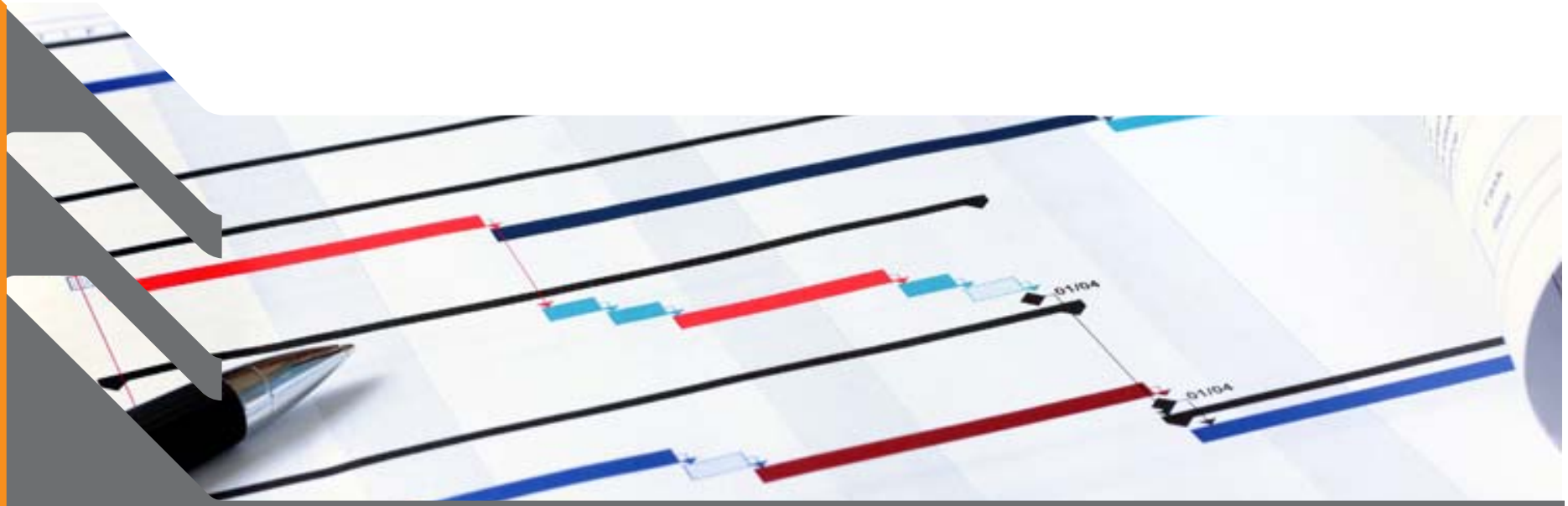
PMA Consultants
the value of amazing service



Logic Gantt Chart *RIP*
1896 - ?

Gui Ponce de Leon, PhD, PE, PMP, LEED AP

GPM Boot Camp

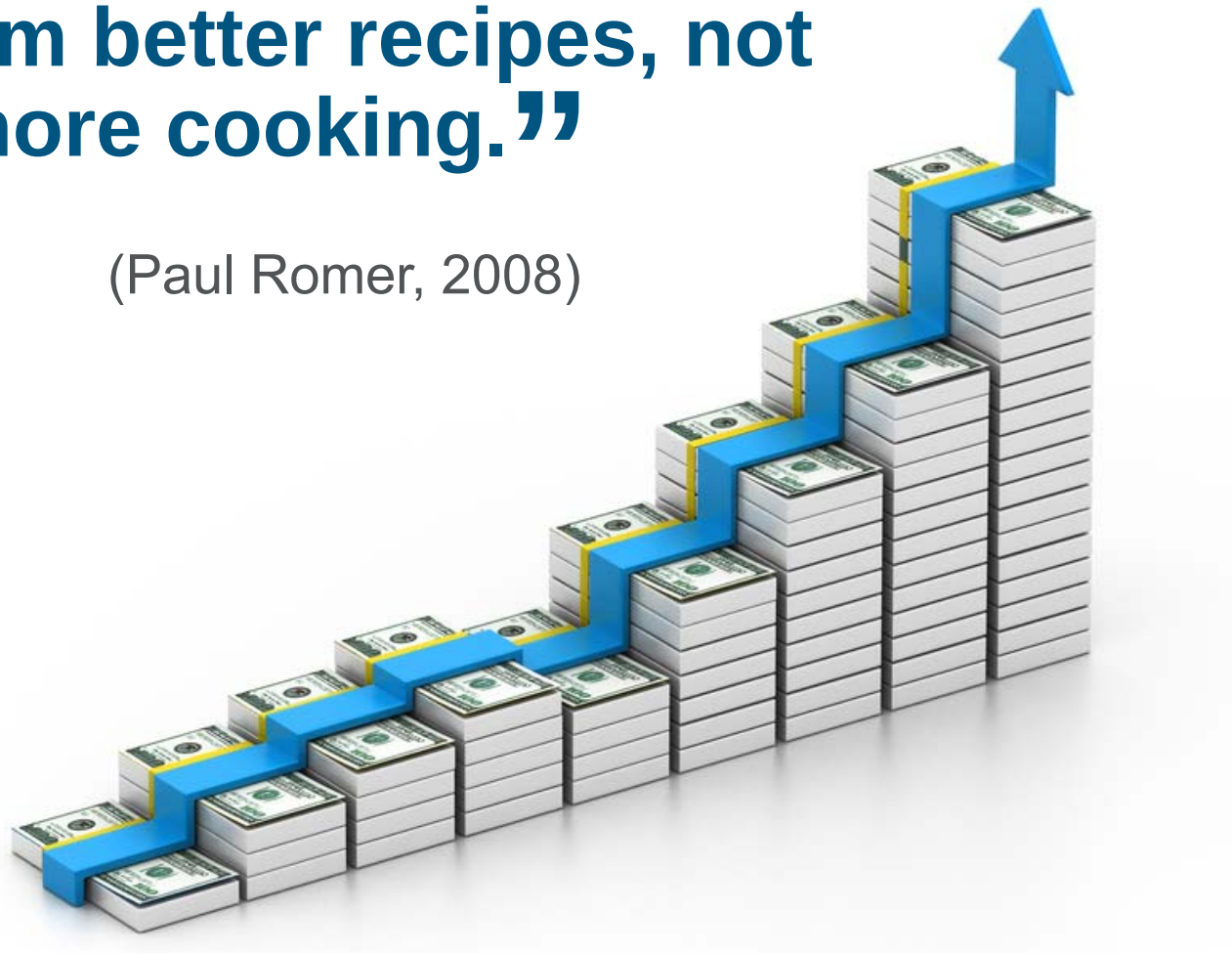
Newark, New Jersey

March 8th, 2013

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“Human history teaches us, however, that economic growth springs from better recipes, not just from more cooking.”

