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**Project Controls Expo**  
**09/10 Nov London 2011**

# **Schedule Maturity**

# Speaker Profile

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- ❑ Terry Horton – Principal Consultant at OTC Optima
- ❑ OTC Optima is an established consultancy delivering tangible business benefits through the implementation of effective project management practices
- ❑ Worked on a number of projects in the Construction, Oil & Gas, A & D and public sector
- ❑ Implemented several PM System and Control solutions
- ❑ Carry out audits on large capital projects

# Index

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- Why have a mature schedule?
- What do we mean by schedule maturity?
- How can you measure your maturity?
- How can you check your measures?
- Are there any tools to help?
- Benefits

# Why Have a Mature Schedule?

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- Your quality policies and standards will demand it
- Your customers and your managers will certainly demand it (and will check the quality)
- A sound schedule leads to project success
- A weak schedule often gets changed repeatedly
- What about professional pride?

# Schedule Maturity not PM Maturity

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- I am looking at schedule maturity not project management maturity
  - Although schedule maturity is a key component of PM maturity
- By schedule maturity I mean schedule quality
  - i.e. How good is the schedule
- It's not looking at the technical solution of the project
- It's looking at
  - Is it a good schedule?
  - Does it make sense?
  - Does it all tie up?

# What Constitutes a Sound Schedule?

- ❑ A schedule is a forecast
- ❑ Used as a benchmark against which to measure performance
- ❑ Means of defining scope
- ❑ Means of defining responsibility
- ❑ Means of communicating the plan to stakeholders



# Linking Scope to Work

- Schedule needs to reflect the work needed to achieve the overarching objective of the project
- Separate deliverables from the work
- Start your plan with a WBS



# CPM Building Blocks

<b>Project</b>	Defines start or finish of the job Encapsulates the defined work
<b>Activities</b>	Defines duration for a given scope of work
<b>Logic Links</b>	Defines sequence of work
<b>Calendars</b>	Defines when an activity/ resource can work
<b>Constraints</b>	Defines date overrides
<b>Resources</b>	Defines who/what is available to execute work
<b>Resource Assignment</b>	Links the “executors” to their work

- Scheduling tools are an excellent means of modelling these moving parts.

But.....

