Evidence Issues in Forensic Use of CPM Scheduling

prepared by

Fredric L. Plotnick, Ph.D., Esq., P.E.

for the

THE FLORIDA BAR

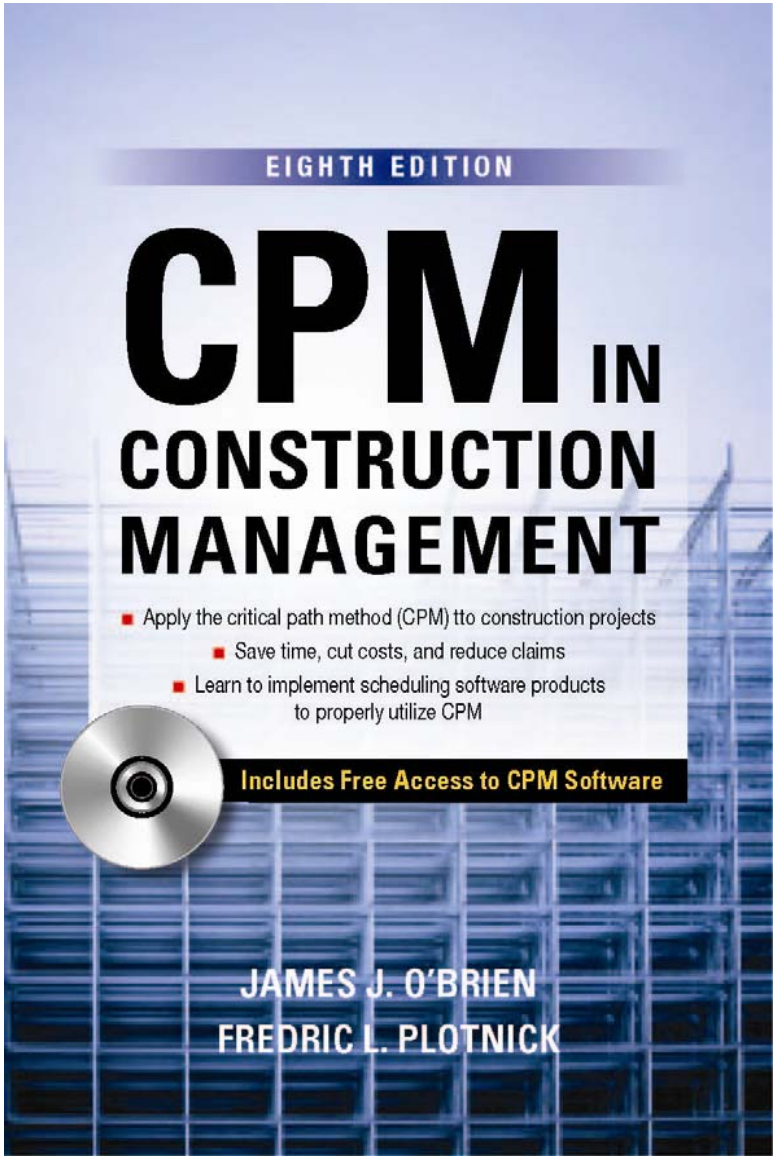
FOR THE PUBLIC

MEMBER SERVICES

Curriculum Vitae

- **Fredric L. Plotnick,** Ph.D., Esq., P.E.
- Education 75 – 77 – 80 – 93 – 08
- Teaching – Drexel – Temple – U of P
- Licensed PA – NJ – FL – MD
- Bechtel – Hill – IUCS – Fuller GATX
- **EnProMaC 1983 – present**
  Engineering & Property Management Consultants, Inc.
- USN Guideline Specification, 1986 ● now UFGS
- CPM in Construction Management, 5th, 6th, 7th, 8th
- Contracts and the Legal Environment for Engineers & Architects, 7th

- **Construction CPM Conference**
- PSPE, ASCE, AACE, PMI, …
- ABA•FC, PBA, NJSBA, FBA, …
- also enjoys fishing



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PLOTNICK and the Florida Bar

FLA BAR JOURNAL ● Pro Bono Publico v Pauperus

FLA P.E. ● MCE Requirement on Law ● credit for PA

DREXEL CIVE 571 ● Forefront HASP Electronic Seal

PSPE MCE BOOTCAMP COURSES

ENR 2013 Fla SCt Reverses Course on Economic Loss Rule

CCC Accredited by FLA BAR for Construction Certification Credits

Today's Presentation

The Industrial Exemption

Prepared and Presented by Fredric L. Plotnick, Ph.D., Esq., P.E.

This Activity is credited for 1 PDH (60 minutes) and has been approved for NY credit.

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Fredric L. Plotnick

ENR Engineering News-Record

This blog discusses CPM scheduling, engineering law and other aspects of project management.

Oranges, Apples and Pairs

November 14, 2013 *No Comments*

I have been away from my blog for too long. I don't know if it is writer's block or just being too busy. August was a couple of claims and trying to find time to catch a fish. September featured a presentation to the GAO on why they should consider my RDCPM protocol as part of a new metric to review CPM schedule. Let us continue the discussion on Schedule Risk, Measured Mile and Half Steps. Read on …

Schedule Risk, The Measured Mile and Half Steps

July 9, 2013 *No Comments*

Professional and technical association conference presentations are providing more detail in forensic analyses. This is a good thing. As to why, read on …

Location-Based Scheduling and the Confluence of CPM and BIM

April 23, 2013 *One Comment*

Location Location Location. The confluence of CPM with BIM continues to bring additional benefits to the users of these tools. Read on …

Fla. Supreme Court Reverses Course on Economic Loss: A Must-Read for Designers

March 16, 2013 *No Comments*

Rarely will a practitioner live through a full swing of the pendulum of the expansion and retraction of a judicial doctrine. Read how the latest decision of the Florida Supreme Court again changes the legal landscape.

- How reliable is CPM to establish a claim of delay or disruption?
- Claims before CPM
- Claims after CPM
- Current State-of-the-Art
- Frye v Daubert
- Intrinsic Unreliability of CPM
- Daubert **II**
- Robinson Factor Analysis
- Analytical Gap Test
- Specific Flaws of this CPM
- All leading to …

Pre-CPM Claims of Delay

- Generally, if two parties claim concurrent delays, the court will not try to unravel the factors involved and will disallow the claims by both parties.

  In United States vs. Citizens and Southern National Bank, 367 F. 2d 473 (1966), a subcontractor was able to show delay damages caused by the general contractor. However, the general contractor, in turn, was able to demonstrate that portions of the damages were caused by factors for which he was not responsible. **In the absence of clear evidence separating the two claims, the court rejected both claims**, stating:

  "**As the evidence does not provide any reasonable basis for allocating the additional costs among those contributing factors, we conclude that the entire claim should have been rejected**."

CPM in Construction Management, 8th Edition, page 647

Post-CPM Claims of Delay

- **The courts gave early recognition to the validity of CPM. In 1972** (Appeal of *Minmar Builders, Inc.* GSBCANo. 3430, 72-2 BOA), the court rejected a claim based on bar graph schedules, stating:

  "The schedules were not prepared by the Critical Path Method (CPM) and, hence, are not probative as to whether any particular activity or group of activities was on the critical path or constituted the pacing element for the project."

- Also in 1972, a Missouri Court (*Natkin & Co. v. Fuller.* 347 F Supp 17) stated that bar charts did not "afford an overall coordinated schedule of the total work covered by the contract."

- An Illinois court (*Pathman Construction Co. v. Hi-Way Electric Co.* 65 Ill. App. ad 480, 382 N.E. 2d 453,460) in 1978 noted that

  "**technological advances and the use of computers to devise work schedules and chart progress on a particular project have facilitated the court's ability to allocate damages**."

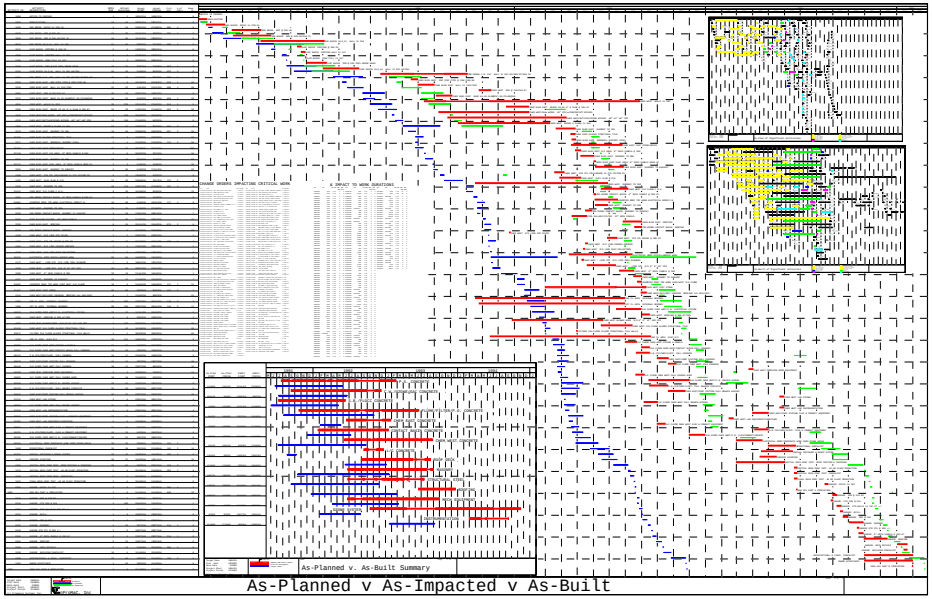
CPM in Construction Management, 8th Edition, page 637

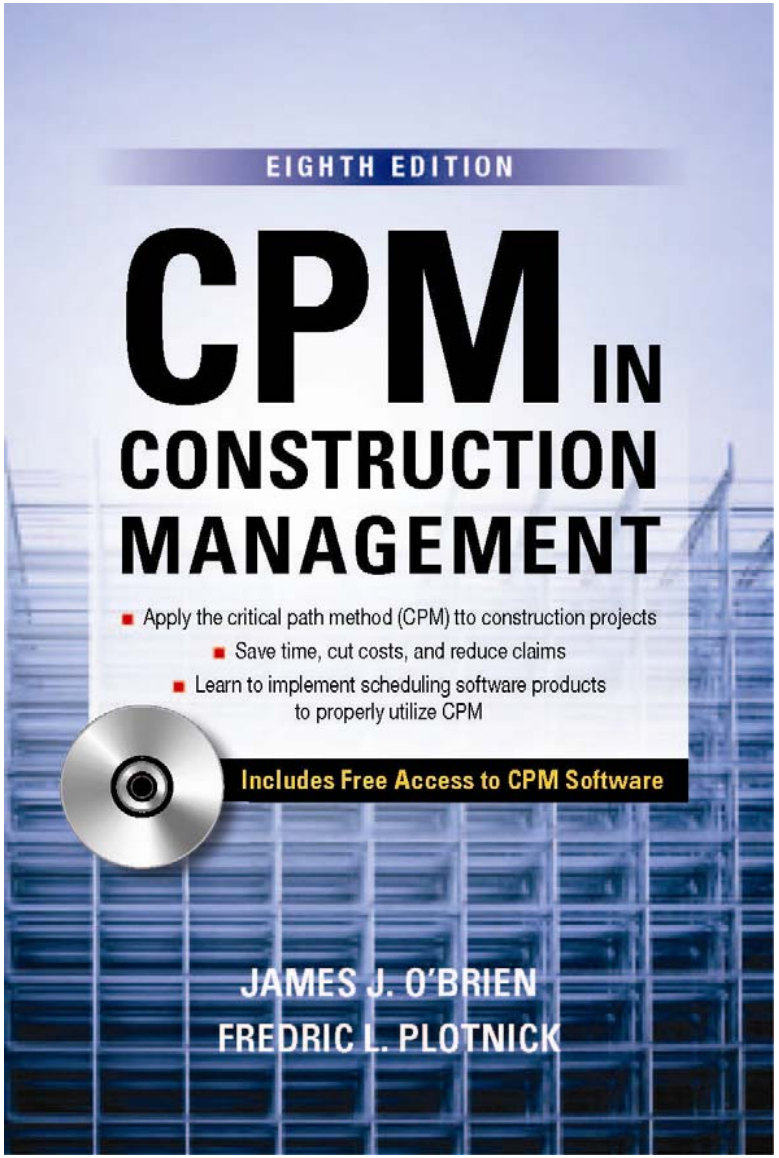
State of the Art Analysis & Presentation

- Analysis of Delay
- As-Planned
- As-Built
- As-Impacted
- Zeroing-Out

Relief From L/D's
Extended Overhead

- Windows
- Zeroing-Out Windows



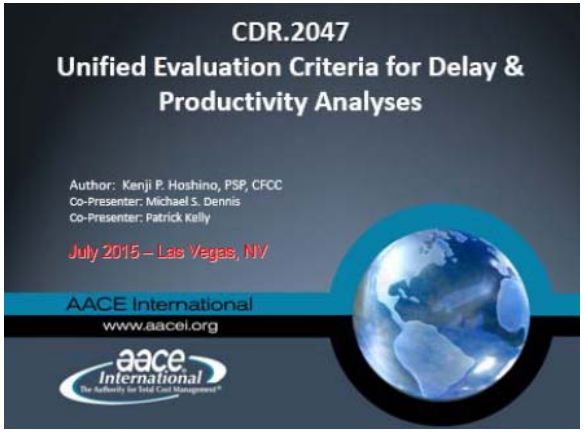


Peer Review v AACE 29RP-03

Evaluation of FSA Methods in "CPM in Construction Management, 8th Ed."

