

4-6 October, Nationals Park, Washington DC



## Proven Success Stories at Airport Capital Programs

Chris Carson, FRICS, FAACE, FGPC



(W)[www.projectcontrolexpo.com/usa](http://www.projectcontrolexpo.com/usa) (M) +44 (0) 203 883 1386 (E)[usa@projectcontrolexpo.com](mailto:usa@projectcontrolexpo.com)

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# Chris Carson, PSP, DRMP, CEP, CCM, PMP

- Director of Program & Project Controls, Vice President, ARCADIS
- Certifications:
  - DRMP: Decision & Risk Management Professional – AACE International
  - PSP: Planning & Scheduling Professional – AACE International
  - CEP: Certified Estimating Professional – AACE International
  - CCM: Certified Construction Manager – CMAA
  - PMP: Project Management Professional – PMI
- University of Virginia, Mechanical Engineering, 1972
- 45 years of experience in CM and CM Services specializing in Planning and Scheduling, Cost Management, Risk Management, Forensic Analysis, Dispute Resolution
- Fellowships and Awards
  - Selected as a 2015 Fellow by RICS (Royal Institution of Chartered Surveyors)
  - Selected as a 2014 Fellow of Project Controls by the Guild of Project Controls
  - Selected as a 2013 AACE Fellow by AACE International
  - Recipient of the 2021 AACE International “O. T. Zimmerman Founder’s Award”
  - Recipient of the 2011 AACE International “Technical Excellence Award”
  - Received award for “Significant Contributions to The Scheduling Industry” from PMI, 2009
  - Awarded first CMAA “Chairman’s Award” for contributions to CMAA and the CM profession, 2006
  - Top Ten Contributor to AACE Recommended Practices





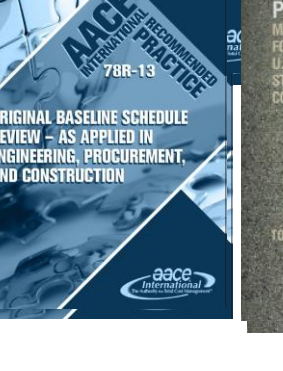
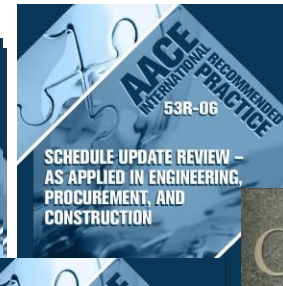
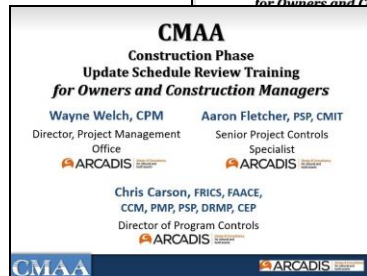
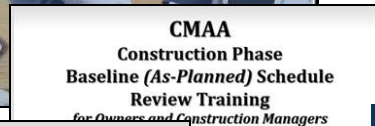
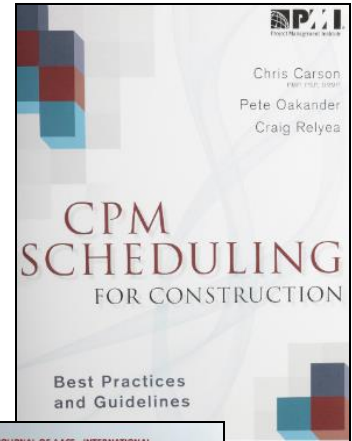
# Chris Carson, FRICS, FAACE, FPC



## • OVER 75 PUBLICATIONS:

- ✦ PMI book, “CPM Scheduling for Construction - Best Practices and Guidelines”
- ✦ CMAA Guidelines contributor – Time & Claims Management
- ✦ AACE RPs, Journal articles in Scheduling, Risk, Cost, Forensic Analysis – 18 total RPs with 2 Currently in Peer Review
- ✦ Three articles published in 2021 AACE Cost Engineering Journals

## • OVER 750 SEMINARS/TRAINING/PRESENTATIONS



# Introduction

**"Megaprojects are large-scale, complex ventures that typically cost \$1 billion or more, take many years to develop and build, involve multiple public and private stakeholders, are transformational, and impact millions of people"**

*Oxford Handbook of Megaproject Management*



# Global Aviation Projects

London Heathrow Airport



Berlin Brandenburg Int'l Airport



Sao Paulo Airport



Arcadis has a global reputation among airport authorities and operators.

Frankfurt Airport



Amsterdam Schiphol Airport



# US Aviation Projects



**8** Airports  
within last 10 years

**\$2** Billion





# Involvement in Airport Capital Programs

- Central Terminal Optimization Program (TOP), Miami International Airport
  - Central Base Apron & Utilities Subprogram, South Terminal Program: Baggage handling system, Concourse “E” Renovations & Chiller Plant, Miscellaneous Projects Subprogram, Passenger Boarding Bridges Subprogram
- Terminal One Redevelopment Program, Newark Airport
  - Terminal One, Entry Bridges, Access & At-Grade Roads and Road Widening, Parking Garage & Toll Plaza, Pedestrian Walkway, Perimeter Ditch, Airside Utilities & Paving North & South, Demolition Terminals A1, A2, A3
- North Terminal Development Program, Miami International Airport
  - North Terminal Gate Renovations, Baggage Handling System, Interiors, Art Program, A-B Pre-demolition, Regional Commuter Facility, BC Mitigation
- South Terminal Development Program, Phase 2, Miami International Airport
- MIA Mover Light Rail, Miami International Airport
- Automated People Mover, Miami International Airport
- Airside C Terminal & Cooling Tower, Tampa International Airport