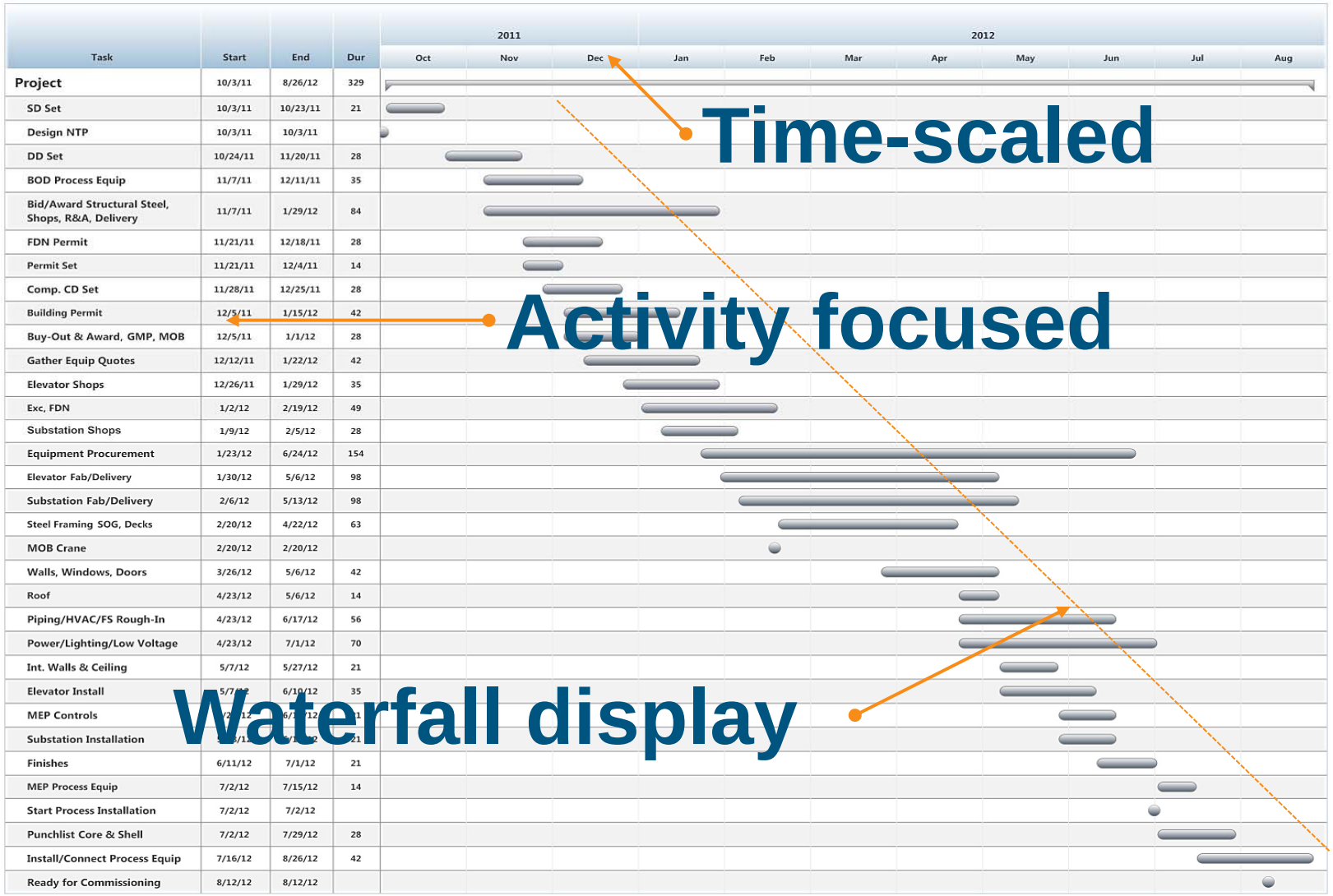
(Paul Romer, 2008)



Romer, Paul M. “Economic Growth.” In *The Concise Encyclopedia of Economics*, edited by David Henderson. Library of Economics and Liberty. Article published August 2008. http://www.econlib.org/library/Enc/EconomicGrowth.html#