Kenji P. Hoshino, PSP, CFCC

February 1, 2016
Construction CPM Conference New Orleans



Total Score

	Performance Evaluation Criteria	Raw Score: OBP - "Time Impact Evaluation"	Raw Score: OBP - "Window"	Raw Score: MIP - 3.6 (Bifurcated CPA)	Weighted Score: Weight Value	Weighted Score: OBP - "Time Impact Evaluation"	Weighted Score: OBP - "Window"	Weighted Score: MIP - 3.6 (Bifurcated CPA)	Perfect: Raw	Perfect: Weighted
1	Quality of Source Data for Unimpacted Condition	2	1	3	10%	0.20	0.10	0.30	3	0.30
2	Quality of Source Data for Impacted Condition	2	2	2	10%	0.20	0.20	0.20	3	0.30
3	Integration of Actual Events into the Analysis	1	1	2	10%	0.10	0.10	0.20	3	0.30
4	Granularity & Volume of Data Used for Analysis	2	2	2	10%	0.20	0.20	0.20	3	0.30
5	Validity of Comparison of Unimpacted to Impacted	3	3	2	10%	0.30	0.30	0.20	3	0.30
6	Consideration of the Sensitivity of the Impacted Elements	3	3	3	15%	0.45	0.45	0.45	3	0.45
7	Periodicity of Variance Measurement	1	1	3	10%	0.10	0.10	0.30	3	0.30
8	Chronological Treatment of Cause & Effect	2	2	3	5%	0.10	0.10	0.15	3	0.15
9	Proximity in Time of the Cause to the Claimed Effect	1	2	2	5%	0.05	0.10	0.10	3	0.15
10	Consideration of Completeness of All Causal Elements	3	3	2	5%	0.15	0.15	0.10	3	0.15
11	Segregation of Effects from Non-Claimable Causes	3	3	2	5%	0.15	0.15	0.10	3	0.15
12	Overall Cleanness / Minimizing Room for Manipulation	1	1	3	5%	0.05	0.05	0.15	3	0.15
		24	24	29	100%	2.05	2.00	2.45	36	3.00

OBP "TIE" vs MIP 3.6 (IAP)

	Performance Evaluation Criteria	Raw Score: OBP - "Time Impact Evaluation"	Raw Score: MIP - 3.6 (Impacted As-Planned)	Weighted Score: Weight Value	Weighted Score: OBP - "Time Impact Evaluation"	Weighted Score: MIP - 3.6 (Impacted As-Planned)
1	Quality of Source Data for Unimpacted Condition	2	2	10%	0.20	0.20
2	Quality of Source Data for Impacted Condition	2	1	10%	0.20	0.10
3	Integration of Actual Events into the Analysis	1	1	10%	0.10	0.10
4	Granularity & Volume of Data Used for Analysis	2	2	10%	0.20	0.20
5	Validity of Comparison of Unimpacted to Impacted	3	3	10%	0.30	0.30
6	Consideration of the Sensitivity of the Impacted Elements	3	3	15%	0.45	0.45
7	Periodicity of Variance Measurement	1	1	10%	0.10	0.10
8	Chronological Treatment of Cause & Effect	2	2	5%	0.10	0.10
9	Proximity in Time of the Cause to the Claimed Effect	1	1	5%	0.05	0.05
10	Consideration of Completeness of All Causal Elements	3	2	5%	0.15	0.10
11	Segregation of Effects from Non-Claimable Causes	3	2	5%	0.15	0.10
12	Overall Cleanness / Minimizing Room for Manipulation	1	2	5%	0.05	0.10
		24	22	100%	2.05	1.90

Winner

OBP "Window" vs MIP 3.7 (TIA)

	Performance Evaluation Criteria	Raw Score: OBP - "Window"	Raw Score: MIP - 3.7 (Time Impact Analysis)	Weighted Score: Weight Value	Weighted Score: OBP - "Time Impact Evaluation"	Weighted Score: MIP - 3.7 (Time Impact Analysis)
1	Quality of Source Data for Unimpacted Condition	1	3	10%	0.10	0.30
2	Quality of Source Data for Impacted Condition	2	1	10%	0.20	0.10
3	Integration of Actual Events into the Analysis	1	1	10%	0.10	0.10
4	Granularity & Volume of Data Used for Analysis	2	2	10%	0.20	0.20
5	Validity of Comparison of Unimpacted to Impacted	3	2	10%	0.30	0.20
6	Consideration of the Sensitivity of the Impacted Elements	3	3	15%	0.45	0.45
7	Periodicity of Variance Measurement	1	3	10%	0.10	0.30
8	Chronological Treatment of Cause & Effect	2	2	5%	0.10	0.10
9	Proximity in Time of the Cause to the Claimed Effect	2	2	5%	0.10	0.10
10	Consideration of Completeness of All Causal Elements	3	2	5%	0.15	0.10
11	Segregation of Effects from Non-Claimable Causes	3	2	5%	0.15	0.10
12	Overall Cleanness / Minimizing Room for Manipulation	1	2	5%	0.05	0.10
		24	25	100%	2.00	2.15

Winner

Purpose: Compensable Delay & Rebuttal of LDs

OBP Windows Analysis
- MIP 3.7 Variable Period, Static logic
- Using partially updated baseline
- Or a impact-modeled MIP 3.2

VS

OBP Time Impact Evaluation
- Enhanced MIP 3.6.F
- w/ 'Not-Quite' MIP 3.8 verification

Half-Step Update Analysis

Forensic Use of Analysis	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9
Non-Compensable Time Extension	OK	OK	OK	OK	OK	OK	OK	OK	OK
Compensable Delay	OK	OK	OK	OK	OK			OK	OK
Right to Finish Early Compensable Delay								OK	OK
Entitlement to Early Completion Bonus	OK	OK	OK	OK	OK	OK	OK	OK	OK
Disruption Without Project Delay	OK	OK	OK	OK	OK	OK	OK		
Constructive Acceleration				OK		OK	OK		

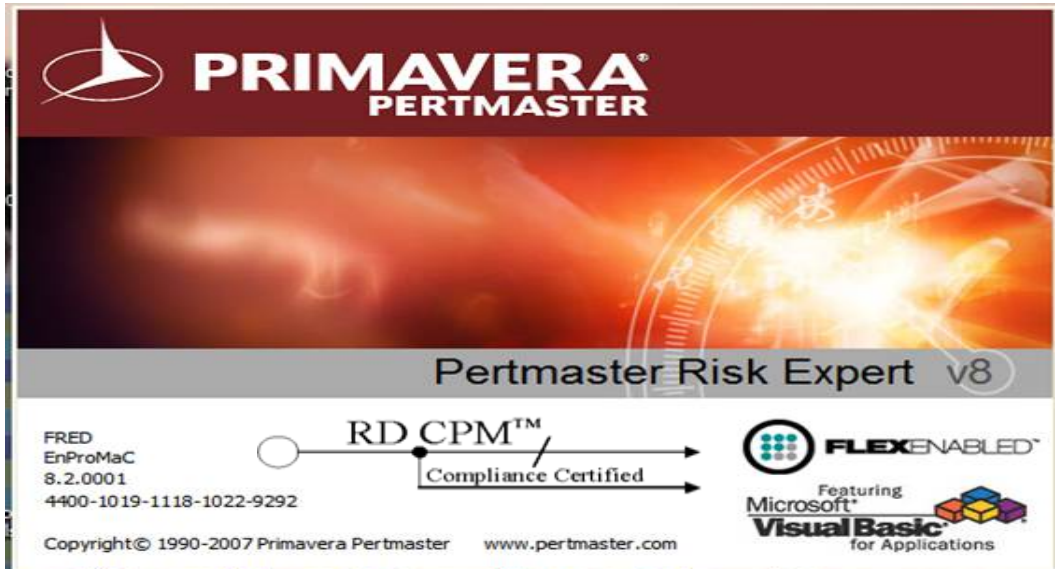
RP 29R-03 - Section 5: Choosing a Method

The AACEi compilation 29RP-03 is deemed by the authors of this text to document a number of, but clearly not all, methodologies that have been used in one trial setting or another. 29RP-03 does provide a number of tips to practitioners on source validation and on providing the operating parameters of a number of methodologies purported to have been accepted in at least one forum. However, the authors of this text believe that none of these approaches, as provided in 29RP-03, should pass a *Daubert* review.

CPM in Construction Management, 8th Edition, page 700.

Add Probability and Risk

- Pertmaster – Monte Carlo -15%/+20%
- Calculate probability of finish by set date
- Track alternate critical paths by frequency
- What was natural risk of project delay?



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Asta Powerproject® INTAVER INSTITUTE

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Safran

Risk in Scheduling?
Where would I learn about that?

- **MON12 - Preparing a P6 schedule for Risk Analysis**
- Presented by Darryl Townsend of DRMcNatty & Associates, Inc.
- **MON13 - Microsoft New Project and Portfolio Management Solution for Construction Project Management**
- Managing cost, schedule, task updates, risks and collaboration across project stakeholders
- **MON32 - Schedule Risk Analysis doesn't have to be hard!**
- All too often Schedule Risk Analysis (SRA) is only performed because it was required for a proposal. Once the contract is won SRA goes out the window. Where SRA is not mandated it may be ignored because it is perceived as a lot of effort for questionable return. This presentation will demonstrate the benefits of using SRA throughout the project life cycle and show that benefits can be achieved with little additional effort.
  Presented by John Owen, COO of Barbecana Inc.
- **MON42 - Doing a P6/Acumen Risk Analysis**
- Presented by Darryl Townsend of DRMcNatty & Associates, Inc.
- **TUE13 - Deltek Open Plan Download to 1st Update**
- This session will lead attendees from download of Open Plan software from Deltek's website, or from the link provided in the back of of the text CPM in Construction Management, 8th Edition, to delivery of the first update report to management of the Contractor and the Owner. Presented by Rob Edwards

Project ORACLE PRIMAVERA phoenix PROJECT MANAGER

Risk Ready – Risk Integral – Risk Add-On

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Risk in Scheduling?
Where would I learn about that?

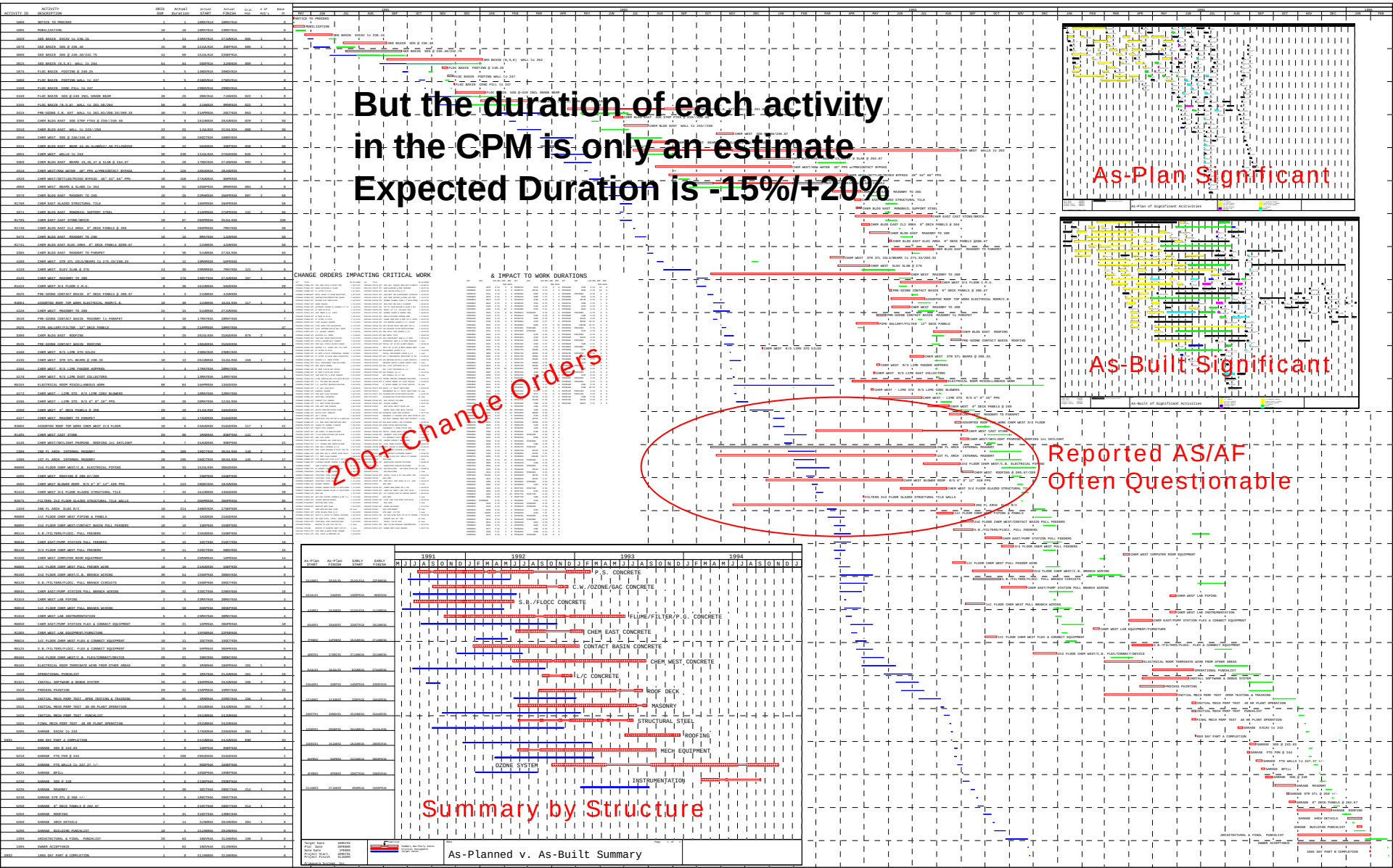
- **TUE14 - Safran Risk**
- Risk analysis tools can be complicated. The complex interfaces and lack of process support can leave you wondering about the quality of your risk analysis. Did you capture all of your risks? Did you build the model correctly? In this session, you'll learn how Safran Risk addresses these issues. You'll learn how the process-led interface provides confidence in your risk modeling process, and you'll learn new techniques for capturing all of your risks in the comprehensive risk register – including risk factors (uncertainty), risk events, and risk calendars. You'll also learn how Safran Risk's best-in-class analytics can provide you quantified insight into how risks are impacting your project. Come see why Safran Risk is defining the new standard in schedule risk analysis. Presented by Wes Gillette – Director of Client Services, Safran
- **TUE17 - Mitigating Delay Claims and Scheduling Best Practices**
- Session addresses Claims and Risk Awareness, specifically as it related to construction scheduling. How to mitigate claims when construction change is inevitable. Learn about the principle causes of dispute and how to avoid claims as it relates to the project schedule function. Presented by Raquel Shohet, EI, PSP, of Hill International, with over 25 years of construction industry experience in the engineering, cost, scheduling, estimating, and field disciplines.
- **TUE33 - Deltek Acumen Risk: The Rewards of Schedule Risk Analysis**
- CPM schedules are excellent at providing a completion forecast based on the planned duration and sequence of work. However, they fall short in accounting for external risk events – those discrete events that have an impact on a project execution teams' ability to execute the plan. This presentation focuses on the second step towards improving project maturity: identifying and reducing project risk exposure through project risk analysis. Learn best practices when running a schedule or cost risk analysis and hear how Deltek Acumen Risk and Risk book combine the accuracy of Monte-Carlo risk analysis with a straightforward, team-oriented user experience to simplify this process.Presented by Tom Polen

Risk in Scheduling?
Where would I learn about that?

