.
Complex Projects Controls Issues: Planning

• Multiple schedules, in multiple formats, utilizing multiple sources of external information, at varying levels of detail used by multiple departments

• Lack of integrated schedules or ties from detailed schedules to master schedule (manual date and logic transfers)

• Schedules lack labor or construction equipment resource information

• Short Interval Schedules do not support the master schedule
Complex Projects Controls Issues: Scheduling

• High volume of In Progress activities
• High volume of extended duration activities
• Use of FS lags to control planned activity dates
• Remaining Durations not accurate
• Monthly instead of weekly updates
• Lack of resources to schedule and status all of the work fronts
Complex Projects Controls Issues: Budgeting

• Multiple budgeting / estimate at completion systems and values
• System for moving from conceptual budgets to quantity at completion budgets varies widely by department / entity
• Timeliness of budget development
Complex Projects Controls Issues: Tracking

• Multiple Units of Measure for similar/same item in use by different departments
• Differing EAC values between departments for the same item
• Differing Percent Complete between departments
• Multiple Tracking/Reporting systems and formats in use for similar/same items
Complex Projects Controls Issues: Financial

• The hold back of money on cost loaded schedule items causes activities to extend well beyond their original forecast
• Schedule budgets not in alignment with cost systems
• Activities in progress with no billings
Complex Projects Controls Issues: Risk Assessment

- Risk Analysis performed with limited input
- Duration ranges are based on previous month performance of a select set of activities rather than cumulative performance on a broad base of activities
- Mitigation strategies not being developed and implemented for all high risk items
Lessons Learned about complex projects

• The bigger the project the more often the basics get skipped. (Budgets, updates, reporting, resource loading)

• Joint Ventures need more attention due to competing interests and company / country culture differences

• The more complex the work the more basic controls and cross checks need to be in place. (i.e., rather than just track concrete poured also track rebar received, rebar placed, cement received & placed, to get cross checks on progress)
Lessons Learned about complex projects

- Low bid may not be best value
- When financials are bad do not skimp on project controls and measurement
- Follow through on the project planning and kick-off
- Resource loaded schedules are key
# Scheduling Practices and Project Success

<table>
<thead>
<tr>
<th>Outcome Metric</th>
<th>Resource Loaded CPM</th>
<th>CPM</th>
<th>Milestone</th>
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<td>Absolute Schedule Performance</td>
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*Cost & Schedule Comparable to Similar Projects*

*Cost & Schedule Baseline Comparison*
Recommendations for Effective Project Controls

• Keep it Simple
• Track performance as well as progress
• Multiple, smaller metrics rather than one big metric
• Evaluate all major resources
• Weekly Measurement & Response
• Monthly Analysis & Evaluation
• Quarterly Reforecast
Simplicity is the result of a concentration of ideas and information, and not about leaving out ideas and information.
References

• **Videos /Web Cams:**
  • [http://www.youtube.com/watch?v=olZ_6UVmoKo](http://www.youtube.com/watch?v=olZ_6UVmoKo)
  • [https://www.youtube.com/watch?v=9svL4qlkOW8](https://www.youtube.com/watch?v=9svL4qlkOW8)
  • [https://www.youtube.com/watch?v=QfGP1ZXjKZI](https://www.youtube.com/watch?v=QfGP1ZXjKZI)
  • [https://www.youtube.com/watch?v=93qtCpfckPE](https://www.youtube.com/watch?v=93qtCpfckPE)

• **Articles:**
Project Planning, Scheduling, Controls and Knowledge

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