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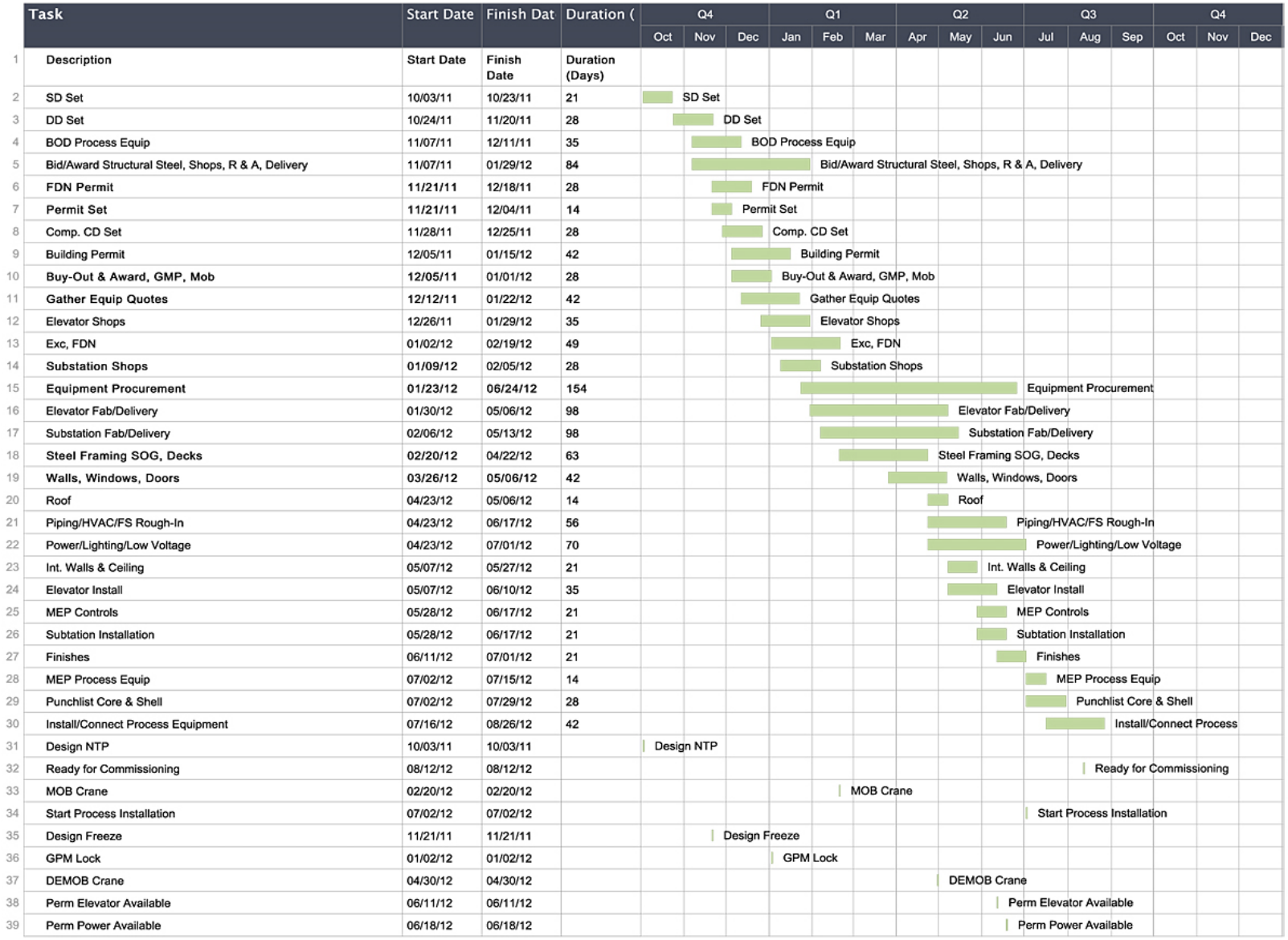
The Gantt Chart Hardly Needs an Introduction



Task	Start	End	Dur
Project	10/3/11	8/26/12	329
SD Set	10/3/11	10/23/11	21
Design NTP	10/3/11	10/3/11	
DD Set	10/24/11	11/20/11	28
BOD Process Equip	11/7/11	12/11/11	35
Bid/Award Structural Steel, Shops, R&A, Delivery	11/7/11	1/29/12	84
FDN Permit	11/21/11	12/18/11	28
Permit Set	11/21/11	12/4/11	14
Comp. CD Set	11/28/11	12/25/11	28
Building Permit	12/5/11	1/15/12	42
Buy-Out & Award, GMP, MOB	12/5/11	1/1/12	28
Gather Equip Quotes	12/12/11	1/22/12	42
Elevator Shops	12/26/11	1/29/12	35
Exc, FDN	1/2/12	2/19/12	49
Substation Shops	1/9/12	2/5/12	28
Equipment Procurement	1/23/12	6/24/12	154
Elevator Fab/Delivery	1/30/12	5/6/12	98
Substation Fab/Delivery	2/6/12	5/13/12	98
Steel Framing SOG, Decks	2/20/12	4/22/12	63
MOB Crane	2/20/12	2/20/12	
Walls, Windows, Doors	3/26/12	5/6/12	42
Roof	4/23/12	5/6/12	14
Piping/HVAC/FS Rough-In	4/23/12	6/17/12	56
Power/Lighting/Low Voltage	4/23/12	7/1/12	70
Int. Walls & Ceiling	5/7/12	5/27/12	21
Elevator Install	5/7/12	6/10/12	35
MEP Controls	5/7/12	6/1/12	21
Substation Installation	5/7/12	6/1/12	21
Finishes	6/11/12	7/1/12	21
MEP Process Equip	7/2/12	7/15/12	14
Start Process Installation	7/2/12	7/2/12	
Punchlist Core & Shell	7/2/12	7/29/12	28
Install/Connect Process Equip	7/16/12	8/26/12	42
Ready for Commissioning	8/12/12	8/12/12	

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Another Common Gantt Chart Format



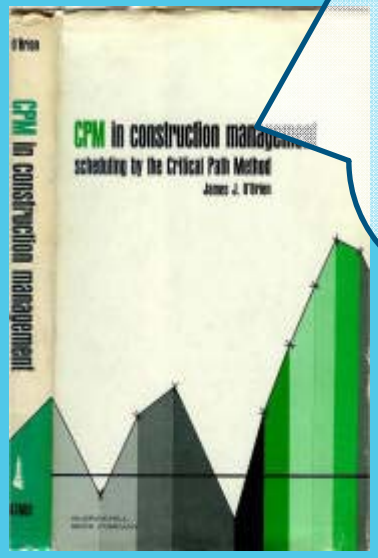
	Task	Start Date	Finish Dat	Duration (
1	Description	Start Date	Finish Date	Duration (Days)
2	SD Set	10/03/11	10/23/11	21
3	DD Set	10/24/11	11/20/11	28
4	BOD Process Equip	11/07/11	12/11/11	35
5	Bid/Award Structural Steel, Shops, R & A, Delivery	11/07/11	01/29/12	84
6	FDN Permit	11/21/11	12/18/11	28
7	Permit Set	11/21/11	12/04/11	14
8	Comp. CD Set	11/28/11	12/25/11	28
9	Building Permit	12/05/11	01/15/12	42
10	Buy-Out & Award, GMP, Mob	12/05/11	01/01/12	28
11	Gather Equip Quotes	12/12/11	01/22/12	42
12	Elevator Shops	12/26/11	01/29/12	35
13	Exc, FDN	01/02/12	02/19/12	49
14	Substation Shops	01/09/12	02/05/12	28
15	Equipment Procurement	01/23/12	06/24/12	154
16	Elevator Fab/Delivery	01/30/12	05/06/12	98
17	Substation Fab/Delivery	02/06/12	05/13/12	98
18	Steel Framing SOG, Decks	02/20/12	04/22/12	63
19	Walls, Windows, Doors	03/26/12	05/06/12	42
20	Roof	04/23/12	05/06/12	14
21	Piping/HVAC/FS Rough-In	04/23/12	06/17/12	56
22	Power/Lighting/Low Voltage	04/23/12	07/01/12	70
23	Int. Walls & Ceiling	05/07/12	05/27/12	21
24	Elevator Install	05/07/12	06/10/12	35
25	MEP Controls	05/28/12	06/17/12	21
26	Subtation Installation	05/28/12	06/17/12	21
27	Finishes	06/11/12	07/01/12	21
28	MEP Process Equip	07/02/12	07/15/12	14
29	Punchlist Core & Shell	07/02/12	07/29/12	28
30	Install/Connect Process Equipment	07/16/12	08/26/12	42
31	Design NTP	10/03/11	10/03/11	
32	Ready for Commissioning	08/12/12	08/12/12	
33	MOB Crane	02/20/12	02/20/12	
34	Start Process Installation	07/02/12	07/02/12	
35	Design Freeze	11/21/11	11/21/11	
36	GPM Lock	01/02/12	01/02/12	
37	DEMOB Crane	04/30/12	04/30/12	
38	Perm Elevator Available	06/11/12	06/11/12	
39	Perm Power Available	06/18/12	06/18/12	