- **TUE37a - Who Should Own Float? Mitigating Delays by Float-Preallocation Method**
- Float reduces risk by protecting against delays in network schedules. But who owns it remains a contentious issue. We will discuss the results of a National Science Foundation-funded research on allocating project float – between the sum of raw durations and the contract deadline – to the critical path. A mathematical model from social decision-making has inspired how to fairly allocate so that the critical participants can reach an evenly low risk level. Simulations validate the new approach. Presented by Gunnar Lucko, Associate Professor of Civil Engineering and Director of Construction Engineering and Management Program, Department of Civil Engineering, The Catholic University of America, Washington, DC 20064. lucko@cua.edu
- **TUE44a - Risky Project Project Risk Analysis and Risk Management Software**
- RiskyProject is integrated project risk management and risk analysis software. RiskyProject facilitates all steps of project risk management process: risk identification, analysis, mitigation and response planning, and risk communication. RiskyProject performs both qualitative and quantitative risk analysis. It performs schedule and cost risk analysis using Monte Carlo simulations. RiskyProject's risk register includes all information about risks. These risks can be assigned to project schedule and used in risk analysis.Presented by Lev Virine of Risky Project
- **TUE44b - PMA Netpoint Risk**
- **WED13 - Doing a P6/Acumen Risk Analysis**
- Presented by Darryl Townsend of DRMcNatty & Associates, Inc.
- **WED23 - Project Risk Analysis with Risk Events Step by Step**
- Efficiency of project risk analysis process depends on how project uncertainties are identified and modelled. Uncertainties in task durations and costs can be modelled using statistical distributions. Uncertainties can also be modelled using discrete risk events (threats, opportunities, or both), which can be assigned to the project tasks and resources. Presented by Lev Virine of Risky Project

"**technological advances and the use of computers … have facilitated the court's ability to allocate damages**."
Pathman Construction

State of the Art Analysis & Presentation

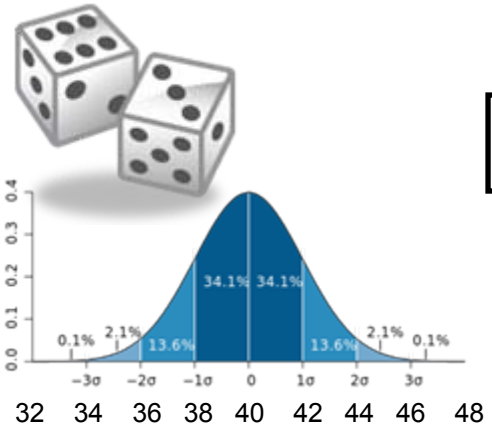


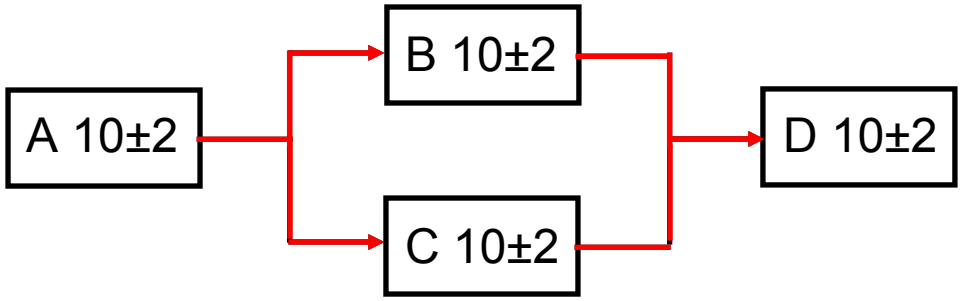
Intrinsic Unreliability of CPM

- Two Math Anomalies from Merge Bias
- $10 + 10 + 10 \neq 30$
- Leveled Schedule $\leq$ 2 x Optimal Schedule

Risk and Monte Carlo Simulation

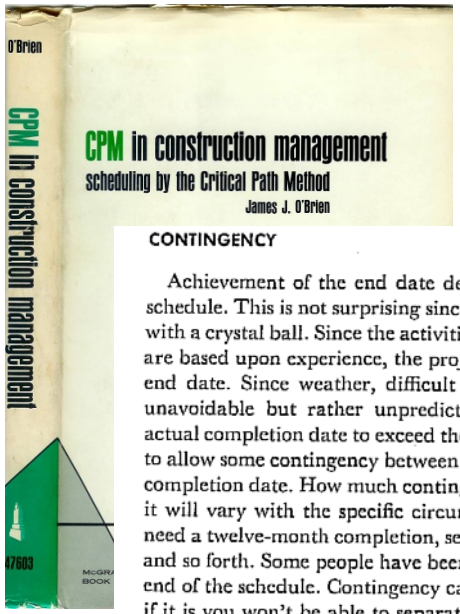
A 10±2
B 10±2
C 10±2
D 10±2
≈ 40
Estimating





Scheduling

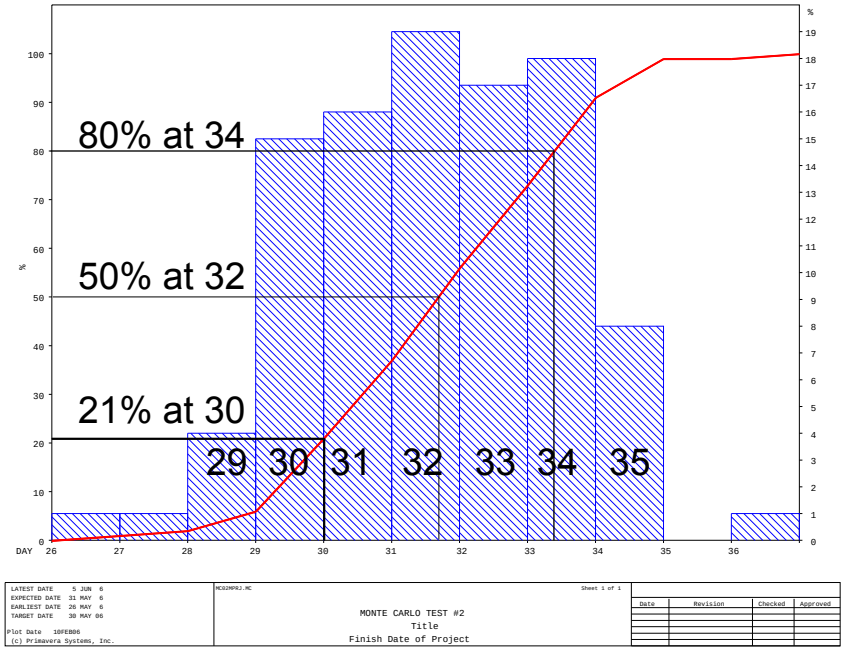
Project Duration ≈ 32 ≥ 31⅔ > 30
P_{80} ≈ 34 for further assuarnces

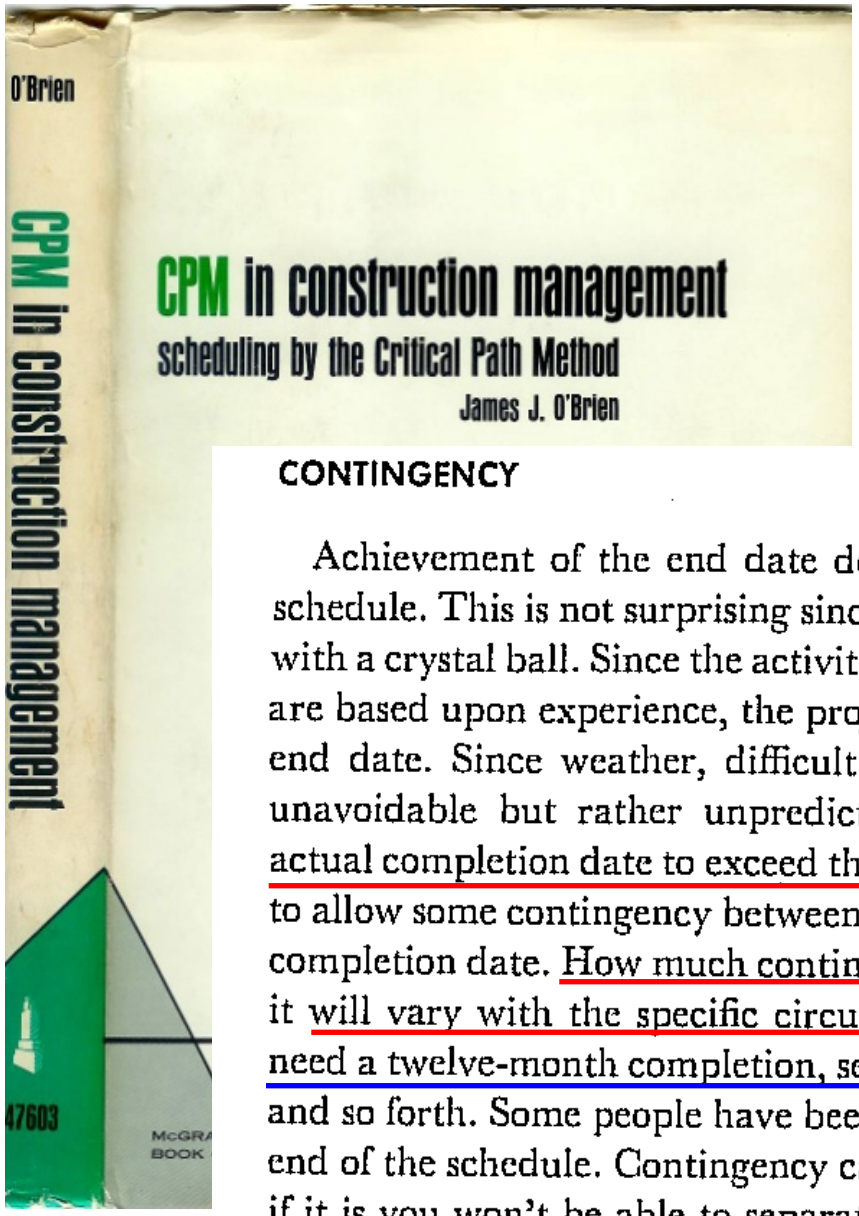


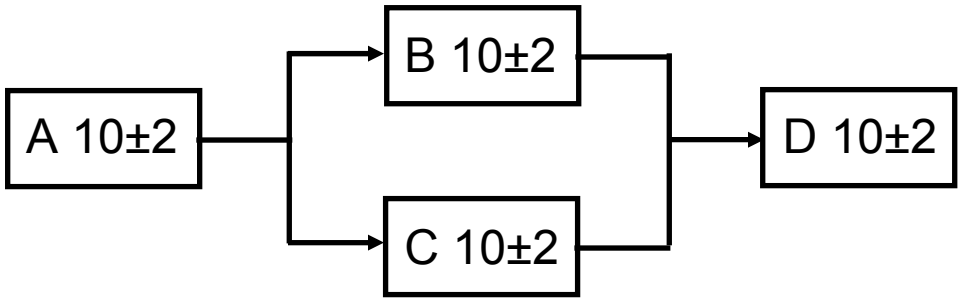
CONTINGENCY

Achievement of the end date desired is unfortunately not an acceptable schedule. This is not surprising since we know that CPM has not furnished us with a crystal ball. Since the activities and times estimates used in the network are based upon experience, the project rarely finishes ahead of the computed end date. Since weather, difficult site conditions, labor disputes, etc., are unavoidable but rather unpredictable, there a definite tendency for the actual completion date to exceed the first CPM end date. It is then reasonable to allow some contingency between the CPM end date and the actual desired completion date. How much contingency? There is no definite answer to this; it will vary with the specific circumstances of the project. However, if you need a twelve-month completion, set your CPM goal at about eleven months, and so forth. Some people have been reluctant to set a flat contingency at the end of the schedule. Contingency can be buried in the activity estimates, but if it is you won't be able to separate true estimates from contingency.

Excerpt from page 142 of CPM in Construction Management







CONTINGENCY

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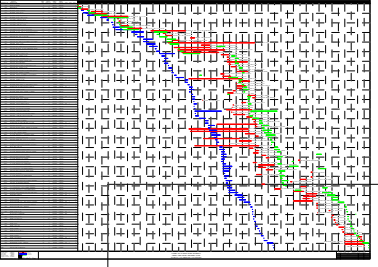
Excerpt from page 142 of CPM in Construction Management

State of the Art Analysis?



LATEST DATE 23 SEP 93
EXPECTED DATE 5 AUG 93
EARLIEST DATE 16 JUN 93
TARGET DATE 14 JUN 93

Plot Date 24NOV08
(c) Primavera Systems, Inc.

Probability of completion on time is less than one percent

Completion by 05AUG93 has only 50% chance

Completion by 27AUG93 has only 90% chance

Why?

LATEST DATE	23 SEP 93
EXPECTED DATE	5 AUG 93
EARLIEST DATE	16 JUN 93
TARGET DATE	14 JUN 93

Plot Date 24NOV08
(c) Primavera Systems, Inc.

W00VMPRJ.MC

Sheet 1 of 1

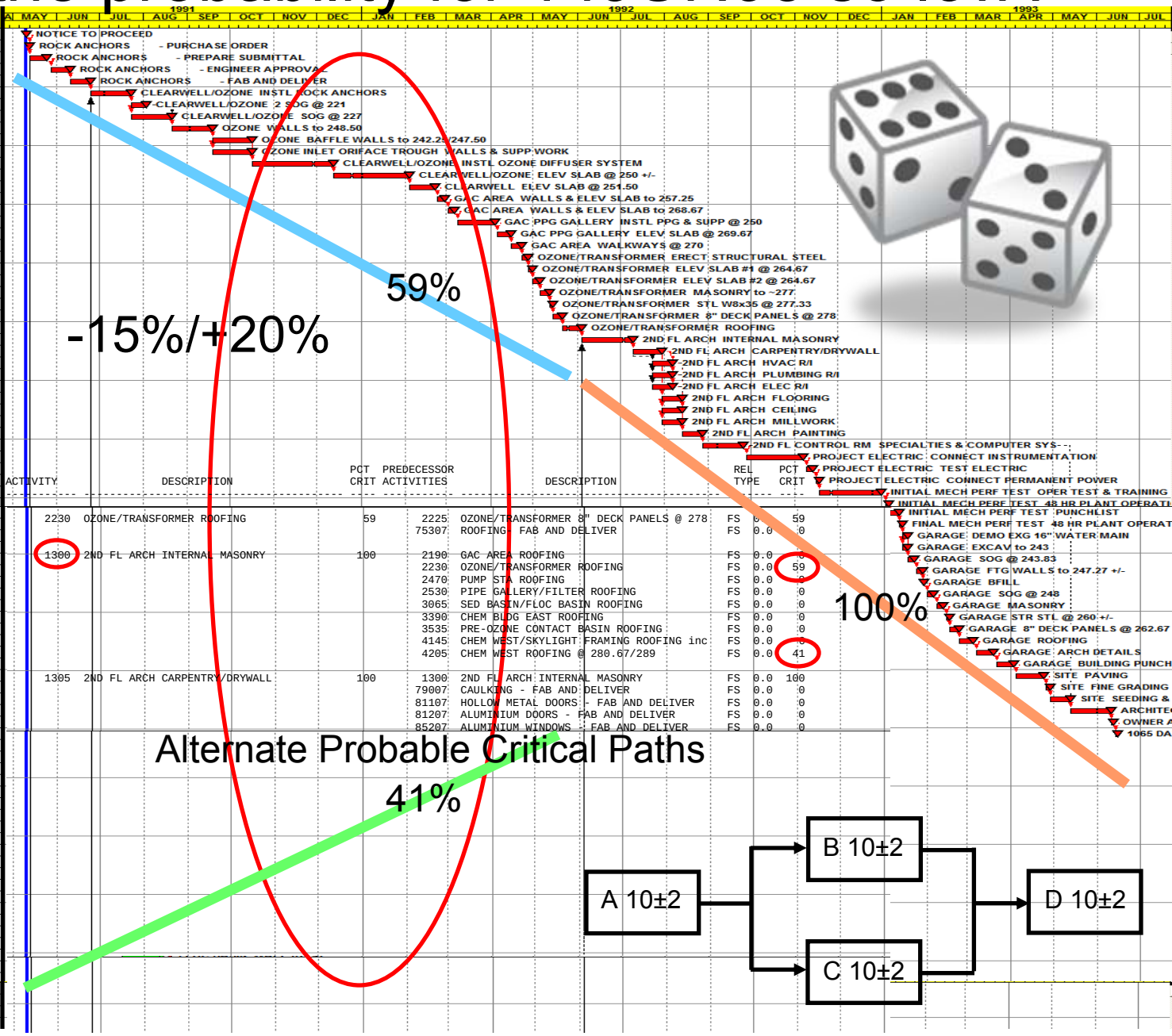
Not Named WATER AUTHORITY
Not Named WATER TREATMENT PLANT
Initial Schedule Submittal (As-Planned)
Finish Date of Project

ALLAN A. MYERS, INC. -- ENPROMAC, INC.