- They do little for making sure the building blocks are used correctly

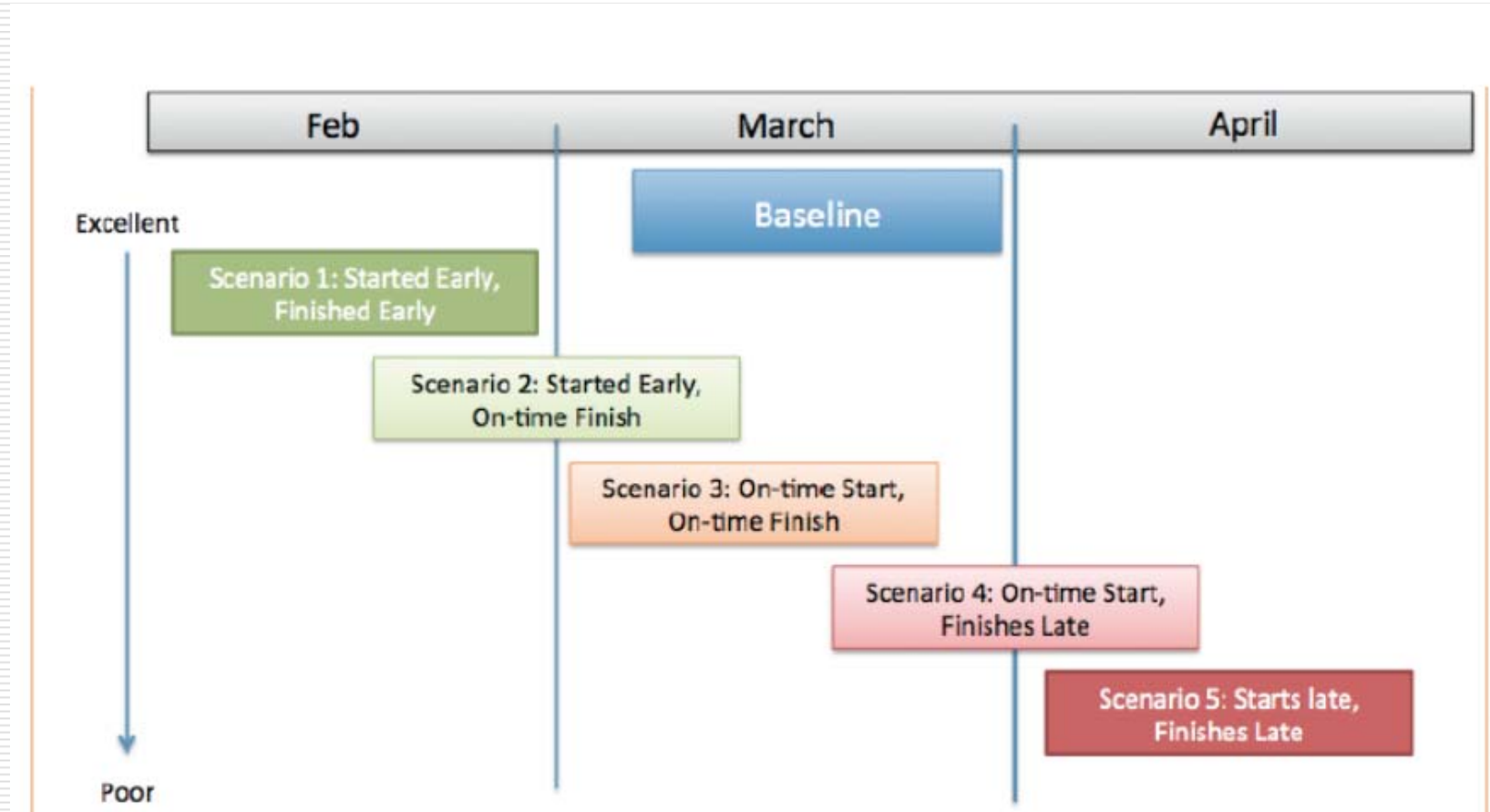


# Sound Schedule Leads to Project Success

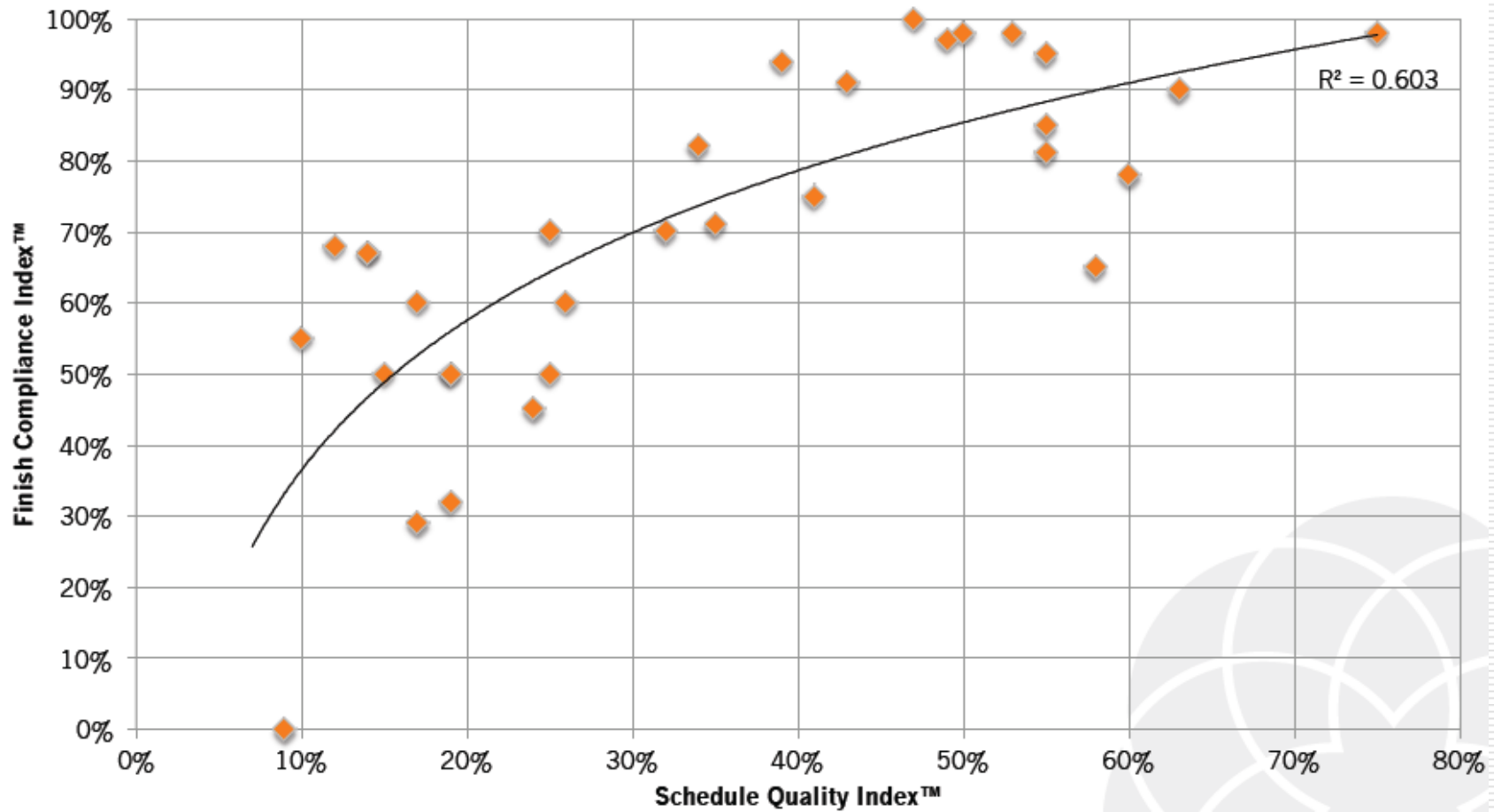
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- Results from 35 projects ranging from \$15M to \$30B were analysed
- A graph of Finish Compliance Index™ was plotted against Schedule Quality Index™
  - Finish Compliance Index™ number of activities that were completed within the expected baseline period
  - Schedule Quality Index™ weighted values for no. of critical activities, number of constraints, number of lags, etc.
- The graph shows the Baseline Compliancy Matrix™
- Result shows that the higher the quality of the schedule, the higher the chance of success