# Introduction

- These Airport Capital Programs can be:
  - Single projects
  - Single programs with limited projects
  - Single programs with many projects
  - Single programs with many disciplines
- With Project Delivery Methods of:
  - Design-Bid-Build
  - Design-Build / EPC / PPP
  - Multi-Prime
  - CM at Risk
  - Combination

# Construction Industry Institute (CII) Best Practices

## Result in greatest cost protection from front-end planning

Group	Best Practices	Owner		Contractor	
		Cost Growth	Schedule Growth	Cost Growth	Schedule Growth
<b>Planning</b>		√			
	FEP	√			
	Alignment During FEP	√			
	Planning for Start-up	√	√	√	
<b>Execution</b>				√	
	Constructability			√	
	Change Management	√			
<b>Organization and Behavior</b>					
	Partnering	√			
	Team Building		√		

**CII Best Practices Guide, Table 1-1.**  
 Summary of statistically significant relationship between CII Best Practices implementation and project performance

# Global Construction Disputes

## Disruptive Influence of Disputes and Claims

Three quarters (75%) of those who participated in the study experienced a claim or dispute in the last five years, including 83% of the GC respondents.

**The top risk factors are related to coordination or planning & scheduling**

(“SmartMarket Report – Managing Risk in the Construction Industry”, Dodge, 2016)

### Top Risk Factors

(According to All Respondents)

Dodge Data & Analytics, 2017

Labor Procurement Risks/  
Subcontract Management



Schedule Changes



Contractual Specification of Risk



Planning/Scope Changes



Contractual Risks  
(Owners of Project Specs,  
Warranty Guarantees, etc.)





# Project Controls for Airport Capital Programs

- From dozens of megaproject disputes, failure correlates with:
  - Low detail master schedules
  - Lack of integration in engineering and trade scheduling
  - Managing schedules missing significant project influences
  - Weak schedule maintenance practices
  - Lack of strong planning & scheduling leadership
  - Lack of senior management support for high-end scheduling
  - Poor or insufficient technical analysis
  - Inability to identify and predict performance failures
  - Inability to identify delays in time to mitigate

# Airport Capital Programs Scheduling

# Introduction

- Airport Capital Programs require a high degree of coordination
- Failures are often due to coordination issues
- The schedule is the primary coordination tool and primary road to failure
- Planning & managing an Airport Capital Program with a multi-prime program is best handled by an Integrated Program Schedule
  
- This session illustrates a structured approach to airport capital program scheduling, resulting in claims avoidance efforts built into the scheduling effort



# Introduction

- Risk is a major concern in programs – balance risk & control
- Multi-Prime project delivery is highest risk & greatest control for owner

PROJECT DELIVERY METHODS				
P3	Design-Build	Design-Bid-Build	CM at Risk Contracts	Multiple Prime Contracts
LEAST	OWNER'S RISK			GREATEST
GREATEST	CONTRACTOR'S RISK			LEAST
LEAST	OWNER'S CONTROL			GREATEST
GREATEST	CONTRACTOR'S CONTROL			LEAST

# Airport Capital Program Differentiators

- Multi-prime programs are common in Airport Capital Programs
- Multi-prime programs are very different from smaller or simpler projects
- In programs, program managers or owners do not have the ability or desire to direct daily work
- This creates additional risks due to conflicts between:
  - Contractor work zone overlaps
  - Contractor lay-down areas
  - Contractor parking and access areas
  - Contractor sequencing overlaps
  - Engineering package sequencing and implementation

# Scheduling Differences

- Project schedules rarely contain all the owner responsibilities
  - Those are carried in Master Schedules, if at all
  - General Contractors determine the sequencing of all trades
- Program schedules must contain all owner responsibilities
  - PMO activities such as design, procurement, award
  - Third party influences
  - Supporting or enabling projects
  - Engineering design/handoff
- Program schedules must also coordinate all primes



# Contractual Differences

- Project contracts address scope of work for project only – the prime must contract trade work
- Program contracts are individual contracts
  - Do not accommodate other primes
  - Engineering design responsibilities often split
  - Do not include all the coordinating requirements to work with other primes
  - Are sequenced such that not all scope is understood early
  - Cannot easily require primes to solve their coordination issues
- Even when one prime is “assigned” coordination responsibilities, there is still some legal limitations to pursuing inter-project claims or disputes

# Project Planning – Schedule is Driver

- Since coordination is so important in a program
  - Schedule management is vital
  - This requires an early Schedule Management Plan along with the Program Controls Plan
  - Schedule Management includes:
    - RASCI chart showing responsibilities
    - Schedule specification language specific to integration
    - Addressing dedicated schedule components
    - Identification of inter-project dependencies
    - Integration of risk management
    - Assessment, analysis, forecasting, change management
    - Communications & reporting
  - Data management is vital for accurate, timely data



# Value of an Integrated Schedule

- Main areas of risk are conflicts between contracts and disciplines
- Source of delays, cost overruns, disruption, & claims
- Project schedules must be integrated into one common schedule in order to understand the impacts between projects
- Stand-alone project schedules are different from the project schedules once integrated into the program schedule
- Milestone dates are often different once project schedule are integrated into the program schedule
- This requires a higher level of analysis and control by the program or megaproject manager

# Standard Contract Requirements

- Each project contract needs specific language:
  - Aligned data dates
  - Common and restricted WBS levels
  - Common and restricted Activity Codes
  - Basis of schedule details
  - Program milestones
  - Inter-project dependency milestones
  - Mitigation requirements when milestones slip in one project
  - Delay language for predicted and absorbed delays
    - Predicted delays use RP No. 52R-06 “Time Impact Analysis”
    - Absorbed delays use RP 29R-03 “Forensic Schedule Analysis”