Date	Revision	Checked	Approved

Why is the probability for 14JUN93 so low?

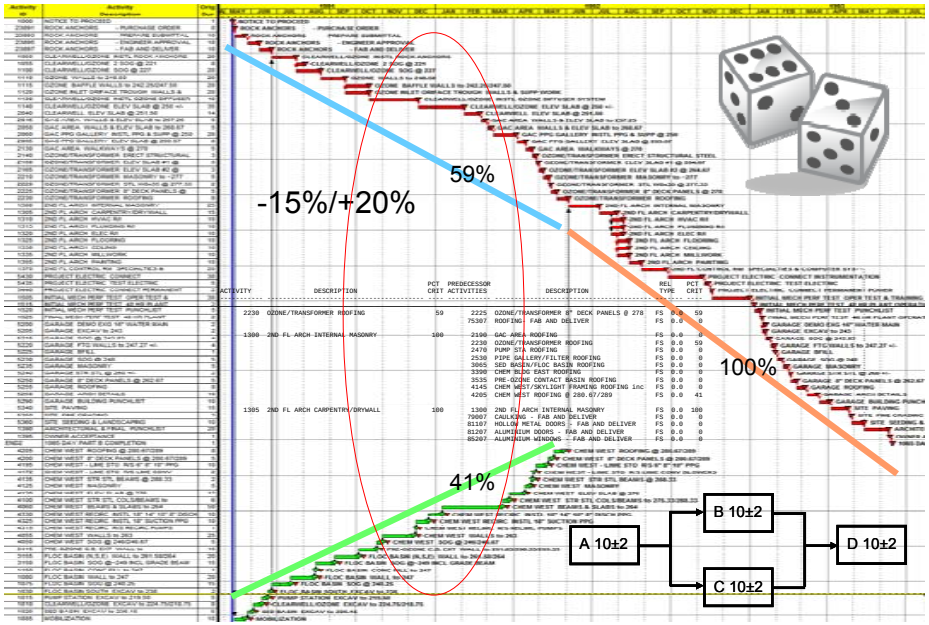
Activity ID	Activity Description	Orig Dur
1000	NOTICE TO PROCEED	1
23891	ROCK ANCHORS - PURCHASE ORDER	0
23893	ROCK ANCHORS - PREPARE SUBMITTAL	10
23895	ROCK ANCHORS - ENGINEER APPROVAL	10
23897	ROCK ANCHORS - FAB AND DELIVER	10
1050	CLEARWELL/OZONE INSTL ROCK ANCHORS	20
1055	CLEARWELL/OZONE 2 SOG @ 221	8
1100	CLEARWELL/OZONE SOG @ 227	20
1110	OZONE WALLS to 248.50	20
1115	OZONE BAFFLE WALLS to 242.25/247.50	20
1120	OZONE INLET ORIFACE TROUGH WALLS &	20
1130	CLEARWELL/OZONE INSTL OZONE DIFFUSER	40
1140	CLEARWELL/OZONE ELEV SLAB @ 250 +/-	35
2040	CLEARWELL ELEV SLAB @ 251.50	14
2045	GAC AREA WALLS & ELEV SLAB to 257.25	5
2050	GAC AREA WALLS & ELEV SLAB to 268.67	5
2060	GAC PPG GALLERY INSTL PPG & SUPP @ 250	20
2065	GAC PPG GALLERY ELEV SLAB @ 269.67	8
2130	GAC AREA WALKWAYS @ 270	5
2140	OZONE/TRANSFORMER ERECT STRUCTURAL	3
2160	OZONE/TRANSFORMER ELEV SLAB #1 @	3
2165	OZONE/TRANSFORMER ELEV SLAB #2 @	3
2210	OZONE/TRANSFORMER MASONRY to ~277	5
2220	OZONE/TRANSFORMER STL W8x35 @ 277.33	2
2225	OZONE/TRANSFORMER 8" DECK PANELS @	5
2230	OZONE/TRANSFORMER ROOFING	8
1300	2ND FL ARCH INTERNAL MASONRY	25
1305	2ND FL ARCH CARPENTRY/DRYWALL	15
1310	2ND FL ARCH HVAC R/I	10
1315	2ND FL ARCH PLUMBING R/I	10
1320	2ND FL ARCH ELEC R/I	10
1325	2ND FL ARCH FLOORING	10
1330	2ND FL ARCH CEILING	10
1335	2ND FL ARCH MILLWORK	10
1355	2ND FL ARCH PAINTING	10
1370	2ND FL CONTROL RM SPECIALTIES &	20
5430	PROJECT ELECTRIC CONNECT	30
5435	PROJECT ELECTRIC TEST ELECTRIC	5
5440	PROJECT ELECTRIC CONNECT PERMANENT	2
1505	INITIAL MECH PERF TEST OPER TEST &	30
1515	INITIAL MECH PERF TEST 48 HR PLANT	2
1520	INITIAL MECH PERF TEST PUNCHLIST	5
1525	FINAL MECH PERF TEST 48 HR PLANT	2
5200	GARAGE DEMO EXG 16" WATER MAIN	2
5205	GARAGE EXCAV to 243	2
5215	GARAGE SOG @ 243.83	4
5220	GARAGE FTG WALLS to 247.27 +/-	4
5225	GARAGE BFILL	1
5230	GARAGE SOG @ 248	5
5235	GARAGE MASONRY	5
5240	GARAGE STR STL @ 260 +/-	2
5250	GARAGE 8" DECK PANELS @ 262.67	5
5255	GARAGE ROOFING	8
5260	GARAGE ARCH DETAILS	10
5290	GARAGE BUILDING PUNCHLIST	10
5340	SITE PAVING	15
5350	SITE FINE GRADING	3
5360	SITE SEEDING & LANDSCAPING	10
1390	ARCHITECTURAL & FINAL PUNCHLIST	20
1395	OWNER ACCEPTANCE	1
END2	1065 DAY PART B COMPLETION	1

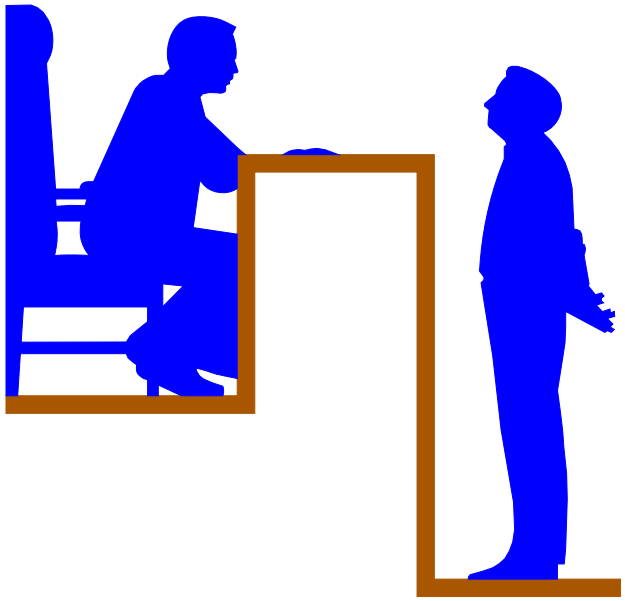


ACTIVITY	DESCRIPTION	PCT CRIT	PREDECESSOR ACTIVITIES	DESCRIPTION	REL TYPE	PCT CRIT
2230	OZONE/TRANSFORMER ROOFING	59	2225	OZONE/TRANSFORMER 8" DECK PANELS @ 278	FS	59
			75307	ROOFING - FAB AND DELIVER	FS	0
1300	2ND FL ARCH INTERNAL MASONRY	100	2190	GAC AREA ROOFING	FS	0
			2230	OZONE/TRANSFORMER ROOFING	FS	59
			2470	PUMP STA ROOFING	FS	0
			2530	PIPE GALLERY/FILTER ROOFING	FS	0
			3065	SED BASIN/FLOC BASIN ROOFING	FS	0
			3390	CHEM BLDG EAST ROOFING	FS	0
			3535	PRE-OZONE CONTACT BASIN ROOFING	FS	0
			4145	CHEM WEST/SKYLIGHT FRAMING ROOFING inc	FS	0
			4205	CHEM WEST ROOFING @ 280.67/289	FS	41
1305	2ND FL ARCH CARPENTRY/DRYWALL	100	1300	2ND FL ARCH INTERNAL MASONRY	FS	100
			79007	CAULKING - FAB AND DELIVER	FS	0
			81107	HOLLOW METAL DOORS - FAB AND DELIVER	FS	0
			81207	ALUMINIUM DOORS - FAB AND DELIVER	FS	0
			85207	ALUMINIUM WINDOWS - FAB AND DELIVER	FS	0

Evidence Issues for any CPM

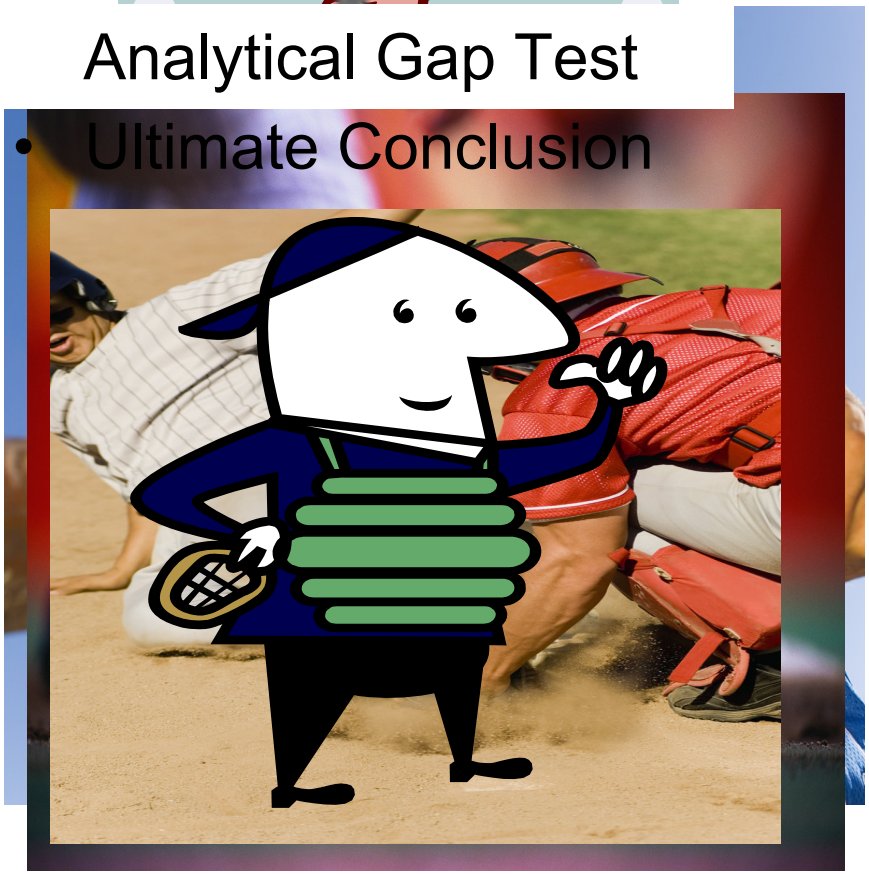
- CPM may be less certain than generally believed
- Certainty of the proffered CPM should be questioned
- Understanding of the “expert” relating to Risk is fair game





Specific Flaws of this CPM

- Frye Credential Test
- Daubert Theory Test
- Analytical Gap Test
- Ultimate Conclusion



Specific Flaws of this CPM

- Is the As-Planned a CPM or only a bar-chart?
  - Logic network from one start end to one finish end – no other open ends!
  - Every activity must have a physical methodology predecessor & successor
  - Activities Placed by Logic Restraints – NOT Date Constraints
  - Proper Logic May Be Restated in "ADM" Finish-to-Start-no-Lag Format
  - Resource (PREFERENTIAL) Logic Not Probative for Delay Analyses
    - But how do we distinguish Physical from Resource Logic?

- How reliable is <u>this</u> CPM to establish a claim of delay or disruption?

As-Planned Logic?