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Back in 1965, the Gantt Chart was Viewed with Some Skepticism

If the bar graph is so well suited to construction activity, why look for another planning aid? The reason lies in the fact that the bar graph is limited in what it can present. In the preparation of the bar chart, the scheduler is almost necessarily influenced by desired completion dates, often actually working backward from the completion dates. The resultant mixture of planning and scheduling is often no better than wishful thinking.

If a bar graph is carefully prepared, the scheduler goes through the same thinking process that the CPM planner does. However, the bar graph cannot show (or record) the interrelationships and interdependencies which control the progress of the project. At a later date, even the originator is often hard pressed to explain his plan using the bar graph.



O'Brien, J. (1965). *CPM in construction management* [p 3]. New York: McGraw-Hill, Inc.

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Nowadays, the Gantt Chart has many supporters

Tuesday, May 17, 2011

Gantt Chart for Gantt Charts Sake

There are a number of articles online related to how Gantt Charts are an over rated form of project planning. In my view there is no point in bashing the Gantt Chart. A Gantt Chart is simply a visualisation of your project plan and project information. It enables you to effectively visualise time without having to wade through rows and rows of dates. A gantt chart gives you the ability to see where tasks fall in relation to each other. Can you imagine trying to interpret the relationships between 200 tasks from a row of dates. This would be a largely impossible task. With the advent of Gantt Charts by Henry Gantt in the early 1800's this problem was resolved.

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of these are still

Gantt chart has evolved to become the primary means of communicating project plans and for good reason.

The gantt chart has evolved to become the primary means of communicating project plans and for good reason. They are simple and easy to understand; they cross language barriers, and provide a means for people to collaborate on project planning and delivery.

Retrieved on 9/24/12 from http://chart-gantt.blogspot.com/

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But, A Gantt Devotee Recently Broke Rank

From: dave@gantthead.com [mailto:contactus@reply.gantthead
Sent: Monday, October 15, 2012 1:36 PM
To: Timothy Deane Mather
Subject: Project Management is Changing (and so are we...)

Greetings Fellow ganttheads,

We are proud to announce that effective today, gantthead will be changing its name to ProjectManagement.com.

When gantthead launched in 2000, every project worth managing was run using a gantt chart. However, times change and many project leaders are much more focused on their KanBan Boards than on a linear schedule. Although some of the tools and approaches may be changing, our commitment to you and your work has not. The name change doesn't mean we hate gantt charts--it just means that we want our site to be the logical destination for everything related to project management, the place you think of first when you need help. For those new to the craft, we are a lot easier to find...and by growing faster, we can only help everyone become better.

We continue to be your one-stop shop for Project Management answers, helpi ou "unstuck" and helping you confidently meet every new challenge that comes your way with:

- Over 11K how-to articles to jumpstart your projects.
- Over 1K Deliverable Templates to save you time and e
- Over 550K Peer Connections & experts to offer specifi

As always, if there is a way we can help you that doesn'
or just give me a ring at one of the numbers listed belo

We are now ProjectManagement.com. Our mission is (
So come out and take a look at the new site. We'll look

Best,

Dave

Subject: Project Management is Changing (and so are we…)

…times change and many project leaders are much more focused on their KanBan Boards than on a linear schedule.

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A CENTURY WORTH OF GANTT CHARTS

1915 1925 1935 1945 1955 1965 1975 1985 1995 2005 2015

Mid-1910s Henry Gantt creates Gantt charts as a tool for production scheduling in the job shop environment

1931 Construction begins on the Hoover Dam using Gantt charts

1956 The Interstate Highway System begins construction; Gantt charts are used as the scheduling method

1957 CPM improves on Gantt charts by expressly recognizing the logic ties or dependencies between activities

1957 to Mid-1980s Gantt charts survive CPM as one of the formats often used to display CPM schedules

Mid-1980s Gantt charts with logic ties aka Logic Gantt charts become the CPM software graph of choice