# Compliance Scenarios



# Baseline Compliancy Metric™

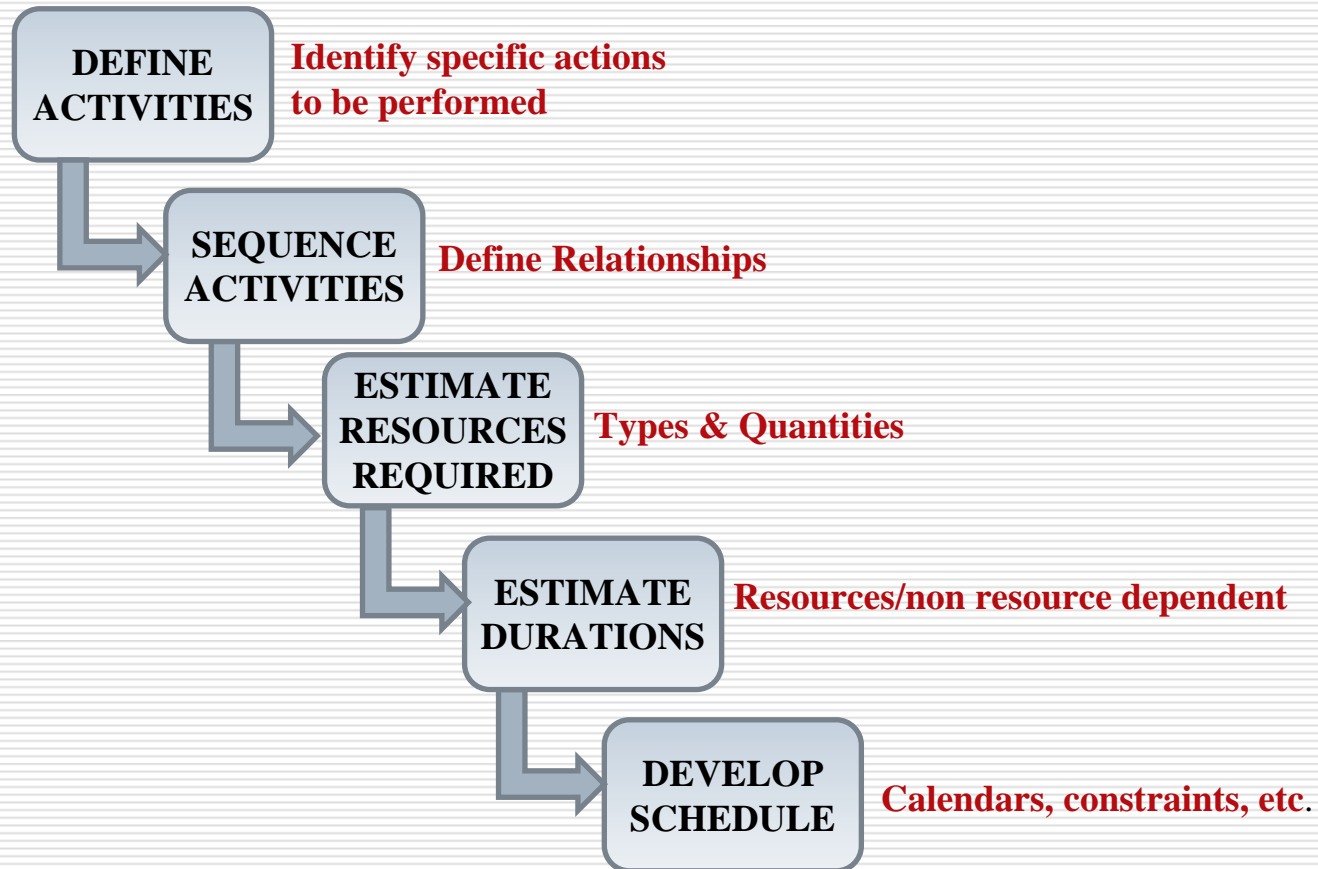


# The Challenge with Gantt Charts

Task Name	Duration	Start	Finish	9											
				Qtr 1, 2010				Qtr 2, 2010				Qtr 3, 2010			
				Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	D		
SYSTEM IMPLEMENTATI	507 days	05 Apr '10	13 Mar '12	[Gantt bar]											
REQUIREMENTS	26 days	05 Apr '10	10 May '10	[Gantt bar]											
Contract Award	0 days	05 Apr '10	05 Apr '10	05/04											
Review Scope	10 days	05 Apr '10	16 Apr '10	DES,ENG,DOC											
Agree Scope	3 days	19 Apr '10	21 Apr '10	MAN[0.5],PM											
Prepare Reqmts do	10 days	22 Apr '10	05 May '10	DES,PM,PCM,ENG											
Agree Reqmts	3 days	06 May '10	10 May '10	MAN,PM											
Contract Accepted	0 days	10 May '10	10 May '10	10/05											
PROJECT MGMT	507 days	05 Apr '10	13 Mar '12	[Gantt bar]											
INITIATION	25 days	05 Apr '10	07 May '10	[Gantt bar]											
Establish Projec	5 days	05 Apr '10	09 Apr '10	PCM,PM											
Establish WBS,	10 days	12 Apr '10	23 Apr '10	PCM,PM,DES,ENG											
Review Schedu	10 days	26 Apr '10	07 May '10	PM[0.5],PCM,ENG[0.5],DES[0.5]											
START UP	78 days	05 Apr '10	21 Jul '10	[Gantt bar]											
Establish Projec	5 days	05 Apr '10	09 Apr '10	PM,PCM											
Define Processi	20 days	10 May '10	04 Jun '10	DOC,PCM,DES[0.25],ENG[0.25]											
Define Procedu	30 days	10 May '10	18 Jun '10	DOC,DES[0.5],PCM											
Rev & Agree	3 days	21 Jun '10	23 Jun '10	PM,PCM											
Develop Detail p	15 days	24 Jun '10	14 Jul '10	DES,ENG,INT,PM,PCM											
Establish Baseli	5 days	15 Jul '10	21 Jul '10	PCM,PM											
Baseline Set up	0 days	21 Jul '10	21 Jul '10	21/07											

- Usually need access to the plan
  - Need to be a skilled user
  - Hard copies are difficult to assimilate
- Highly vertical in nature
  - A row per activity required
  - Humans like timelines
- Logic adds complexity
  - Difficult to trace
  - Complex logic can swamp a plan
- Details can be lost in summaries
- Normally just shows earliest/latest dates
- Very activity centric