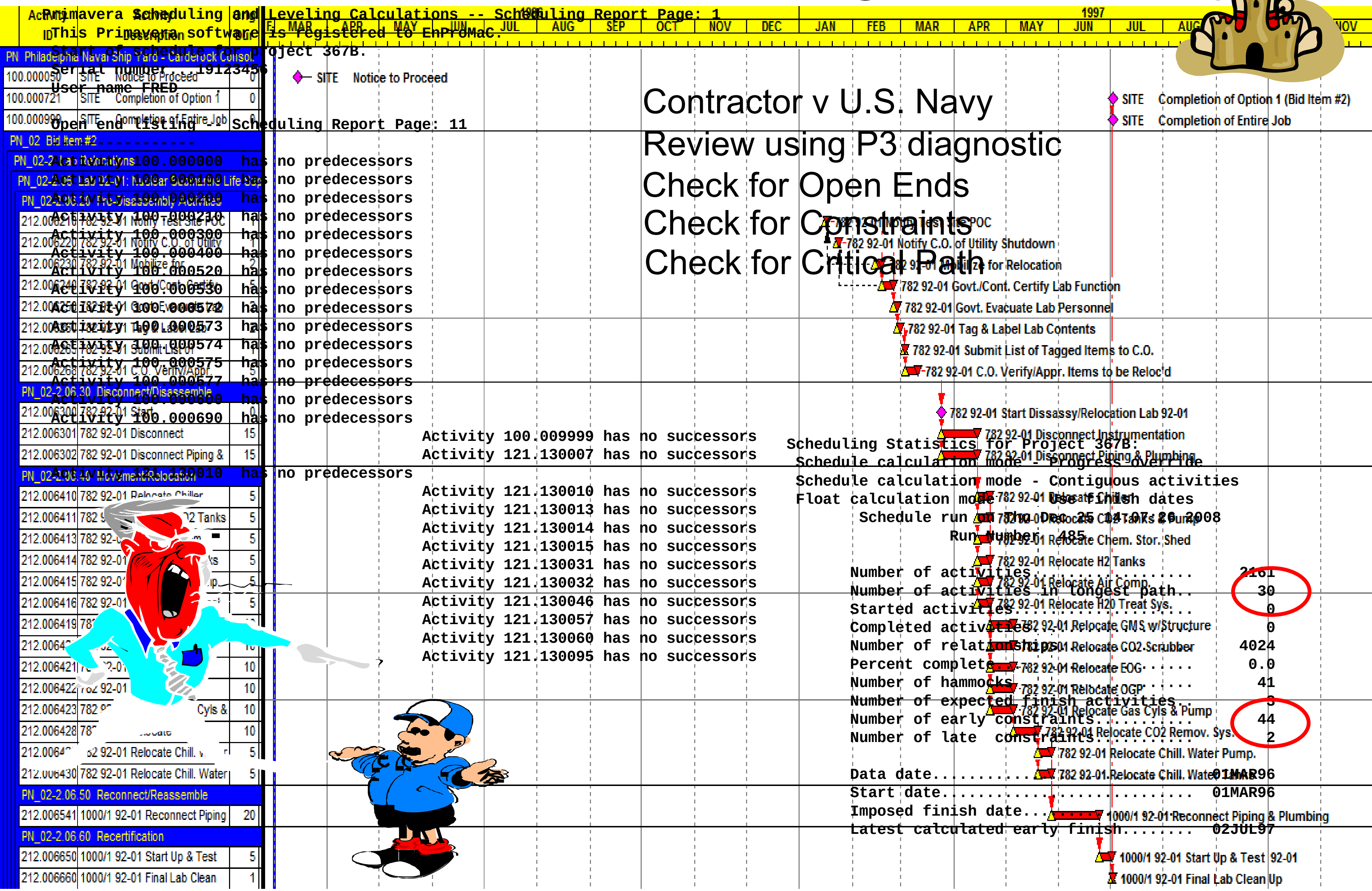
Contractor v U.S. Navy

Review using P3 diagnostic

Check for Open Ends

Check for Constraints

Check for Critical Path




```
Primavera Scheduling and Leveling Calculations -- Scheduling Report Page: 1
This Primavera software is registered to EnProMac.
Start of schedule for project 367B.
Serial number ..... 19123456
User name FRED

Open end listing -- Scheduling Report Page: 11
-----------
Activity 100.000000 has no predecessors
Activity 100.000100 has no predecessors
Activity 100.000200 has no predecessors
Activity 100.000210 has no predecessors
Activity 100.000300 has no predecessors
Activity 100.000400 has no predecessors
Activity 100.000520 has no predecessors
Activity 100.000530 has no predecessors
Activity 100.000572 has no predecessors
Activity 100.000573 has no predecessors
Activity 100.000574 has no predecessors
Activity 100.000575 has no predecessors
Activity 100.000577 has no predecessors
Activity 100.000600 has no predecessors
Activity 100.000690 has no predecessors
          Activity 100.009999 has no successors
          Activity 121.130007 has no successors
Activity 121.130010 has no predecessors
          Activity 121.130010 has no successors
          Activity 121.130013 has no successors
          Activity 121.130014 has no successors
          Activity 121.130015 has no successors
          Activity 121.130031 has no successors
          Activity 121.130032 has no successors
          Activity 121.130046 has no successors
          Activity 121.130057 has no successors
          Activity 121.130060 has no successors
          Activity 121.130095 has no successors

Scheduling Statistics for Project 367B:
 Schedule calculation mode - Progress override
 Schedule calculation mode - Contiguous activities
 Float calculation mode - Use finish dates
     Schedule run on Thu Dec 25 14:07:26 2008
           Run number 485

Number of activities ...................... 2161
Number of activities in longest path..        30
Started activities ........................    0
Completed activities ......................    0
Number of relationships ................. 4024
Percent complete .........................  0.0
Number of hammocks ........................   41
Number of expected finish activities..         3
Number of early constraints ...............   44
Number of late constraints ................    2

Data date.............................. 01MAR96
Start date............................. 01MAR96
Imposed finish date....................
Latest calculated early finish......... 02JUL97
```

As-Planned Logic?

Activity ID	Activity Description	Orig Dur
PN	Philadelphia Naval Ship Yard - Carderock Consol.	
100.000050	SITE Notice to Proceed	0
100.000721	SITE Completion of Option 1	0
100.000999	SITE Completion of Entire Job	0
PN_02	Bid Item #2	
PN_02-2	Lab Relocations	
PN_02-2.06	Lab 92-01: Nuclear Submarine Life Sup	
PN_02-2.06.20	Pre-Disassembly Activities	
212.006230	782 92-01 Mobilize for	2
212.006240	782 92-01 Govt./Cont. Certify	5
212.006210	782 92-01 Notify Test Site POC	1
212.006220	782 92-01 Notify C.O. of Utility	1
212.006250	782 92-01 Govt. Evacuate Lab	2
212.006260	782 92-01 Tag & Label Lab	2
212.006265	782 92-01 Submit List of	1
212.006268	782 92-01 C.O. Verify/Appr.	5
PN_02-2.06.30	Disconnect/Disassemble	
212.006300	782 92-01 Start	0
212.006301	782 92-01 Disconnect	15
212.006302	782 92-01 Disconnect Piping &	15
PN_02-2.06.40	Movement/Relocation	
212.006410	782 92-01 Relocate Chiller	5
212.006411	782 92-01 Relocate CO2 Tanks	5
212.006413	782 92-01 Relocate Chem.	5
212.006414	782 92-01 Relocate H2 Tanks	5
212.006415	782 92-01 Relocate Air Comp.	5
212.006416	782 92-01 Relocate H20 Treat	5
212.006419	782 92-01 Relocate GMS	10
212.006420	782 92-01 Relocate CO2	10
212.006421	782 92-01 Relocate EOG	10
212.006422	782 92-01 Relocate OGP	10
212.006423	782 92-01 Relocate Gas Cyls &	10
212.006428	782 92-01 Relocate CO2	10
212.006429	782 92-01 Relocate Chill. Water	5
212.006430	782 92-01 Relocate Chill. Water	5
PN_02-2.06.50	Reconnect/Reassemble	
212.006541	1000/1 92-01 Reconnect Piping	20
PN_02-2.06.60	Recertification	
212.006650	1000/1 92-01 Start Up & Test	5
212.006660	1000/1 92-01 Final Lab Clean	1

1996: F MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

1997: JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV

SITE Notice to Proceed

SITE Completion of Option 1 (Bid Item #2)

SITE Completion of Entire Job

Contractor v U.S. Navy

Reviewing detail of each activity

Checking Logic of Critical & Near Critical Paths

782 92-01 Mobilize for Relocation

782 92-01 Govt./Cont. Certify Lab Function

782 92-01 Notify Test Site POC

782 92-01 Notify C.O. of Utility Shutdown

782 92-01 Govt. Evacuate Lab Personnel

782 92-01 Tag & Label Lab Contents

782 92-01 Submit List of Tagged Items to C.O.

782 92-01 C.O. Verify/Appr. Items to be Reloc'd

How does critical path start ten months into project?

782 92-01 Start Dissassy/Relocation Lab 92-01

782 92-01 Disconnect Instrumentation

782 92-01 Disconnect Piping & Plumbing

782 92-01 Relocate Chiller

782 92-01 Relocate CO2 Tanks & Pump

782 92-01 Relocate Chem. Stor. Shed

782 92-01 Relocate H2 Tanks

782 92-01 Relocate Air Comp.

782 92-01 Relocate H20 Treat Sys.

782 92-01 Relocate GMS w/Structure

782 92-01 Relocate CO2 Scrubber

782 92-01 Relocate EOG

782 92-01 Relocate OGP

782 92-01 Relocate Gas Cyls & Pump

782 92-01 Relocate CO2 Remov. Sys.

782 92-01 Relocate Chill. Water Pump.

782 92-01 Relocate Chill. Water Tanks

1000/1 92-01 Reconnect Piping & Plumbing

1000/1 92-01 Start Up & Test 92-01

1000/1 92-01 Final Lab Clean Up

Predecessors

Activity: 212.006230 - 782 92-01 Mobilize for Relocation — Jump

211.109033

Activity ID	Rel	Lag	TF	Description
211.109033	FS	0	53	ITE Order & Del. Misc. Iron
212.006130	FS	0	58	782 92-01 Govt. Review/Appr. Relocat

Why do all predecessors of a critical activity have float?

Successors

Activity: 212.006230 - 782 92-01 Mobilize for Relocation — Jump

212.006210

Activity ID	Rel	Lag	TF	Description
212.006210	SF	-22	0	782 92-01 Notify Test Site POC
212.006240	FS	0	0	782 92-01 Govt./Cont. Certify Lab Func
212.006270	FS	0	62	782 92-01 Provide Boxes & Labels for G

Constraints

Early constraint: Start / Finish — 17FEB97

Late constraint: Start / Finish

Start on

Mandatory: Start / Finish

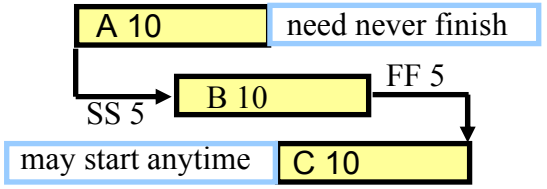
Expected finish

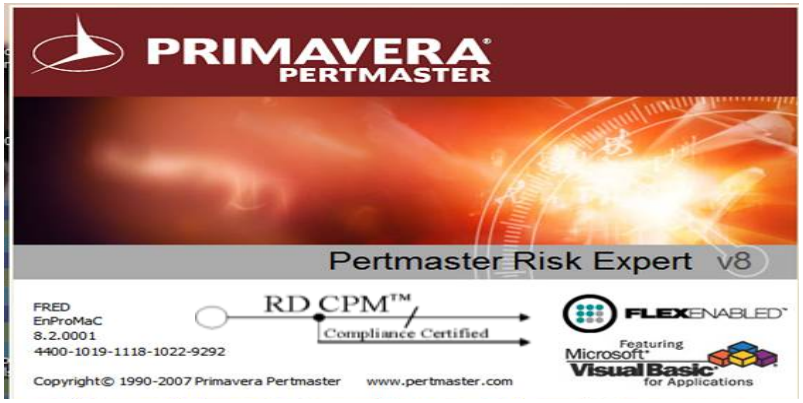
Float constraint: Zero total float / Zero free float

Leveling: Normal

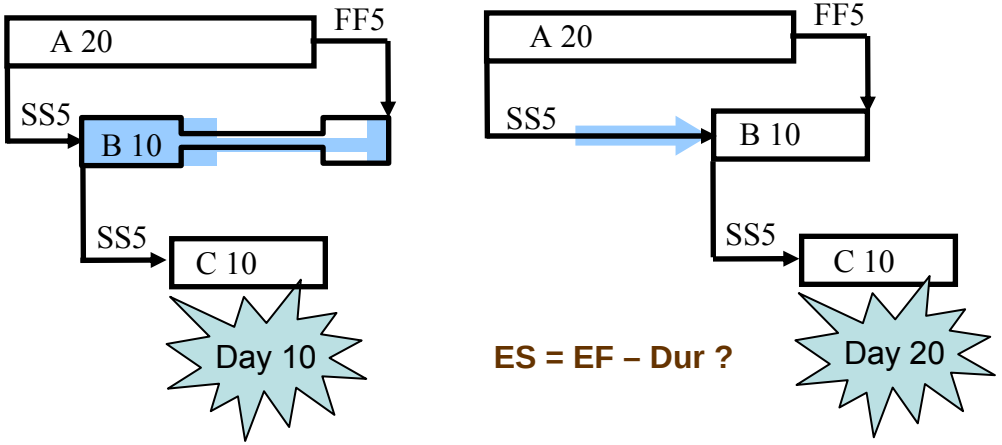
RDM Analysis of the As-Planned Logic

- check for hidden open ends
- check for misunderstood logic
- Interruptible supported by
  P3 – Pertmaster – Asta – Phoenix