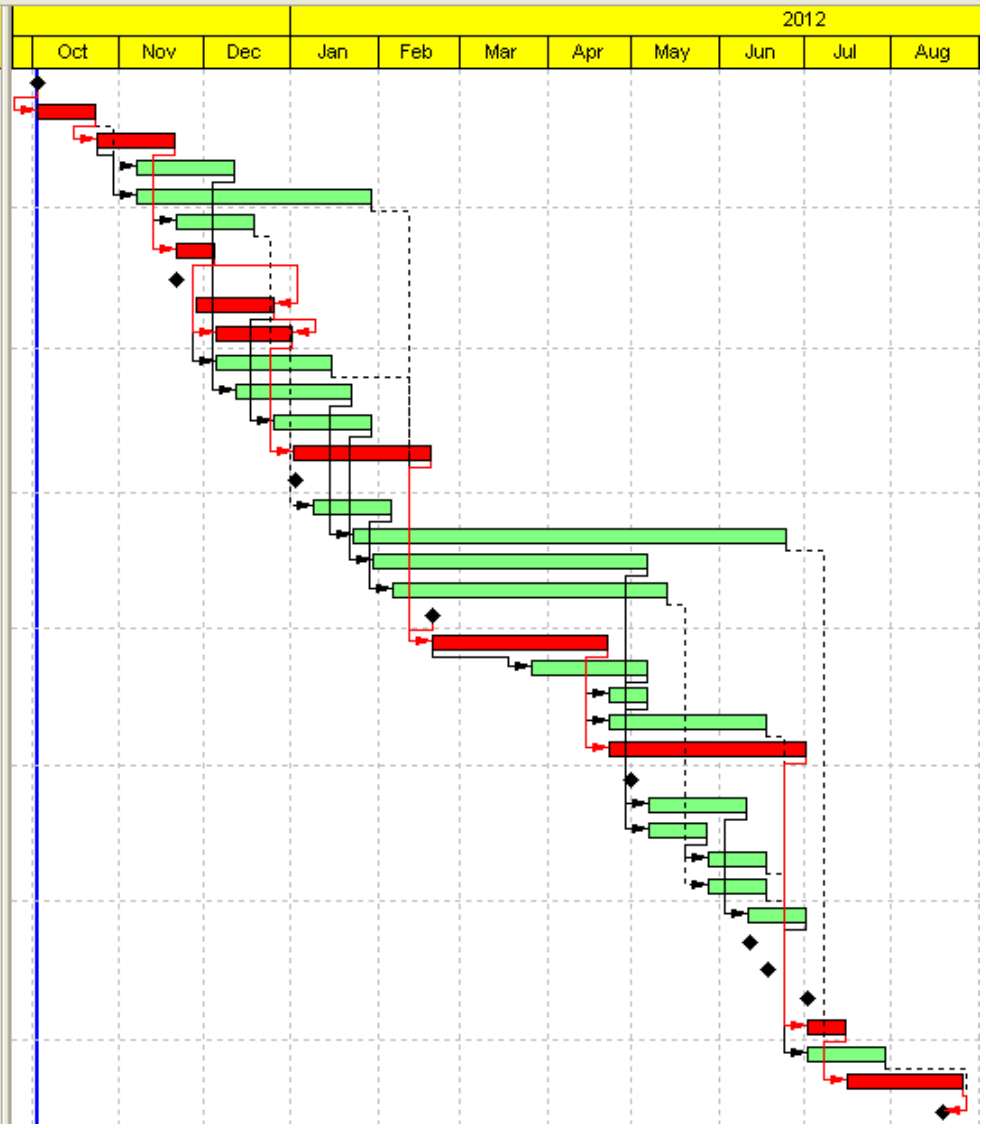
2008 Dr. Gui introduces the graphical path method or GPM® at the PMI College of Scheduling Annual Conference in Chicago

2012 Patrick Weaver debunks the notion that Bar Graphs were invented by Gantt

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Primavera P6 *Logic* Gantt Chart

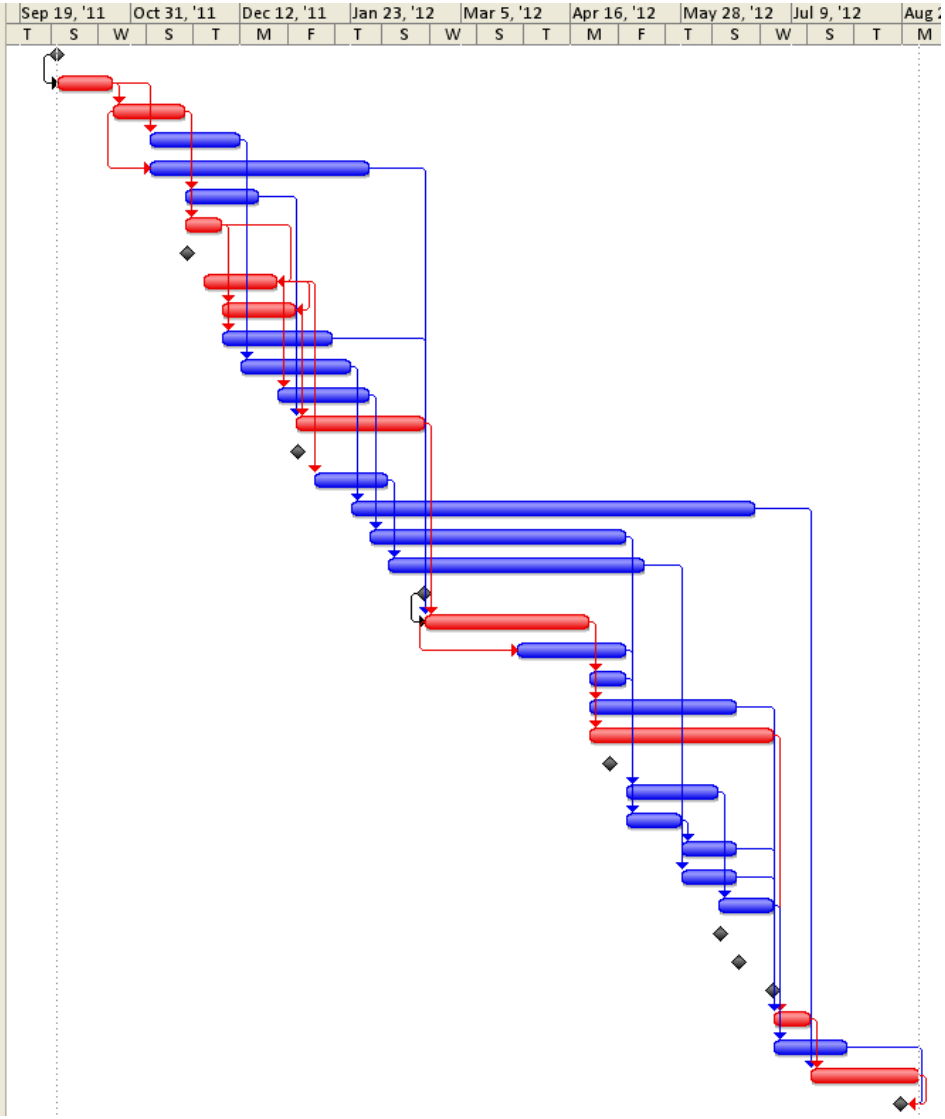
Activity Name	Original Duration	Start	Finish	Predece...	Total Float
Design NTP	0	03-Oct-11*			0
SD Set	21	03-Oct-11	23-Oct-11	~A1010	-7
DD Set	28	24-Oct-11	20-Nov-11	~A1090	-7
BOD Process Equip	35	07-Nov-11*	11-Dec-11	~A1090	14
Bid/Award Structural Steel, Shop...	84	07-Nov-11	29-Jan-12	~A1100	14
FDN Permit	28	21-Nov-11	18-Dec-11	~A1100	7
Permit Set	14	21-Nov-11	04-Dec-11	~A1100	-7
Design Freeze	0		21-Nov-11*		279
Comp. CD Set	28	28-Nov-11	25-Dec-11	~A1140	-7
Buy-Out & Award, GMP, Mob	28	05-Dec-11	01-Jan-12	~A1140, ...	-7
Building Permit	42	05-Dec-11	15-Jan-12	~A1140	28
Gather Equip Quotes	42	12-Dec-11	22-Jan-12	~A1110	14
Elevator Shops	35	26-Dec-11	29-Jan-12	~A1210	21
Exc, FDN	49	02-Jan-12	19-Feb-12	~A1170, ...	-7
GPM Lock	0		02-Jan-12*		237
Substation Shops	28	09-Jan-12*	05-Feb-12	~A1210	21
Equipment Procurement	154	23-Jan-12	24-Jun-12	~A1150	14
Elevator Fab/Delivery	98	30-Jan-12	06-May-12	~A1220	21
Substation Fab/Delivery	98	06-Feb-12	13-May-12	~A1310	21
MOB Crane	0	20-Feb-12*			-7
Steel Framing SOG, Decks	63	20-Feb-12	22-Apr-12	~A1190, ...	-7
Walls, Windows, Doors	42	26-Mar-12	06-May-12	~A1200	7
Roof	14	23-Apr-12	06-May-12	~A1200	7
Piping/HVAC/FS Rough-In	56	23-Apr-12	17-Jun-12	~A1200	7
Power/Lighting/Low Voltage	70	23-Apr-12	01-Jul-12	~A1200	-7
DEMOB Crane	0		30-Apr-12*		118
Elevator Install	35	07-May-12	10-Jun-12	~A1230	21
Int. Walls & Ceiling	21	07-May-12	27-May-12	~A1260, ...	7
MEP Controls	21	28-May-12	17-Jun-12	~A1270	7
Subtation Installation	21	28-May-12*	17-Jun-12	~A1320	7
Finishes	21	11-Jun-12	01-Jul-12	~A1240	21
Perm Elevator Available	0		11-Jun-12*		76
Perm Power Available	0		18-Jun-12*		69
Start Process Installation	0	02-Jul-12*			56
MEP Process Equip	14	02-Jul-12	15-Jul-12	~A1280, ...	-7
Punchlist Core & Shell	28	02-Jul-12	29-Jul-12	~A1360	21
Install/Connect Process Equipment	42	16-Jul-12	26-Aug-12	~A1160, ...	-7
Ready for Commissioning	0		19-Aug-12*	~A1350, ...	0