# Development of the Schedule



# Common Problems

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- Lots of open-end activities
- Lots of high float
- Too many overly long durations
- Use of negative lags
- Long positive lags
- Overuse of constraints
- Too many links so plan is “locked solid”



## **Solution**

Need to use an industry recognised standard for checking schedule quality

# DCMA 14 Point Schedule Assessment Metrics

## DCMA 14 Point

1. **Logic:** identify how schedule is linked together
2. **Leads:** leads distorts total float in schedule
3. **Lags:** hides detail in schedule
4. **Relationship Types:** Focus on Finish-to-Start (FS)
5. **Hard Constraints:** overrides natural CPM
6. **High Float:** network may not be logic-driven
7. **Negative Float:** result of forced planning
8. **High Duration:** lack of detail
9. **Invalid Dates:** errors around the data date
10. **Resources:** verification that tasks have resources
11. **Missed Tasks:** comparison to baseline
12. **Critical Path Test:** tests validity of driving path
13. **Critical Path Length Index (CPLI):** "realism"
14. **Baseline Execution Index (BEI):** performance



# GAO Best Practice

## GAO Scheduling Best Practices

1. **Capturing all activities:** Schedule should reflect all activities in WBS (government and contractor)
2. **Sequencing all activities:** Activities sequenced in the logical order they are to be carried out
3. **Assigning resources to all activities:** reflect what resources are needed to do the work
4. **Establishing duration of all activities:** realistically reflect how long each activity will take
5. **Integrating schedule activities horizontally and vertically:** breadth & depth scope
6. **Establishing critical path for all activities:** driving path through schedule
7. **Identifying float between activities:** schedule flexibility can be determined
8. **Conducting schedule risk analysis:** predict level of confidence
9. **Updating schedule using logic and durations to determine the dates:** realism
10. **Creating a baseline schedule**





# What is a Metric?

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- Metric Definition
  - “a measurement used to mathematically gauge a quantity”
- Metric Score
  - Typically a count of activities
  - Can be a summation e.g. cost
- Metric Percentage
  - Provides context e.g. within a set of activities
- Threshold or tripwire
  - Acceptable bandwidth relative to a given basis

# Logic Checks

- Normally target missing successors and/or predecessors
- But what about:
  - Logic density – Average number of links per activity
  - Summary logic – Logic on summary tasks
  - Loops
  - Merge hotspots – Many predecessors into one activity
  - Diverge hotspots – Many successors from one activity
  - Redundant logic – Links not required because the path is covered by other logic
  - Out of sequence progressing – Was the logic valid?
  - Resource links – Logic that was created solely to cover unavailability of a resource



# Merge/ Diverge Pinch Points

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## Merge

- If any ONE link is not achieved, then chance of the successor starting on time is reduced
- Are the resources going to wait until ALL the activities are complete?
- Can lead to out of sequence progress