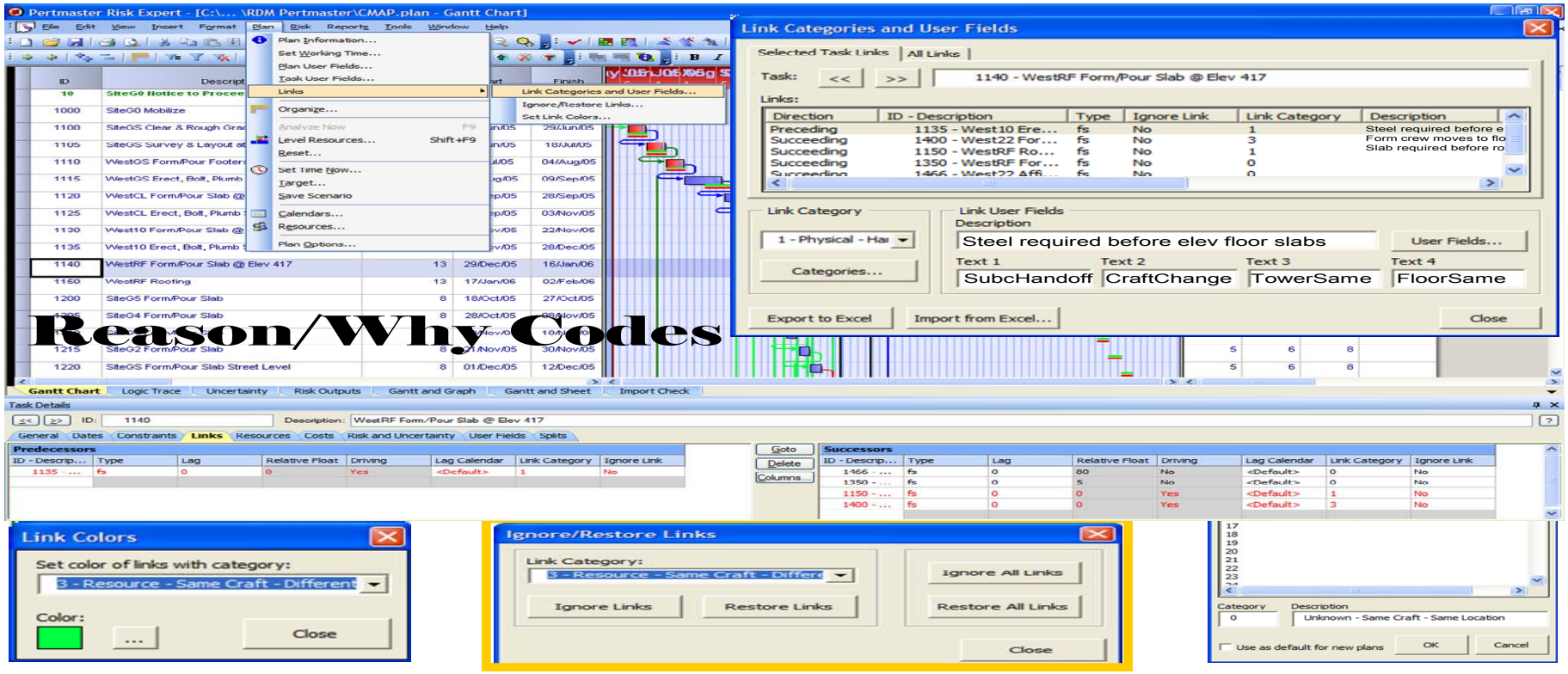


interruptible duration **continuous duration**



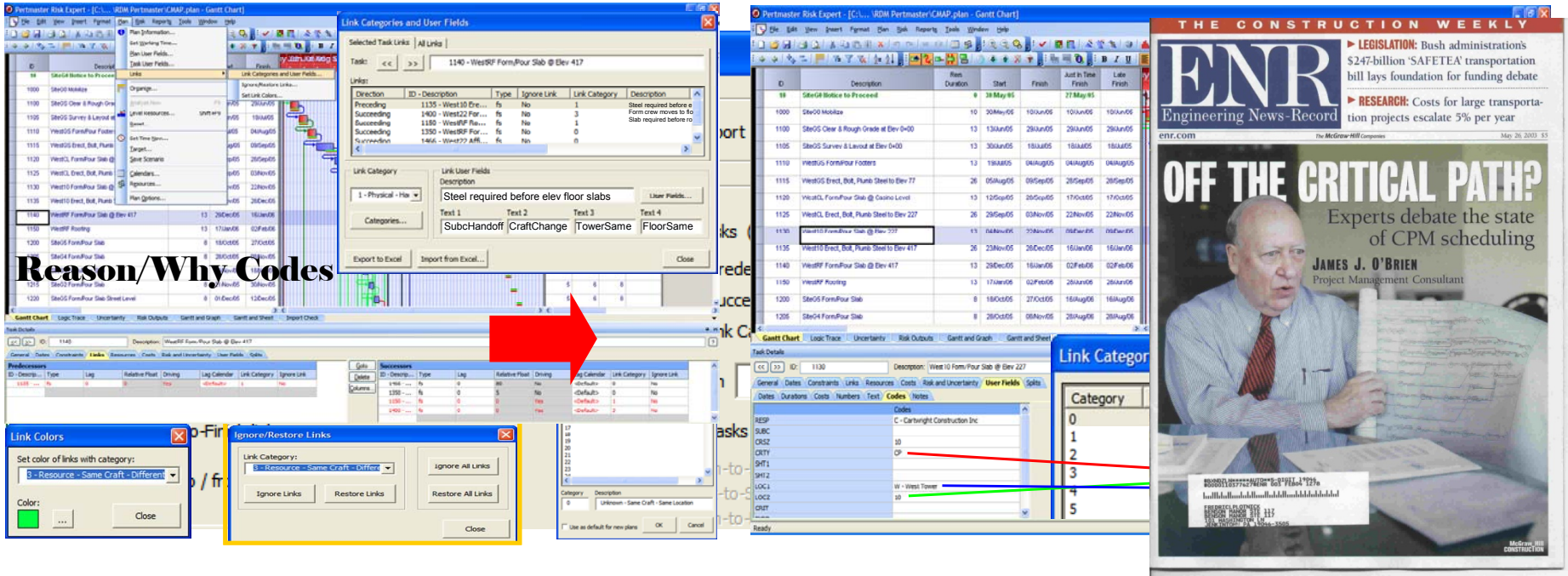
RDM Analysis of the As-Planned Logic

- check for hidden open ends
- check for misunderstood logic
- check for physical v resource logic

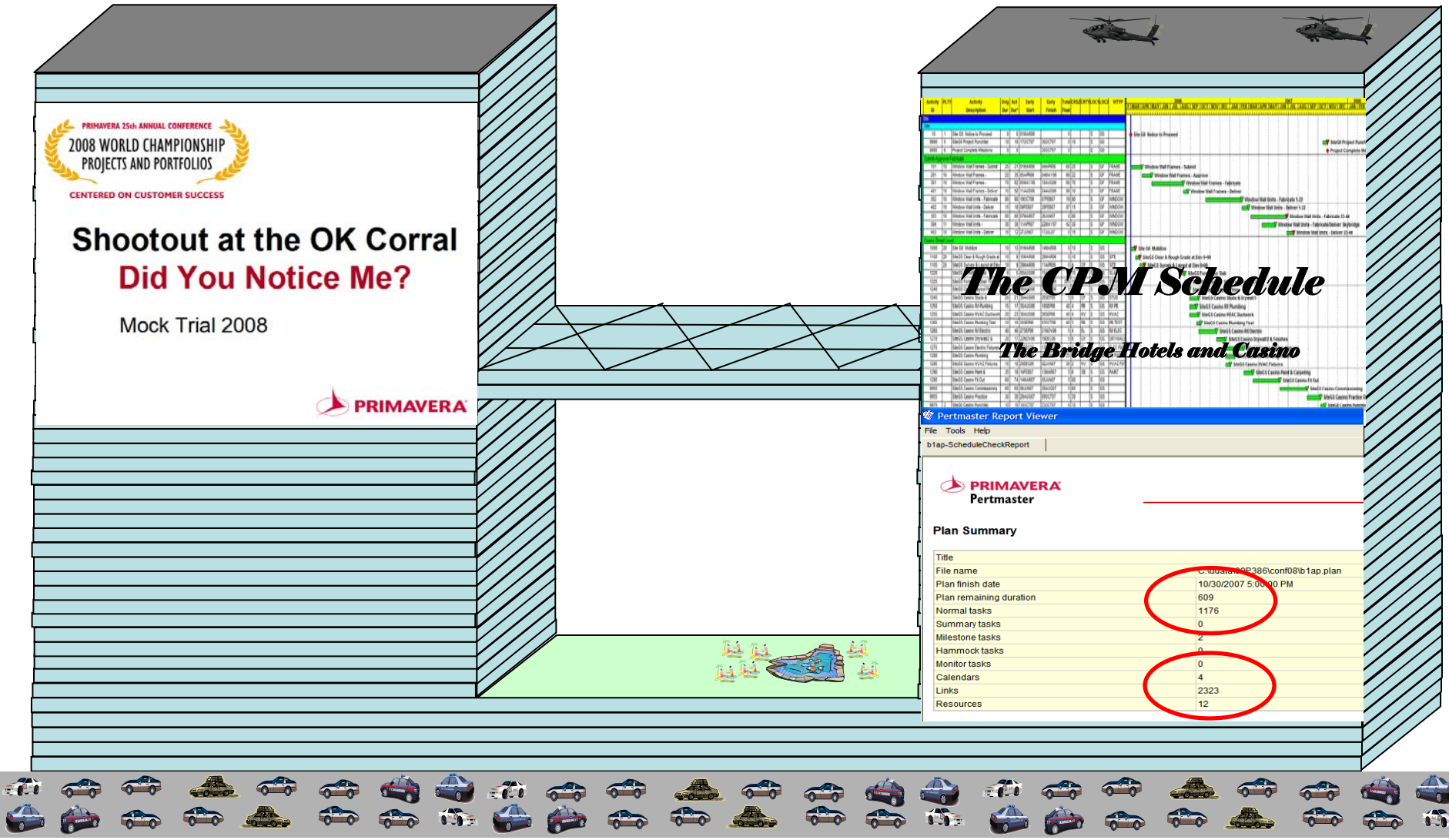


RDM Analysis of the As-Planned Logic

- check for hidden open ends
- check for misunderstood logic
- check for physical v resource logic
- check for physical-logic-only open ends
- check if the as-planned is a CPM or merely a bar-chart

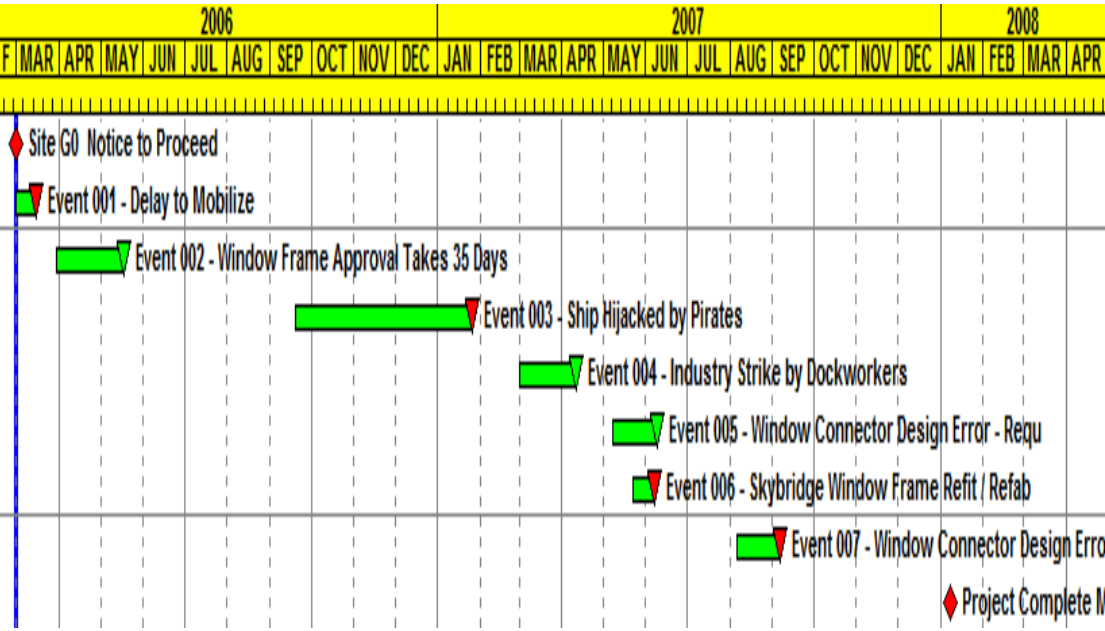


Our Example Today

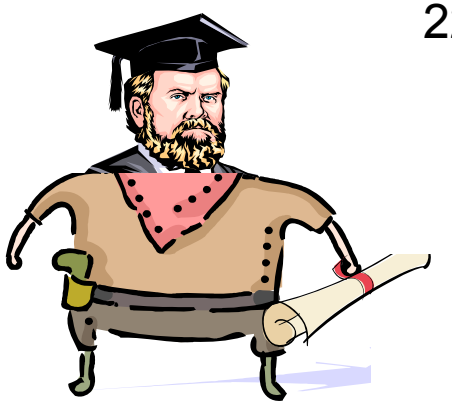


Entitlement to Total Delay

Activity ID	PLT1	Activity Description	Rem Dur	Act Dur*	Early Start	Early Finish	Total Float
10	1	Site G0 Notice to Proceed	0	0	01MAR06		0
E001	15	Event 001 - Delay to Mobilize	10	10	01MAR06	14MAR06	-10
E002	15	Event 002 - Window Frame Approval Takes 35 Days	35	35	30MAR06*	17MAY06	59
E003	15	Event 003 - Ship Hijacked by Pirates	92	92	20SEP06*	25JAN07	-22
E004	15	Event 004 - Industry Strike by Dockworkers	30	30	01MAR07*	11APR07	42
E005	15	Event 005 - Window Connector Design Error - Requ	24	24	08MAY07*	08JUN07	15
E006	15	Event 006 - Skybridge Window Frame Refit / Refab	11	11	23MAY07*	06JUN07	-29
E007	15	Event 007 - Window Connector Design Error - Requ	24	24	06AUG07*	06SEP07	-49
9995	6	Project Complete Milestone	0	0		07JAN08	-69