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MS Project *Logic* Gantt Chart

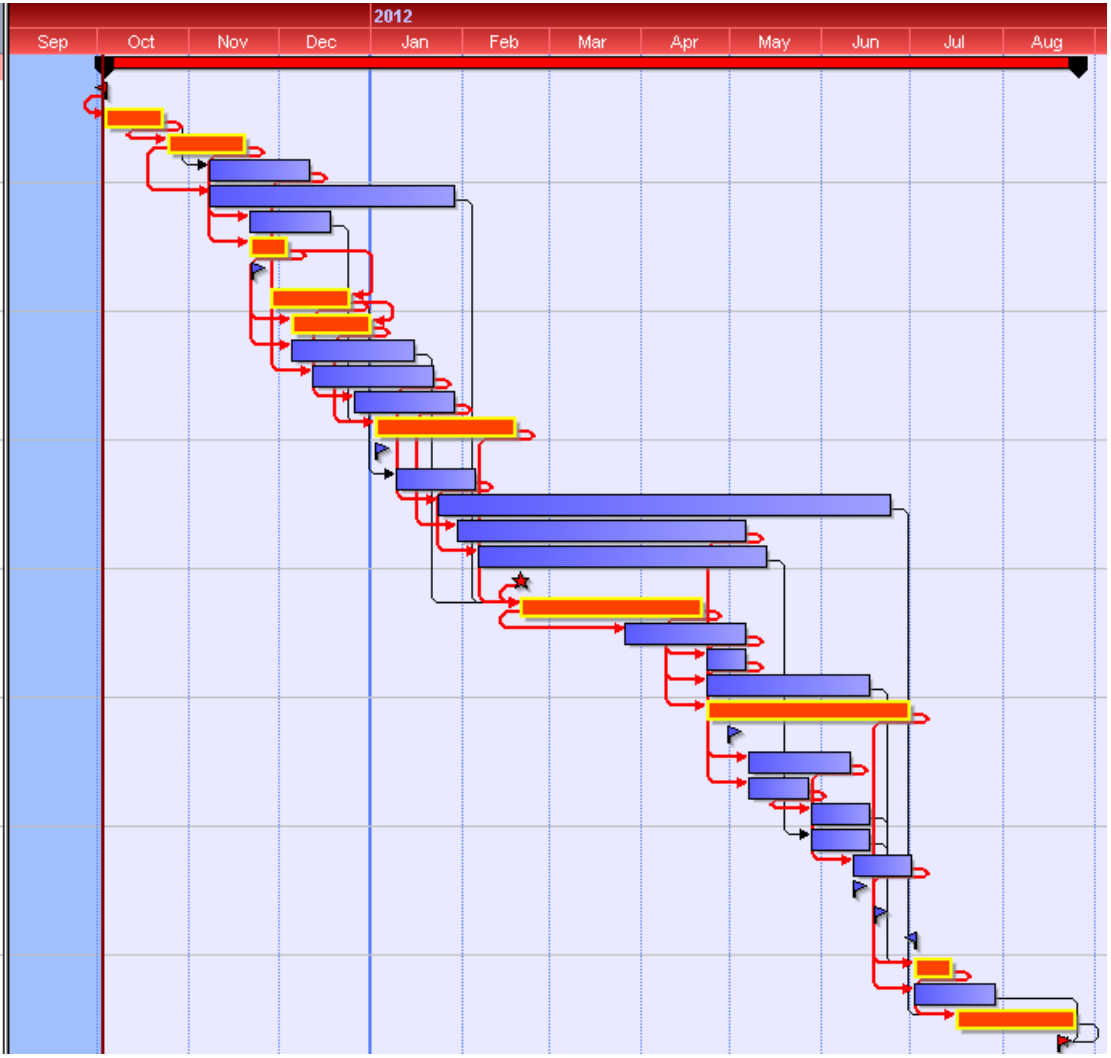
Task Name	Duration	Start	Finish	Predecessors	Total Slack
Design NTP	0 days	Mon 10/3/11	Mon 10/3/11		0 days
SD Set	21 days	Mon 10/3/11	Sun 10/23/11	2SS	-7 days
DD Set	28 days	Mon 10/24/11	Sun 11/20/11	10	-7 days
BOD Process Equip	35 days	Mon 11/7/11	Sun 12/11/11	10	14 days
Bid/Award Structural Steel, S	84 days	Mon 11/7/11	Sun 1/29/12	11SS+14 days	14 days
FDN Permit	28 days	Mon 11/21/11	Sun 12/18/11	11	7 days
Permit Set	14 days	Mon 11/21/11	Sun 12/4/11	11	-7 days
Design Freeze	0 days	Mon 11/21/11	Mon 11/21/11		279 days
Comp. CD Set	28 days	Mon 11/28/11	Sun 12/25/11	15FF+21 days	-7 days
Buy-Out & Award, GMP, Mob	28 days	Mon 12/5/11	Sun 1/1/12	15,22FF+7 days	-7 days
Building Permit	42 days	Mon 12/5/11	Sun 1/15/12	15	28 days
Gather Equip Quotes	42 days	Mon 12/12/11	Sun 1/22/12	12	14 days
Elevator Shops	35 days	Mon 12/26/11	Sun 1/29/12	22	21 days
Exc, FDN	49 days	Mon 1/2/12	Sun 2/19/12	18,14	-7 days
GPM Lock	0 days	Mon 1/2/12	Mon 1/2/12		237 days
Substation Shops	28 days	Mon 1/9/12	Sun 2/5/12	22	21 days
Equipment Procurement	154 days	Mon 1/23/12	Sun 6/24/12	16	14 days
Elevator Fab/Delivery	98 days	Mon 1/30/12	Sun 5/6/12	23	21 days
Substation Fab/Delivery	98 days	Mon 2/6/12	Sun 5/13/12	32	21 days
MOB Crane	0 days	Mon 2/20/12	Mon 2/20/12		-7 days
Steel Framing SOG, Decks	63 days	Mon 2/20/12	Sun 4/22/12	20,19,13,9SS	-7 days
Walls, Windows, Doors	42 days	Mon 3/26/12	Sun 5/6/12	21SS+35 days	7 days
Roof	14 days	Mon 4/23/12	Sun 5/6/12	21	7 days
Piping/HVAC/FS Rough-In	56 days	Mon 4/23/12	Sun 6/17/12	21	7 days
Power/Lighting/Low Voltage	70 days	Mon 4/23/12	Sun 7/1/12	21	-7 days
DEMOB Crane	0 days	Mon 4/30/12	Mon 4/30/12		118 days
Elevator Install	35 days	Mon 5/7/12	Sun 6/10/12	24	21 days
Int Walls & Ceiling	21 days	Mon 5/7/12	Sun 5/27/12	27,26	7 days
MEP Controls	21 days	Mon 5/28/12	Sun 6/17/12	28	7 days
Subtation Installation	21 days	Mon 5/28/12	Sun 6/17/12	33	7 days
Finishes	21 days	Mon 6/11/12	Sun 7/1/12	25	21 days
Perm Elevator Available	0 days	Mon 6/11/12	Mon 6/11/12		76 days
Perm Power Available	0 days	Mon 6/18/12	Mon 6/18/12		69 days
Start Process Installation	0 days	Mon 7/2/12	Mon 7/2/12		56 days
MEP Process Equip	14 days	Mon 7/2/12	Sun 7/15/12	29,31,30,34	-7 days