# Airport Capital Programs Baseline Schedule



# Development of Initial Program Schedule

- Earlier Stakeholders agreements and promises
- Low Program Controls involvement prior to NTP
- Baseline Schedule has three purposes:
  - Duration - establish a reasonable program duration
  - Coordination - identification of interdependencies
  - Monitoring - represent all program level tasks
- It must also be a sound basis for analysis and forecasting as any schedule

# Development of Initial Program Schedule

- Requires the Engineering/CM Subject Matter Experts for detail
- Use Responsibility Assignment Matrix (RAM / RACI / RASCI) for guidelines
- Level 2 schedule is not enough to identify interrelationships between projects
- Identify parts of schedule requiring greater detail
  - Develop work packages impacting two or more projects or
  - Develop a control log to identify and track these interrelationships
- Placeholder schedules will be replaced by contractor schedules, but interrelationships are permanent!

# Size of Integrated Program Schedule

- Educate program team about use of reports customized for each team member
- This is a crucial issue, especially if program team has access into the software database, causing confusion
  - Appropriate reports will show only information needed
- Lessons learned from claims show that poor or non-integrated or low detail program schedules are often at the core of project failure
  - Cannot monitor potential conflicts
  - Cannot provide basis for analysis for delay & mitigation

# Integration of Project Schedules

- The integration process of individual contractor schedules can be complicated
  - Use detailed clear written protocol
  - Protocol should test placeholder schedule replacement

## Process for Program and Project Scheduling

### Program Review of Stand-Alone Project Schedule Process

The Program Scheduler will receive the schedule submission, import it to a dedicated location in the EPS separate from the Program Schedules, open the schedule and provide a quick review of several important issues to confirm that the project schedule is appropriate within the constraints of the project, including, for example:

### Import of Stand-Alone Project Schedule into Program Schedule to Create Integrated Program Schedule

Once the stand-alone Project Schedule has been briefly reviewed as acceptable, the Program Scheduler will import the approved schedule into the Program Schedule, and verify all relationships between this project schedule and both other project schedules and the program schedule are maintained or established.

### Update of Integrated Program Schedule

Program level progress and performance will be collected by the Program Scheduler from the designers, the Program Managers, and any other Stakeholders, and used to update the Program portion of the Program Schedule.

Once all Project Schedules have been imported into the Program Schedule and all logic relationships are verified or established, the Program Schedule will be re-calculated.

### Analysis of Integrated Program Schedule

The Program Scheduler will analyze the integrated Program Schedule first by running comparison reports of all contractual milestones to identify any slippage. Then comparison reports of the