226



Direct Examination

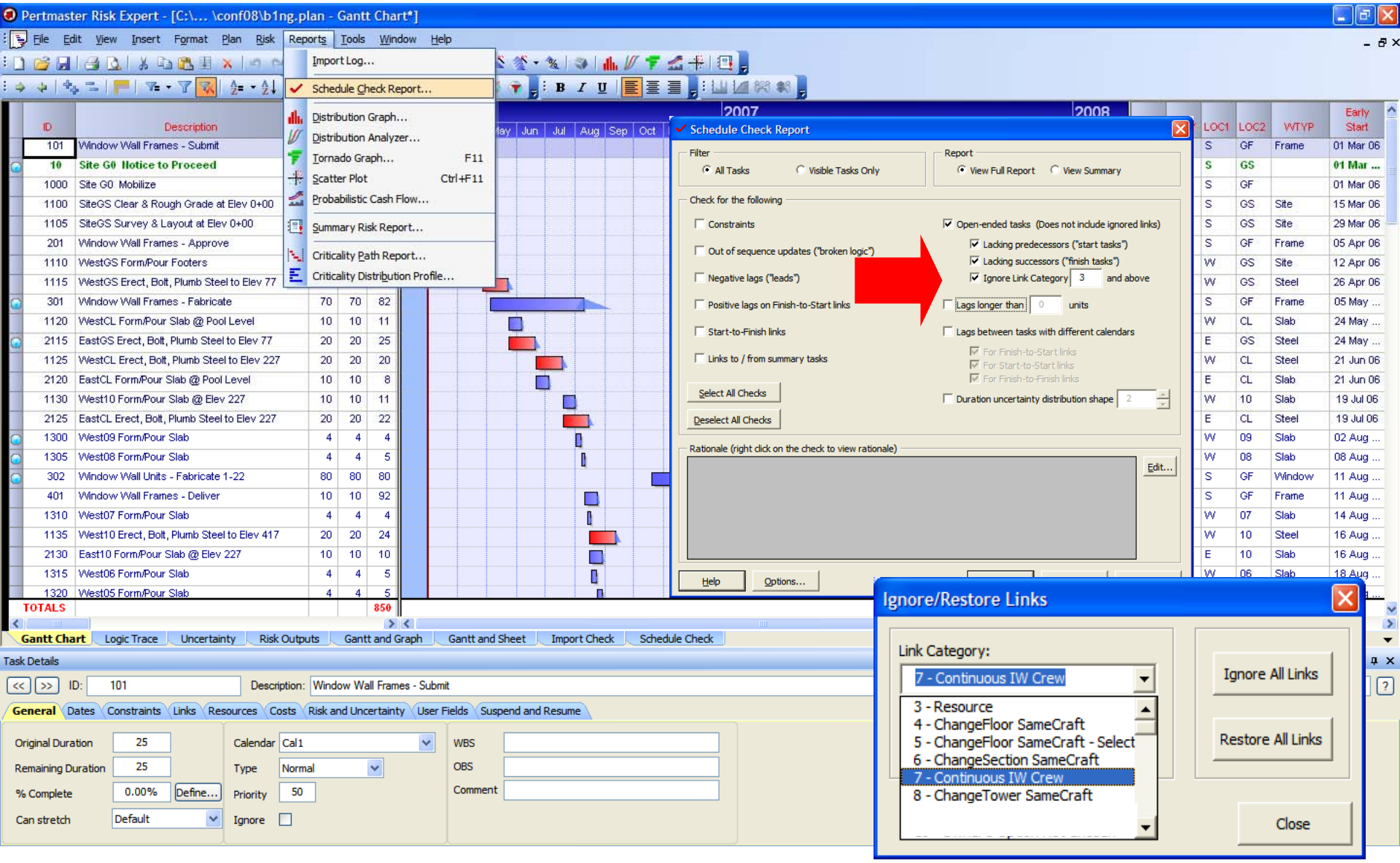
Testimony for the Contractor

attacking the report

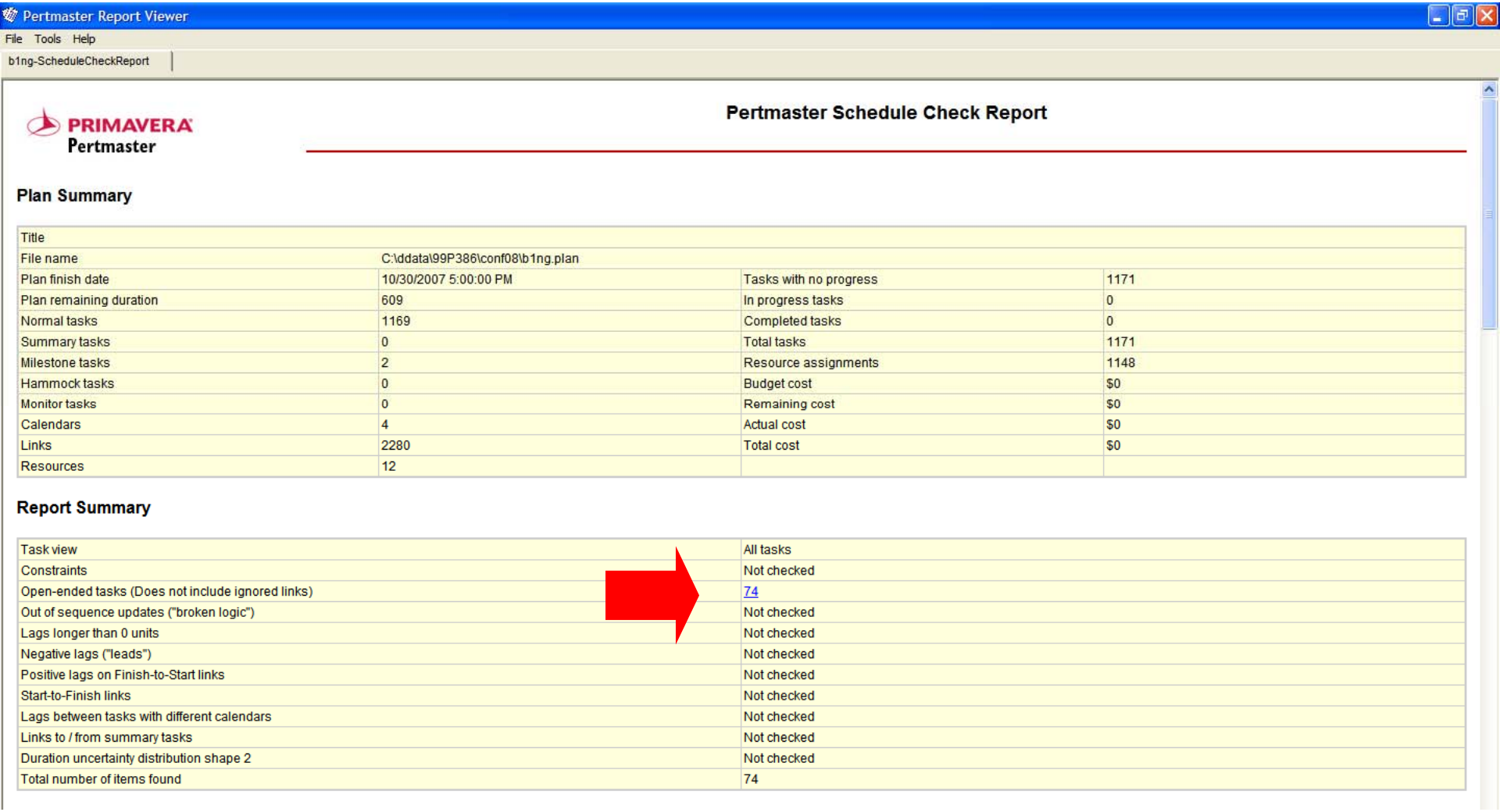
- set the predicate for a proper CPM
  - every activity (other than first) must have a predecessor
  - every activity (other than last) must have a successor
  - if these rules not followed the logic network will have open ends
  - what is wrong with open ends?
  - this required logic must be methodology (physical), not just resource
  - non-physical resource restraint example – crew from tower to tower
  - if non-physical resource restraints are removed – more open ends?
- does CPM used for this analysis meet these criteria?

Cross-Examination

attacking the report



attacking the report



attacking the report

Pertmaster Report Viewer

File Tools Help

b1ng-ScheduleCheckReport

Open-ended tasks (Does not include ignored links)

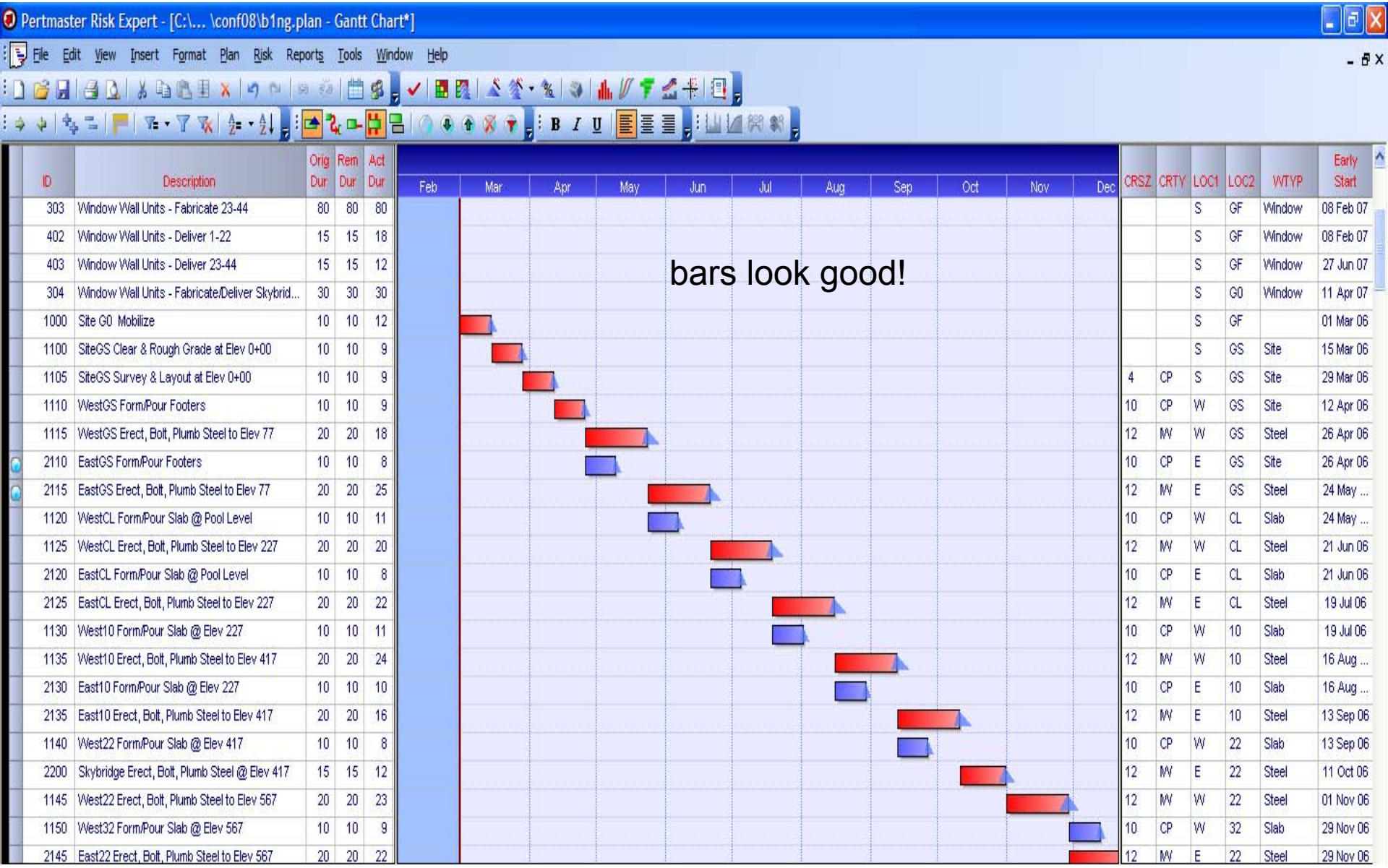
Options selected:Predecessors, Successors

For a schedule risk analysis to be meaningful, it is important that tasks' dates are set by logic (e.g. Finish-to-Start links) rather than constraints. This is so that the risk analysis will recognize the knock-on effect of delays. An open-ended task is one that does not have at least one predecessor and one successor – it indicates a possible lack of logic. Consider closing open-ended tasks:

- If a task has no predecessor, try to find some other tasks which could potentially delay it. Leave it as open-ended if it is the project start milestone.
- If a task has no successors, try to find some other tasks which it could potentially delay. Leave it as open-ended if it is a project finish or reporting milestone.

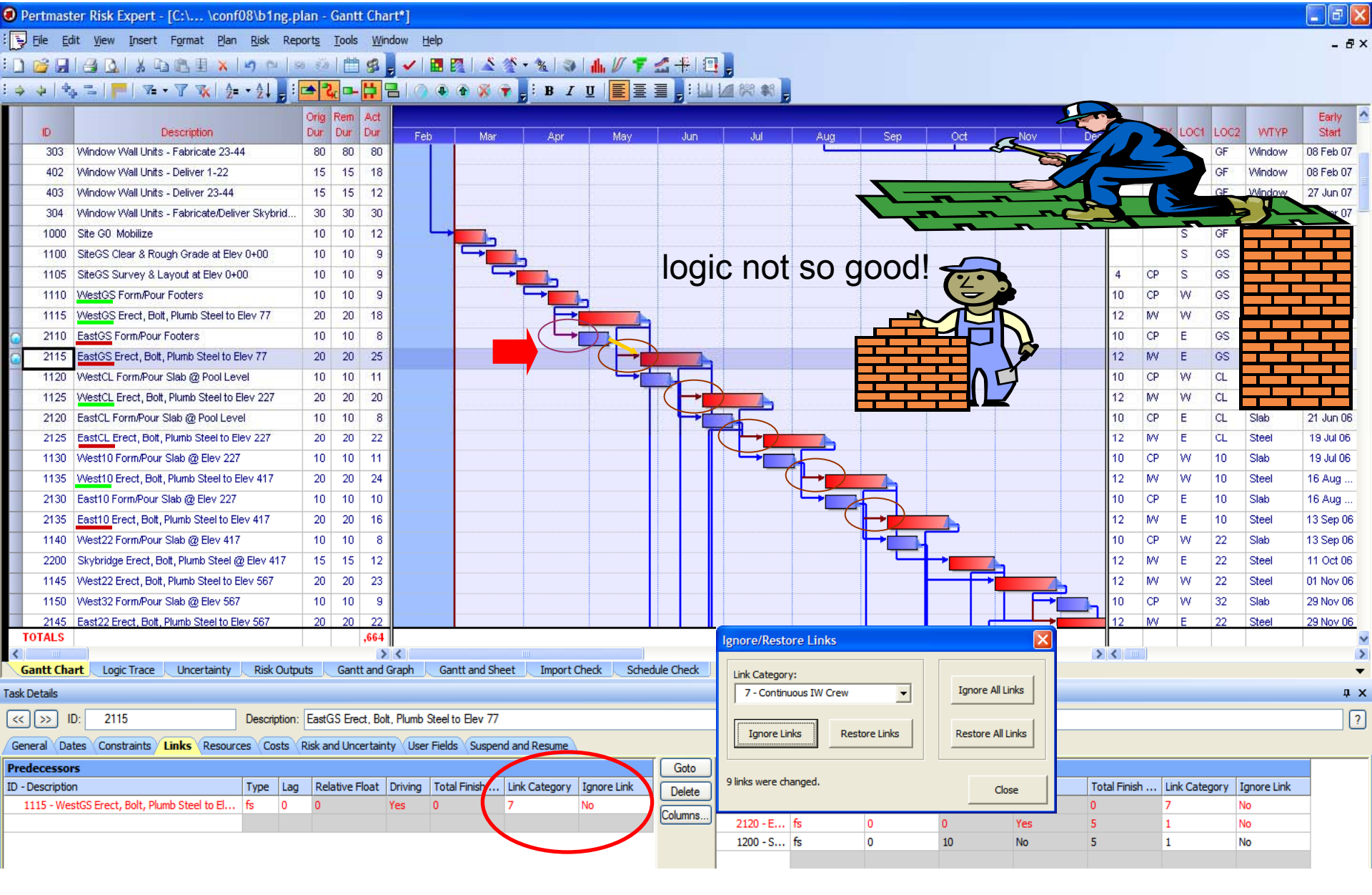
Bookmark	ID	Description	Type	Remaining Duration	Detail
☑	1300	West09 Form/Pour Slab	Normal	4	Finish has no successors
☑	1305	West08 Form/Pour Slab	Normal	4	Finish has no successors
☑	2400	East21 Form/Pour Slab	Normal	4	Start has no predecessors
☑	1360	West03 Affix Window Wall Frames Floors 1-3	Normal	6	Finish has no successors
☑	1460	West12 Affix Window Wall Frames Floors 10-12	Normal	6	Finish has no successors
☑	1470	West22 Affix Window Wall Units Floors 1-22	Normal	12	Start has no predecessors
☑	1362	West06 Affix Window Wall Frames Floors 4-6	Normal	6	Finish has no successors
☑	1364	West09 Affix Window Wall Frames Floors 7-9	Normal	6	Finish has no successors
☑	1364	West09 Affix Window Wall Frames Floors 7-9	Normal	6	Start has no predecessors
☑	1462	West15 Affix Window Wall Frames Floors 13-15	Normal	5	Finish has no successors
☑	1464	West18 Affix Window Wall Frames Floors 16-18	Normal	5	Finish has no successors
☑	2110	EastGS Form/Pour Footers	Normal	10	No successors
☑	2110	EastGS Form/Pour Footers	Normal	10	Start has no predecessors
☑	2115	EastGS Erect, Bolt, Plumb Steel to Elev 77	Normal	20	Start has no predecessors
☑	2360	East03 Affix Window Wall Frames Floors 1-3	Normal	6	Finish has no successors
☑	2362	East06 Affix Window Wall Frames Floors 4-6	Normal	6	Finish has no successors
☑	2364	East09 Affix Window Wall Frames Floors 7-9	Normal	6	Finish has no successors
☑	2410	East19 Form/Pour Slab	Normal	4	Start has no predecessors
☑	2415	East18 Form/Pour Slab	Normal	4	Start has no predecessors
☑	2420	East17 Form/Pour Slab	Normal	4	Start has no predecessors
☑	2425	East16 Form/Pour Slab	Normal	4	Start has no predecessors
☑	2430	East15 Form/Pour Slab	Normal	4	Start has no predecessors
☑	2435	East14 Form/Pour Slab	Normal	4	Start has no predecessors
☑	2440	East13 Form/Pour Slab	Normal	4	Start has no predecessors
☑	2445	East12 Form/Pour Slab	Normal	4	Start has no predecessors