## Diverge

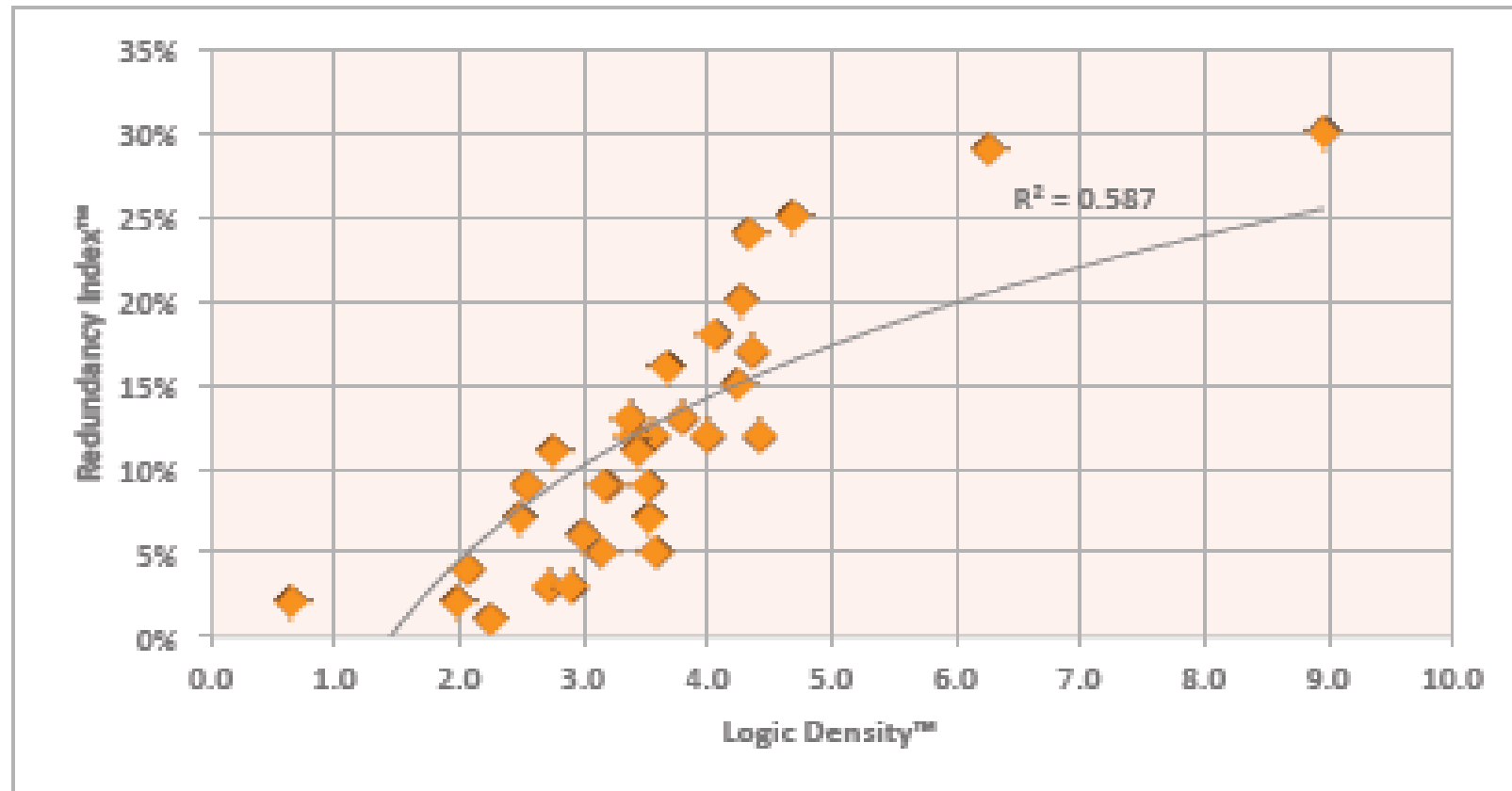
- Are ALL the successors really going to start at the same time?

# Merge/ Diverge Pinch Points

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- ❑ A recent analysis was carried out on 37 capital projects that are complete or nearly complete
- ❑ Two measures were made and compared
  - Logic Density™ - Average number of links per activity
  - Redundancy Index™ - Number of redundant links divided by total number of links
- ❑ The results show that the higher the Logic Density™ then the higher the number of redundant activities
- ❑ Any Logic Density™ greater than 5.0 is an indication that there are a large number of redundant links

# Logic Density™ v Redundancy Index™



# Leads and Lags

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- What are these leads and lags?
  - Are they resource lags?
  - Are they delivery lags or delays?
  - How am I going to progress these lags?
- Can I replace a lag with a real time activity?
  - E.g. Replace a concrete cure lag with a real activity of “Await concrete cure”
- Can I replace a lag with a milestone?
  - E.g. Replace delivery lag with an agreed delivery date milestone
- Why have I got these leads?
  - E.g. Can I replace a lead (negative lag) with a milestone or a link to a preceding activity?

# Other Problems

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- Large floats indicate missing links
- High durations indicate a lack of detail of the work to be carried out
- Hard constraints will fix activities and often corrupt a critical path
  - How does your scheduling tool calculate float when hard constraints are assigned?