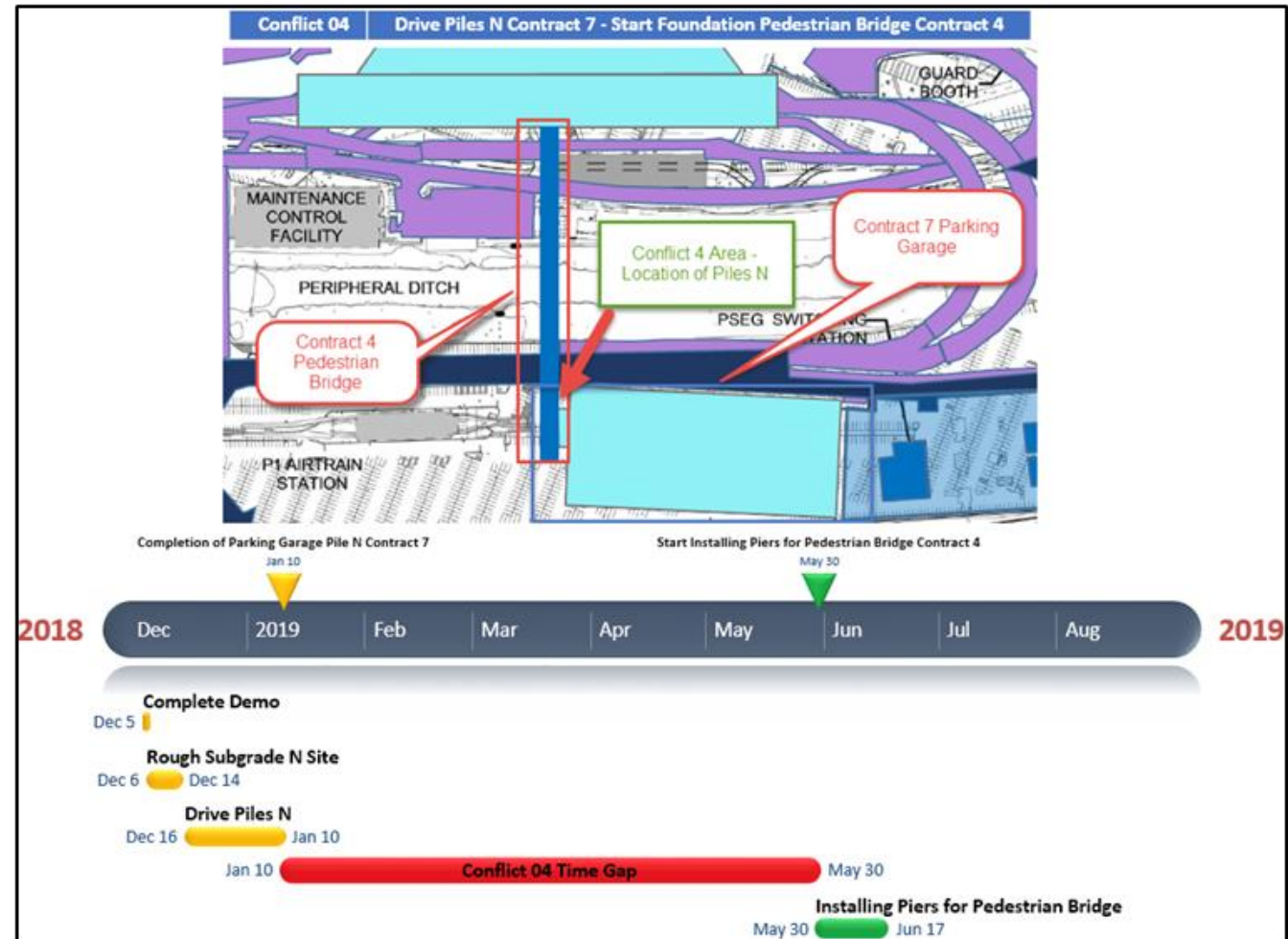
# Inter-Project Dependencies

- Top priority for effort is Inter-Project Dependencies
  - Identification
  - Coordination
  - Management
- All shared spaces, resources, materials coordinated
- Engage responsible parties for each Dependency
  
- This list of Dependencies is progressively elaborated as maturity of package designs evolve
- Goal is to identify as many as possible



# Inter-Project Dependencies

- Each Inter-Project Dependency needs to be clearly defined and explained
- Claims avoidance depends on clarity – use graphics



# Airport Capital Program Schedule Updating

# Schedule Updating

- Multiple stakeholders provide update information
- Must have a clear process to gather update data
- All update data must share common Data Date or inaccurate dates will result
- All updates must be done at same time
  - If more frequent update required, use Reflections (What-If Scenarios) that do not change the main schedule

# Importing Project Schedules

- Import all contractor schedules
- Follow procedures established for validated schedules

## Process for Schedule Import into Program Schedule (Test Proof)

1. **Program work to create Contractor's 04 schedule and set up for future import (for test only)**
  1. Make a copy of the integrated Program Schedule (integrated meaning all projects included) as Test Program Schedule and do this update test on the copy – it will be deleted when the test is over
  2. Save it as the Test Program Baseline (Maintain it I believe – I'll leave the technical Primavera terms up to you)
  3. Ensure the 04 schedule is coded to include all activities to allow it to be a stand-alone contractor's schedule
  4. Isolate and code all constraints in the 04 schedule
  5. Replace any possible constraints in the 04 schedule with logic relationships so they drive to the same dates as the constraints – test replacements by calculating and ensuring no change
  6. Isolate and code all activities in the 04 schedule that have relationships (predecessors or successors) into the integrated Test Program Schedule. This should be any activity in the 04 schedule with a relationship that will be severed when exported, could be between other contracts or could be between 04 and activities in the Program schedule that are not in the projects.
  7. Separately identify all 04 schedule activities with just predecessors in the Program

# Evaluation of Integrated Schedule

- Use standard reports:
  - Comparison to Re-Baseline for contract costs/durations
  - Run Interdependency conflict report
    - Monitors narrowing of time before conflicts
  - Run typical Critical & Near-Critical Path
    - Run Longest Path to each project completion
    - Run TF < 1 month from TF of each Longest Path
      - Identifies project Near-Critical when the project has Float
  - Run Trending analyses
    - Earned Value & Earned Schedule
    - Missed Starts & Finishes
    - Duration Overruns (Tipper – TPR)
    - Float Dissipation or Erosion



# Airport Capital Program Coordination with Contractors

# Schedule Review Feedback

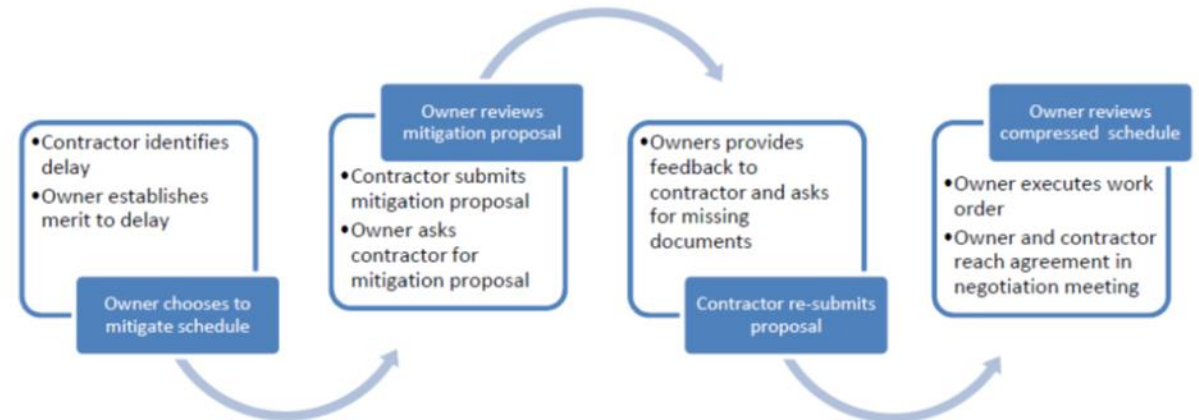
- Integrated Program Schedule will yield different dates and slippage than stand-alone project schedules
- If contract milestones have slipped, may need mitigation
- If Inter-Project Dependencies are about to overlap, may need mitigation
  - Mitigation is easier if Dependency dates are in contracts
  - If not in contracts, may require negotiated mitigation
- Not uncommon to fail to include many of the Dependencies in project contracts