attacking the report

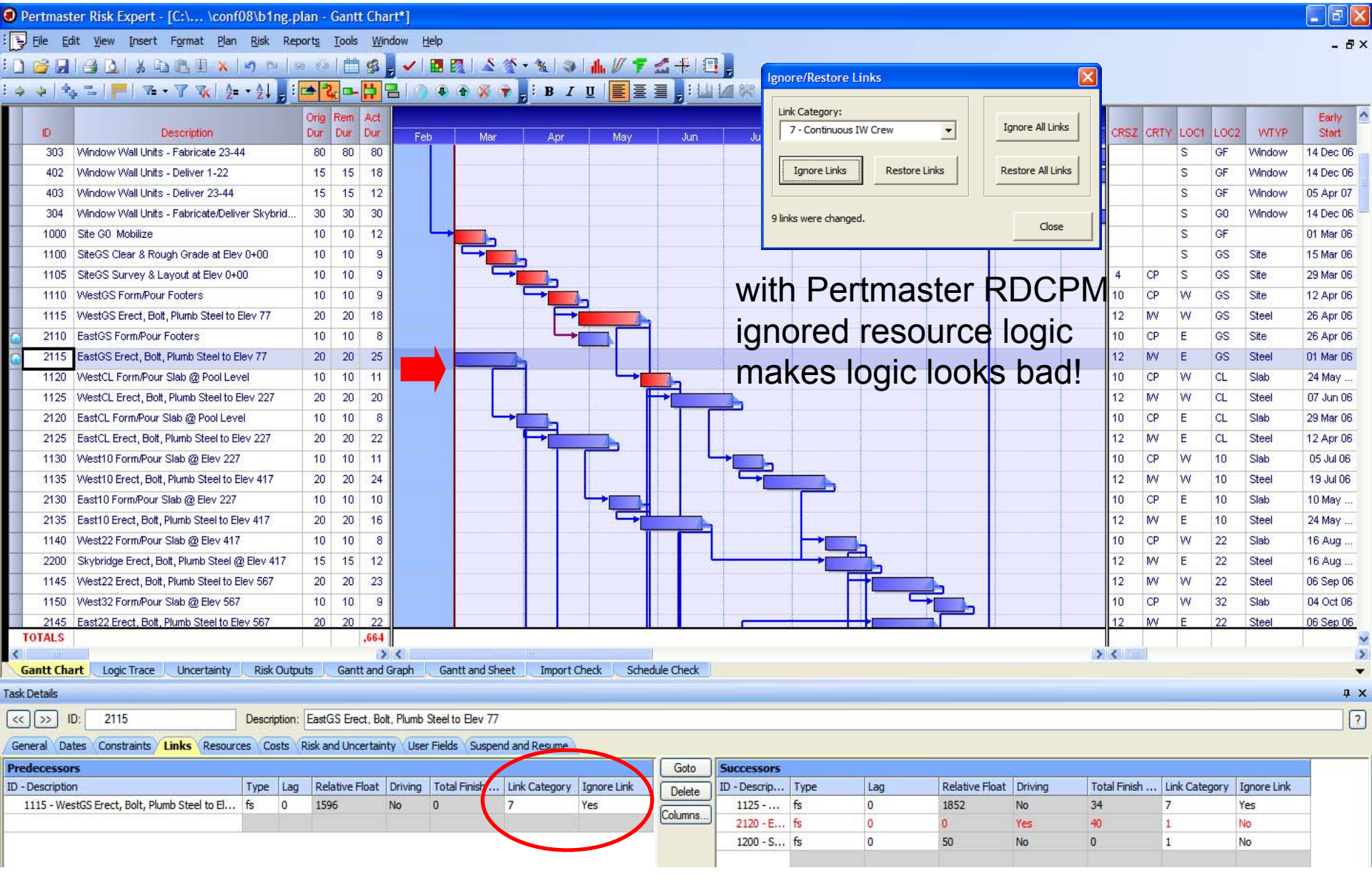


ID	Description	Orig Dur	Rem Dur	Act Dur	CRSZ	CRTY	LOC1	LOC2	WTYP	Early Start
303	Window Wall Units - Fabricate 23-44	80	80	80			S	GF	Window	08 Feb 07
402	Window Wall Units - Deliver 1-22	15	15	18			S	GF	Window	08 Feb 07
403	Window Wall Units - Deliver 23-44	15	15	12			S	GF	Window	27 Jun 07
304	Window Wall Units - Fabricate/Deliver Skybrid...	30	30	30			S	G0	Window	11 Apr 07
1000	Site G0 Mobilize	10	10	12			S	GF		01 Mar 06
1100	SiteGS Clear & Rough Grade at Elev 0+00	10	10	9			S	GS	Site	15 Mar 06
1105	SiteGS Survey & Layout at Elev 0+00	10	10	9	4	CP	S	GS	Site	29 Mar 06
1110	WestGS Form/Pour Footers	10	10	9	10	CP	W	GS	Site	12 Apr 06
1115	WestGS Erect, Bolt, Plumb Steel to Elev 77	20	20	18	12	MW	W	GS	Steel	26 Apr 06
2110	EastGS Form/Pour Footers	10	10	8	10	CP	E	GS	Site	26 Apr 06
2115	EastGS Erect, Bolt, Plumb Steel to Elev 77	20	20	25	12	MW	E	GS	Steel	24 May ...
1120	WestCL Form/Pour Slab @ Pool Level	10	10	11	10	CP	W	CL	Slab	24 May ...
1125	WestCL Erect, Bolt, Plumb Steel to Elev 227	20	20	20	12	MW	W	CL	Steel	21 Jun 06
2120	EastCL Form/Pour Slab @ Pool Level	10	10	8	10	CP	E	CL	Slab	21 Jun 06
2125	EastCL Erect, Bolt, Plumb Steel to Elev 227	20	20	22	12	MW	E	CL	Steel	19 Jul 06
1130	West10 Form/Pour Slab @ Elev 227	10	10	11	10	CP	W	10	Slab	19 Jul 06
1135	West10 Erect, Bolt, Plumb Steel to Elev 417	20	20	24	12	MW	W	10	Steel	16 Aug ...
2130	East10 Form/Pour Slab @ Elev 227	10	10	10	10	CP	E	10	Slab	16 Aug ...
2135	East10 Erect, Bolt, Plumb Steel to Elev 417	20	20	16	12	MW	E	10	Steel	13 Sep 06
1140	West22 Form/Pour Slab @ Elev 417	10	10	8	10	CP	W	22	Slab	13 Sep 06
2200	Skybridge Erect, Bolt, Plumb Steel @ Elev 417	15	15	12	12	MW	E	22	Steel	11 Oct 06
1145	West22 Erect, Bolt, Plumb Steel to Elev 567	20	20	23	12	MW	W	22	Steel	01 Nov 06
1150	West32 Form/Pour Slab @ Elev 567	10	10	9	10	CP	W	32	Slab	29 Nov 06
2145	East22 Erect, Bolt, Plumb Steel to Elev 567	20	20	22	12	MW	E	22	Steel	29 Nov 06

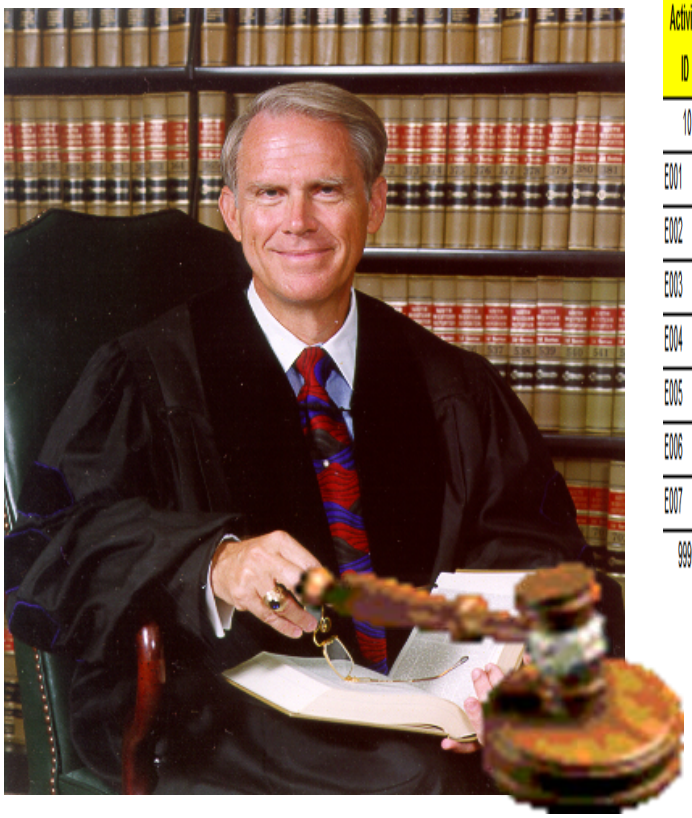
attacking the report



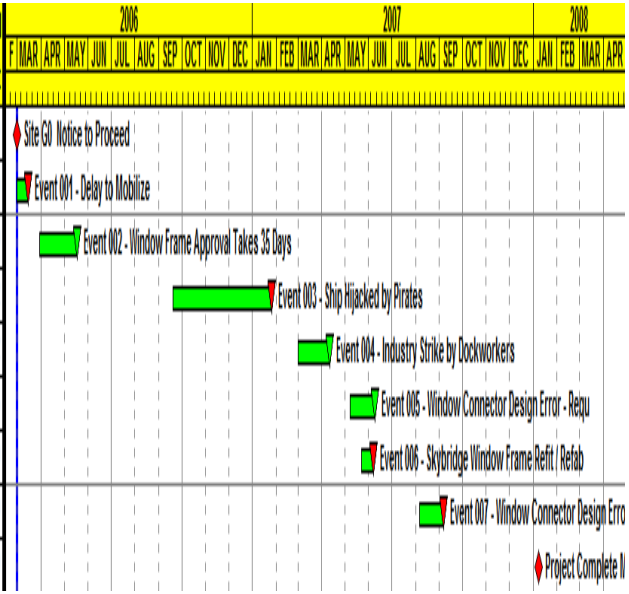
attacking the report



Decision Time



Activity ID	PLT	Activity Description	Rem Dur	Act Dur	Early Start	Early Finish	Total Float
10	1	Site G0 Notice to Proceed	0	0	01MAR06		0
E001	15	Event 001 - Delay to Mobilize	10	10	01MAR06	14MAR06	-10
E002	15	Event 002 - Window Frame Approval Takes 35 Days	35	35	30MAR06*	17MAY06	59
E003	15	Event 003 - Ship Hijacked by Pirates	92	92	20SEP06*	25JAN07	-22
E004	15	Event 004 - Industry Strike by Dockworkers	30	30	01MAR07*	11APR07	42
E005	15	Event 005 - Window Connector Design Error - Requ	24	24	08MAY07*	08JUN07	15
E006	15	Event 006 - Skybridge Window Frame Refit / Refab	11	11	23MAY07*	05JUN07	-29
E007	15	Event 007 - Window Connector Design Error - Requ	24	24	06AUG07*	05SEP07	-49
9985	6	Project Complete Milestone	0	0		07JAN08	-89



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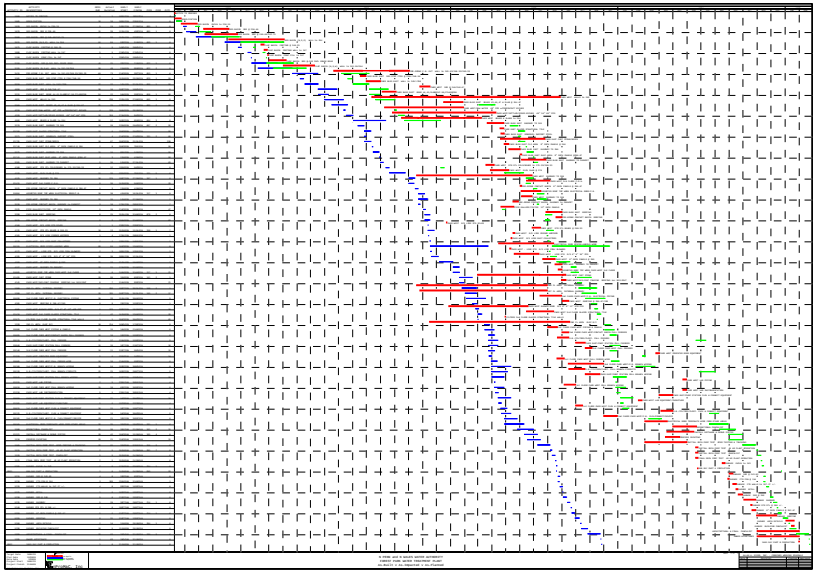
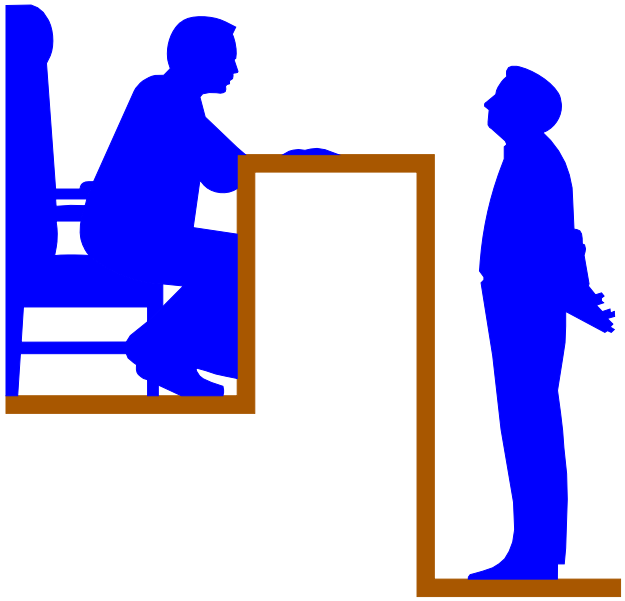
Evidence Issues for this CPM

- The As-Planned Schedule Logic may be flawed
- Distinguishing Methodology from Resource Logic is key
- Understanding of the “expert” relating to Logic is fair game





THE FLORIDA BAR

FOR THE PUBLIC

Q&A

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