Punchlist Core & Shell	28 days	Mon 7/2/12	Sun 7/29/12	37	21 days
Install/Connect Process Equ	42 days	Mon 7/16/12	Sun 8/26/12	17,35	-7 days
Ready for Commissioning	0 days	Sun 8/19/12	Sun 8/19/12	36FF,38FF	-7 days



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Oracle Project Risk Analyzer
Logic Gantt Chart

Description	Start	Finish	Preceding Tasks	Total Finish Float
No title entered by user	03/10/2011	26/08/2012		-7
Design NTP	*03/10/2011			0
SD Set	03/10/2011	23/10/2011	~A1010[ss]	-7
DD Set	24/10/2011	20/11/2011	~A1090	-7
BOD Process Equip	*07/11/2011	11/12/2011	~A1090	14
Bid/Award Structural Steel, Sh...	07/11/2011	29/01/2012	~A1100[ss;14	14
FDN Permit	21/11/2011	18/12/2011	~A1100	7
Permit Set	21/11/2011	04/12/2011	~A1100	-7
Design Freeze		*21/11/2011		279
Comp. CD Set	28/11/2011	25/12/2011	~A1140[ff;21]	-7
Buy-Out & Award, GMP, Mob	05/12/2011	01/01/2012	~A1210[ff;7];~	-7
Building Permit	05/12/2011	15/01/2012	~A1140	28
Gather Equip Quotes	12/12/2011	22/01/2012	~A1110	14
Elevator Shops	26/12/2011	29/01/2012	~A1210	21
Exc, FDN	02/01/2012	19/02/2012	~A1130;~A11	-7
GPM Lock		*02/01/2012		237
Substation Shops	*09/01/2012	05/02/2012	~A1210	21
Equipment Procurement	23/01/2012	24/06/2012	~A1150	14
Elevator Fab/Delivery	30/01/2012	06/05/2012	~A1220	21
Substation Fab/Delivery	06/02/2012	13/05/2012	~A1310	21
MOB Crane	*20/02/2012			-7
Steel Framing SOG, Decks	20/02/2012	22/04/2012	~A1080[ss];~A	-7
Walls, Windows, Doors	26/03/2012	06/05/2012	~A1200[ss;35	7
Roof	23/04/2012	06/05/2012	~A1200	7
Piping/HVAC/FS Rough-In	23/04/2012	17/06/2012	~A1200	7
Power/Lighting/Low Voltage	23/04/2012	01/07/2012	~A1200	-7
DEMOB Crane		*30/04/2012		118
Elevator Install	07/05/2012	10/06/2012	~A1230	21
Int. Walls & Ceiling	07/05/2012	27/05/2012	~A1250;~A12	7
MEP Controls	28/05/2012	17/06/2012	~A1270	7
Subtation Installation	*28/05/2012	17/06/2012	~A1320	7
Finishes	11/06/2012	01/07/2012	~A1240	21
Perm Elevator Available		*11/06/2012		76
Perm Power Available		*18/06/2012		69
Start Process Installation	*02/07/2012			56
MEP Process Equip	02/07/2012	15/07/2012	~A1330;~A12	-7
Punchlist Core & Shell	02/07/2012	29/07/2012	~A1360	21
Install/Connect Process Equip...	16/07/2012	26/08/2012	~A1340;~A11	-7
Ready for Commissioning		*19/08/2012	~A1370[ff];~A	0