# Contractor Mitigation Negotiations

- One contractor will have slipped the predecessor activity leading to an Inter-Project Dependency
- This will cause delay and/or disruption to the contractor with the successor scope of work
- Prefer to negotiate with delaying contractor – that's the source of the problem so it's simpler
  - But with no contractual basis to require mitigation, must negotiate
  - Owner will be at risk for any costs required to accelerate to meet mitigation needs

# Contractor Mitigation Negotiations

- Use a formal mitigation process
  - Analyze to determine extent of mitigation needed
  - Request a mitigation plan from contractor for time needed
    - Plan will then be based on contractor's means & methods
    - Prevents any claim of dictating means & methods
  - Request submission showing how schedule will be mitigated
  - Request trade breakdown of costs to achieve mitigation



# Contractor Mitigation Negotiations

- After receipt of mitigation plan, costs, & schedule
  - Provide independent trade-specific mitigation analysis
  - Identify how many days of mitigation are achieved by each trade
  - Use this to develop a cost/day/trade of mitigation
- This effort will save significant money since many trades do not perform real analyses & provide arbitrary costs
  - The trades often “guess” at the costs to meet the tighter completion dates
  - Commonly, the most expensive mitigation trades offer the least gain in time
  - The excluded trades will often be “pulled along” by more aggressive schedule without additional cost



# Mitigation is Vital to Megaproject Success

- Implement a standard process for:
  - Prospective analysis of predicted delays
    - Resolve with Time Impact Analysis process
    - Negotiate supply chain delays prospectively
    - Resolve timely – within one update period
  - Limit for official recovery requirement
    - Predicting 2 months late (on multi-year project)
  - Continuous optimization/mitigation effort
    - Use standard process
    - Perform every update
    - Gain time regardless of delays and delay responsibility

# Mitigation is Vital to Megaproject Success

- Continuous optimization/mitigation effort

## Potential Mitigation Improvement Opportunities

- If the non-relevant lag is removed between V037A-19020 “Import/Reuse Stockpiled Fill - PH 2D” and V037A-18990 “12” Stabilized Subgrade - PH 2D”, the project completion milestone would gain 6 days, to be now on September 21, 2022.
- By expediting the process of V037A-22150 “Submit - Demo of Power & Lighting Plan - PH 2B” and changing its relationship with V037A-22190 from finish-to-start to start-to-start with a lag of 5 days, the completion of the project would be now on September 14, 2022, gaining 7 days more.
- Contractor mentioned on previous schedule submission, the DCP testing time it is already accounted in the scope of the drainage activities. By changing the relationship between V037A-16110 “DCP Testing PH 2B” and V037A-14280 from finish-to-start to start-to-start, the project will be completed now on September 9, 2022, gaining 5 days more.
- If all the suggestions previously mentioned are implemented in the schedule, the total gain on the project completion milestone would be 18 CD.

It is noteworthy that if these opportunities can be exploited so these small gains are achieved and the schedule continues each month to provide small mitigations similar to these, the project would regain a significant portion of the current project delays. It is vital that the schedule starts gaining time each update instead of continuing to slip further and further behind.

# Mitigation is Vital to Megaproject Success

- Continuous optimization/mitigation effort
- For Miami International Airport, project was predicting over six months late
  - Facilitated a recovery workshop
  - Implemented continuous improvement processes
- Helped regain six months of delay on the main project

*“As a vital member of our team for the current \$1.5B portion of the Terminal Optimization Program, Arcadis has been instrumental in providing collaborative schedule optimization support, including helping the contractor mitigate over 150 calendar days for the Central Terminal Base Apron and Utilities project.”*

**Jorge Gonzales**, Director of Program Controls, **Miami-Dade Aviation Department**

Central Terminal Optimization Program (TOP), Miami International Airport

# Airport Capital Programs Reports

# Program Reports

- Suggested Program level reports:
  - Program Critical Path (mostly because people expect it)
  - Longest Path to each project completion milestone
  - Critical & Near-Critical Path of each Project
  - All Dependencies between project potential conflicts
  - Internal Milestones – design, procurement, award
  - Enabling Projects – may be combined with Internal Milestones
- Combinations of these – Critical & Near-Critical Path per Project with Dependencies
- Schedule reports should show comparisons to contractual Re-Baselined Schedule and/or previous month's schedule
- Review with Program Team continuously until reports are deemed useful!