# Appropriate Use of Constraints

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- Understand use of constraints
  - Delivery dates, reviews
- Understand how your scheduling tool applies constraints
- Look for open ends on constraints
- Understand float around constraints
  - Float is often artificially generated
- Avoid hard constraints
  - They go against the premise of CPM



# Calendars

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- Appropriate use of calendars
  - Use a reasonable number of calendars
  - Make sure resource calendars don't clash with activity calendar
- Use reasonable level of detail
  - Don't use hourly calendar on a 3 year construction project
- Be careful about multiple calendars in a sequence of activities
  - Logic links inherit either predecessor or successor calendar

# How Can I Improve?

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- You need to know what your targets are:
  - E.g. No end dangles, no negative lags, etc.
- You need to know where your problems are
  - How can I check/measure where I am?
- You need to know how you can close the gap
- You need to set yourself a timescale for improvement
  - You can't resolve all the quality shortfalls at once
  - Aim for a lower target initially and then raise the standard
  - Find out why some projects are good and some are bad

# Analysing Data

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- ❑ In the past, when performing quality checks schedule data was exported out of the scheduling program
- ❑ Then the exported database was loaded into another program such as Access, Excel, Oracle, Rbase for grouping, filtering and calculating
- ❑ Depending on size and complexity, the process to develop the spreadsheet or database tables could take days
- ❑ It was not uncommon to forget to export certain data so the process would have to be restarted
- ❑ Missing updates or current data was often provided late which resulted in the analysis having to be carried out at the last minute
- ❑ Hence, many organisations didn't bother

# Not a One-Off Exercise

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- What has changed since last reporting period?
  - Activities added or deleted
  - Logic changed
  - Resources changed
  - Has critical path changed?
  - Start/finish date changes
  - Etc.
  
- Why has the baseline changed?
  - Need to compare revised baseline to previous baseline(s)
  - What are the changes?
  - Are they documented?

# So You Really Need a Tool

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- Manual checking is very labour intensive
- It's easy to miss things
- You need consistency across your projects
- You need to be able to compare projects
- You need to be able to set targets
- You need a repeatable process
- You want a quick answer



# Tool Example

## DCMA Metrics

1. Logic	2. Leads	3. Lags	4. FS Relations	5. Hard Constraint	6. High Float	7. Negative Float	8. High Duration	9. Invalid Dates	10. Resources	11. Missed Activities	13. CPLI	14. BEI	Metric Index™
2 (2%)	0 (0%)	0 (0%)	152 (93%)	1 (1%)	34 (31%)	40 (37%)	16 (15%)	0 (0%)	108 (99%)	12 (11%)	0.96	0.38	90%

## Logic Metrics

Missing Predecessors	Missing Successors	SS Predecessors	SF Predecessors	FF Predecessors	FS Predecessors	Logic Density™	Merge Hotspot	Diverge Hotspot	Logic Hotspot™	Open Start	Open Finish	Open Ends with Constr...	Metric Index™
3 (2%)	5 (4%)	11 (8%)	0 (0%)	1 (1%)	118 (89%)	2.91	13 (10%)	12 (9%)	1 (1%)	0 (0%)	1 (1%)	3 (2%)	93%

# Example Detail Analysis

## DCMA Metrics by Project Code

	1. Logic	2. Leads	3. Lags	4. FS Relations	5. Hard Constraint	6. High Float	7. Negative Float	8. High Duration	9. Invalid Dates	10. Resources	11. Missed Activities	13. CPLI	14. BEI	Metric Index™
Null	1 (33%)	0 (0%)	0 (0%)	2 (100%)	0 (0%)	2 (67%)	0 (0%)	0 (0%)	0 (0%)	3 (100%)	0 (0%)	1.00	0.00	89%
Bristol	0 (0%)	0 (0%)	0 (0%)	8 (73%)	0 (0%)	0 (0%)	8 (80%)	3 (30%)	0 (0%)	10 (100%)	7 (50%)	0.96	0.57	84%
London	1 (6%)	0 (0%)	0 (0%)	31 (97%)	1 (6%)	9 (53%)	6 (35%)	3 (18%)	0 (0%)	17 (100%)	3 (17%)	0.96	0.33	87%
Manchester	0 (0%)	0 (0%)	0 (0%)	28 (93%)	0 (0%)	14 (61%)	4 (17%)	6 (26%)	0 (0%)	23 (100%)	0 (0%)	0.96	N/A	89%
Oxford	0 (0%)	0 (0%)	0 (0%)	39 (89%)	0 (0%)	0 (0%)	17 (61%)	1 (4%)	0 (0%)	28 (100%)	0 (0%)	0.97	N/A	92%
Reading	0 (0%)	0 (0%)	0 (0%)	44 (98%)	0 (0%)	9 (32%)	5 (18%)	3 (11%)	0 (0%)	27 (96%)	2 (7%)	0.96	0.00	92%

# You Need Forensics or Comparisons

What activities have been added?