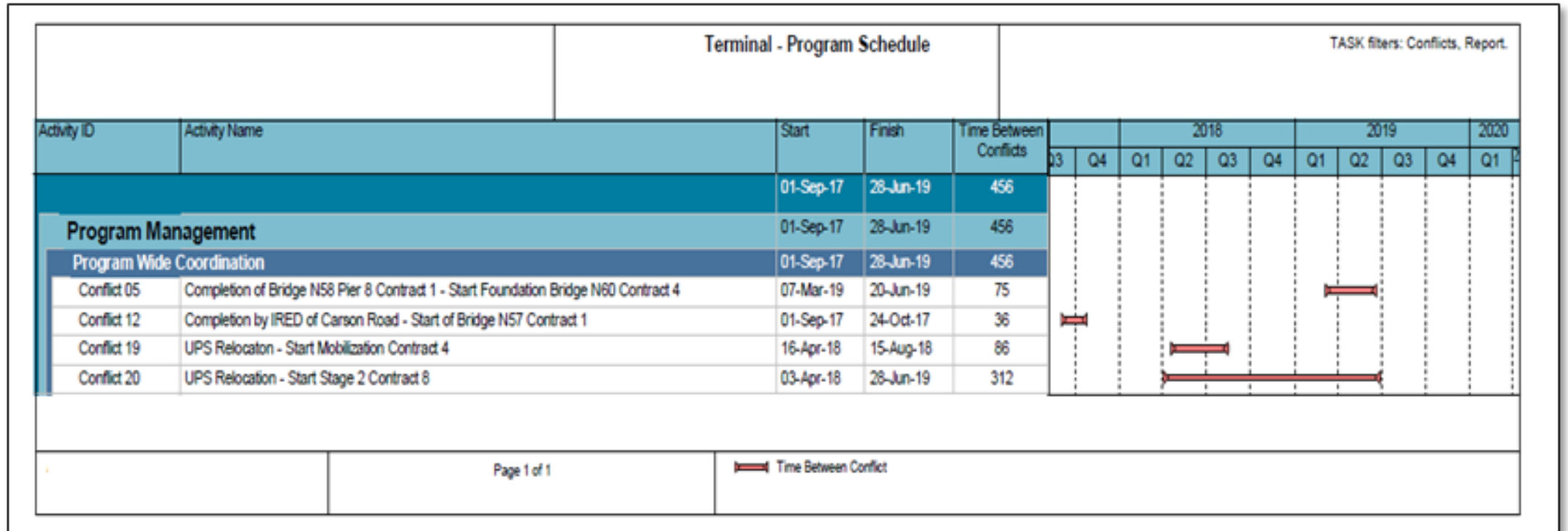
# Interdependency Reports

- This is a vital claims avoidance report to monitor
- Report contains:
  - All activities in a project and all activities driving or being driven by another project
  - Connected logically by a Finish-Start relationship from driver activity to driven activity
  - Run reports on individual Projects as well as All Projects
- Add a Level-of-Effort (LoE) activity to monitor the time distance (buffer) between the driver and driven activities
  - This LoE provides a measure of performance urgency
  - As LoE buffer approaches zero, Program is in a delay situation
    - Requires additional monitoring
    - May require mitigation needs and request