**Added - Removed Activities - 3 (2%)**

Drag a column header here to group by that column.

#	ID	Description	Activity Type	WBS Code	IMP00_BASE	IMP04_APR	IMP05_MAY	IMP00_NEWBASE
1	19	Risk Analysis	Normal	11.3.1.5	✗	✗	✓	✓
2	42	Prepare estimate	Normal	11.4.1.7	✗	✗	✗	✓
3	44	Review Design	Normal	11.4.1.6	✗	✗	✗	✓

Have any of my durations changed?

**Original Duration Modifications - 24 (15%)**

Drag a column header here to group by that column.

#	ID	Description	Activity T...	WBS Code	IMP00_BASE	IMP04_APR	IMP05_MAY	IMP00_NEWBASE
1	10	Prepare Reqmts doc	Normal	11.2.3	10 = 0 (0%)	10 Days = 0 (0%)	10 Days ▼ -7 (-70%)	3 Days
2	9	Agree Scope	Normal	11.2.2	3 = 0 (0%)	3 Days ▲ 2 (67%)	5 Days ▲ 2 (67%)	5 Days
3	8	Review Scope	Normal	11.2.1	10 ▲ 5 (50%)	15 Days ▲ 5 (50%)	15 Days ▲ 5 (50%)	15 Days
4	15	Establish Project Mgmt team	Normal	11.3.1.1	5 = 0 (0%)	5 Days ▲ 3 (60%)	8 Days ▲ 3 (60%)	8 Days
5	11	Agree Reqmts	Normal	11.2.4	3 = 0 (0%)	3 Days = 0 (0%)	3 Days ▲ 2 (67%)	5 Days
6	16	Establish WBS, OBS, RAM	Normal	11.3.1.2	10 = 0 (0%)	10 Days ▲ 2 (20%)	12 Days ▲ 2 (20%)	12 Days
7	4	Set up Bus Team	Normal	11.1.2	3 ▲ 2 (67%)	5 Days ▲ 2 (67%)	5 Days ▲ 2 (67%)	5 Days
8	21	Define Processes	Normal	11.3.2.2	20 = 0 (0%)	20 Days = 0 (0%)	20 Days ▼ -10 (-50%)	10 Days
9	20	Establish Project Team	Normal	11.3.2.1	5 = 0 (0%)	5 Days = 0 (0%)	5 Days ▼ -1 (-20%)	4 Days
10	22	Define Procedures	Normal	11.3.2.3	30 = 0 (0%)	30 Days = 0 (0%)	30 Days ▼ -12 (-40%)	18 Days
11	41	Develop CAPs	Normal	11.4.1.2	10 = 0 (0%)	10 Days = 0 (0%)	10 Days ▲ 22.43 (224%)	32.425 Days
12	40	Define Strategy	Normal	11.4.1.1	10 = 0 (0%)	10 Days = 0 (0%)	10 Days ▲ 2 (20%)	12 Days



# Benefits

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- ❑ If you have a good quality schedule then you will have confidence in your:
  - Capacity planning
  - Earned value
  - Change control
- ❑ Contractor schedule integration becomes more reliable
- ❑ Running a matrix organisation becomes simpler if all the plans within the organisation have a consistent quality target
  - Weaker plans can be readily identified
  - Action can be instigated to resolve the shortfall

# Benefits We've Learned

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- We starting using metric tools last year for carrying out major project reviews
- Our time spent on checking out the detail reduced from days down to hours
  - Common, consistent objective measures
  - More accurate, easily understood measures
  - Repeatable measures
- We could spend more time on schedule acceleration and integration of risk
- The higher quality schedules enabled clients to implement Earned Value and change control more efficiently
- Our client satisfaction increased

# Other Knowledge Areas

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- As well as DCMA and GAO there are other useful knowledge areas
  - NDIA Generally Accepted Scheduling Principles (GASP)
  - Project Management Institute (PMI)
  - Authority for Total Cost Management (AACE)
  - Association of Project Management (APM)
  - Best Practice Institute (BPI)
  - Cabinet Office – Major Projects Authority
  - PRINCE 2

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# Any Questions?

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