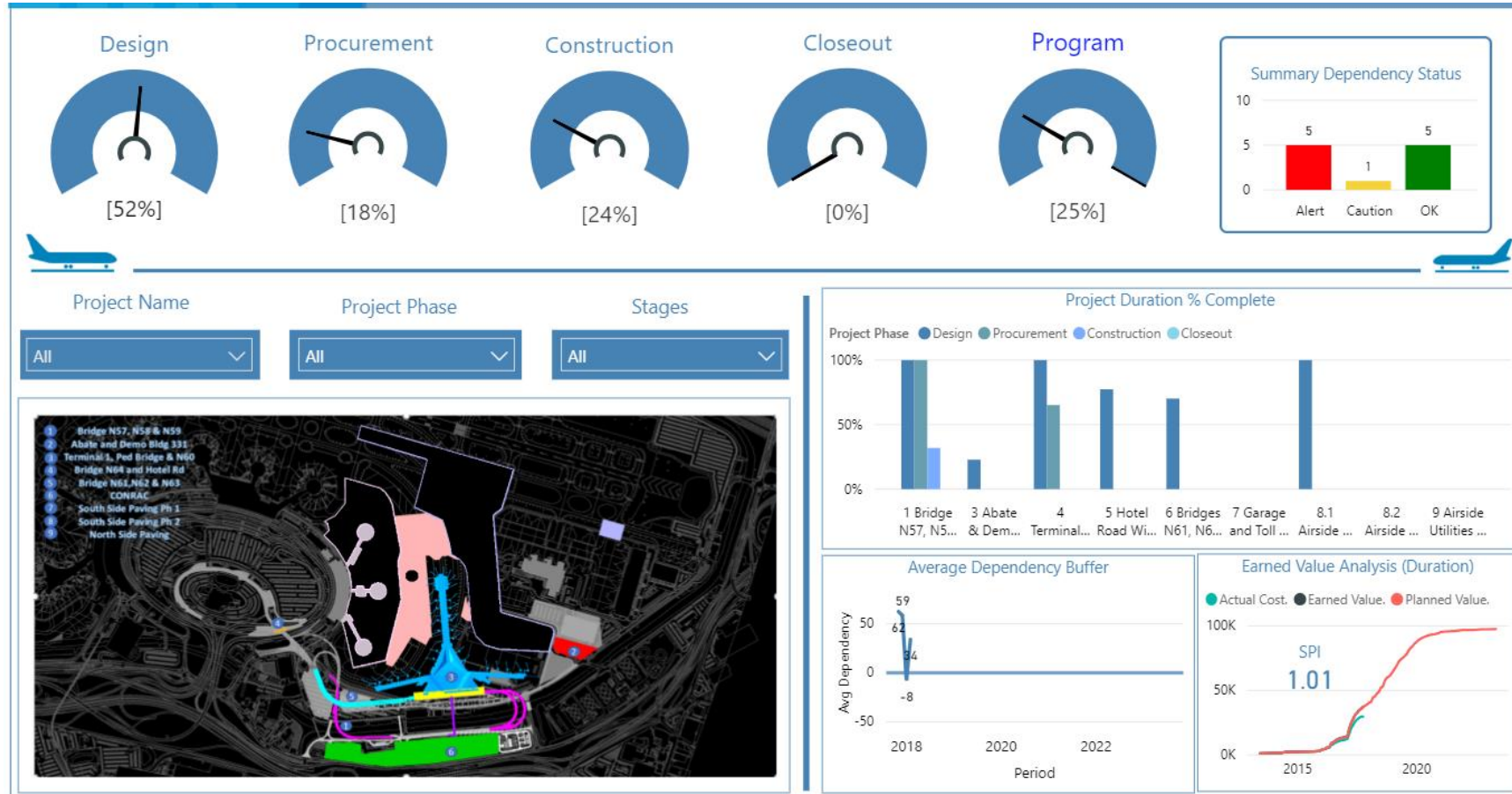


# Interdependency Reports

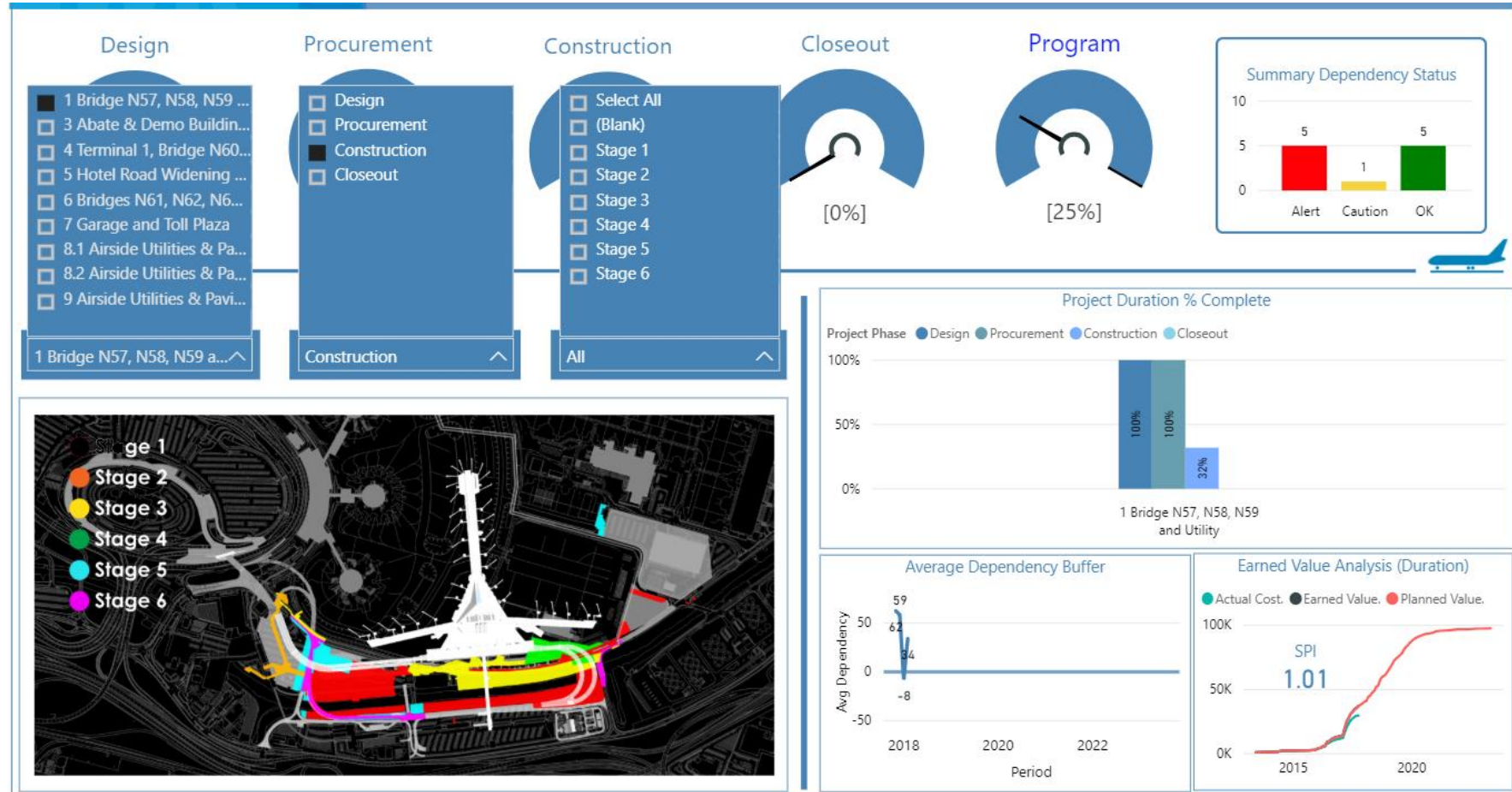
- Interdependency Report sample:



# Performance Dashboard



# Performance Dashboard



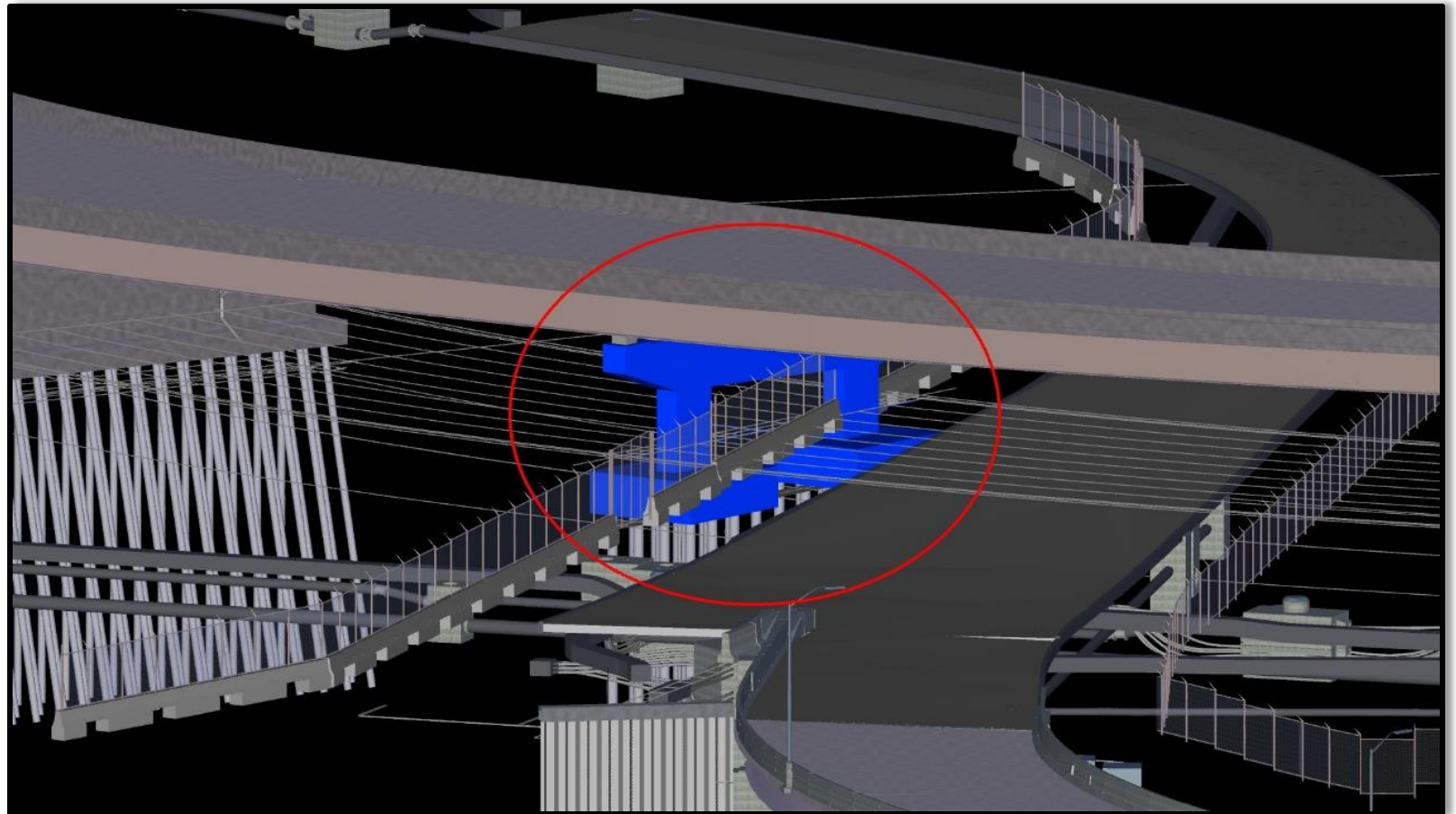
# Value of BIM in Program Scheduling

- Use of BIM 4D modeling is extremely valuable
  - Schedule activities linked directly to BIM 3D objects
  - More intuitive view of reports
- Use of 4D modeling is most valuable in time conflicts:
  - Interdependencies
  - Shared spaces
- Model can be advanced to date of driver activity, rotated for clarity



# Value of BIM in Program Scheduling

- Example of BIM 4D Interdependency Report
  - Fence structure (Contract 5) cannot be installed until bridge pier is installed (C8)



# Airport Capital Programs Lessons Learned



# Lessons Learned on Airport Megaprojects

- CAPEX and OPEX
  - Capital Expenditures (CAPEX) include typical Capital Improvement Plan funds uses
  - Operational Expenditures (OPEX) include business operations fund uses
  - While CAPEX is always taken into account, often OPEX is left out of the picture
  - Fully understand implications of operational disruption
  - Review CAPEX and OPEX at every stakeholder program board

# Lessons Learned on Airport Megaprojects

- Planning

- Allow sufficient lead-in time for producing a coordinated design solution, ensuring operational processes are validated and all Stakeholders either directly or indirectly affected have been engaged.
- Do not start on site until the design / cost meets the brief and budget and appropriate stakeholder engagement has taken place.
- Ensure the business case / brief is signed off by all stakeholders affected by the programme of works.
- Ensure OPEX, both airline and airport, are fully considered in all development design solutions
- Ensure consultation takes place with stakeholders when terminal space is allocated to commercial ventures

# Lessons Learned on Airport Megaprojects

- Program Coordination

- Continually test and check stakeholder requirements.
- Thoroughly review the content of any trigger at least one year in advance and seek appropriate amendments through change control.
- Improve co-ordination between related baggage projects and ensure closer integration / alignment between baggage systems and construction works.
- Implement campus coordination to ensure better coordination between related projects
- Implement formal constructability review
- Improve integration of projects into operations.

# Lessons Learned on Airport Megaprojects

- Processes

- Ensure robust risk management process implemented
- Improve resource planning to ensure right person / right role, and minimal project management changes throughout project duration.
- Ensure the operational processes are validated through the design process
- Project teams must not hold back from giving bad news
- Early identification of program busts enables better mitigation
- Strong mitigation processes must be implemented

# Conclusion

# Conclusion

- Well designed & managed Integrated Schedule is vital for Airport Capital Program success
  - Integrates all Program & Project data
  - Best approach for multi-prime project delivery
  - Coordinates all moving pieces, allowing PgM staff to focus on risks
- Successful Program Scheduling requires constant educational approach
  - Use is not intuitive to Project-oriented CMs
  - Success requires deep collaboration between Program Controls and Program Management
- Proven to support successful Airport Capital Programs





# THANK YOU

Proven Success Stories at Airport Capital Programs

Chris Carson, FRICS, FAACE, FGPC