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Three Perspectives on Gantt Charts
A simple visualization of time



1

A simple visualization of time that engenders the ability to see where project activities fall in relation to each other

- Easily understood by project executives and foremen alike
- A staple of project management for many practitioners

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Three Perspectives on Gantt Charts
A simple visualization of time *(cont'd)*



2.

Gantt charts are subjective vs. rule-based, therefore, Gantt charts are not reliable tools for construction scheduling

- Planners are compelled not just to scope activities but also to place them on the calendar without any consistent rule to guide the sequencing of activities
- The chain of activities controlling completion can only be determined subjectively, commonly by working backward through the Gantt chart

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Three Perspectives on Gantt Charts
A simple visualization of time *(cont'd)*



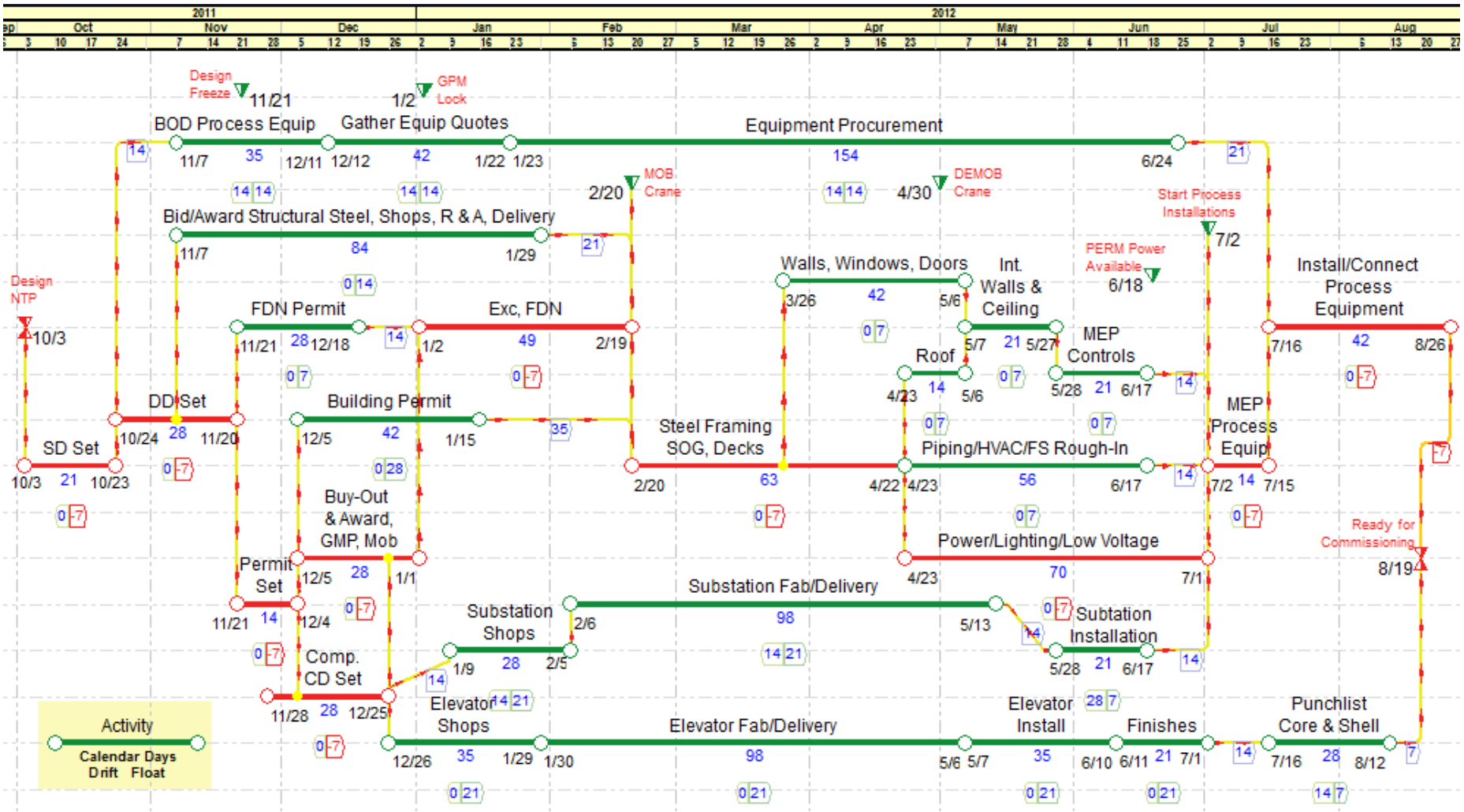
3.

Logic **Gantt charts (with CPM logic ties) are not subjective**

- For projects involving over one hundred activities, Gantt charts with CPM logic ties fail to convey a sense of logical flow
- Combining the time-scaled advantage of Gantt charts with the logic visibility of CPM networks oftentimes yields a convoluted Gantt chart that represents neither well

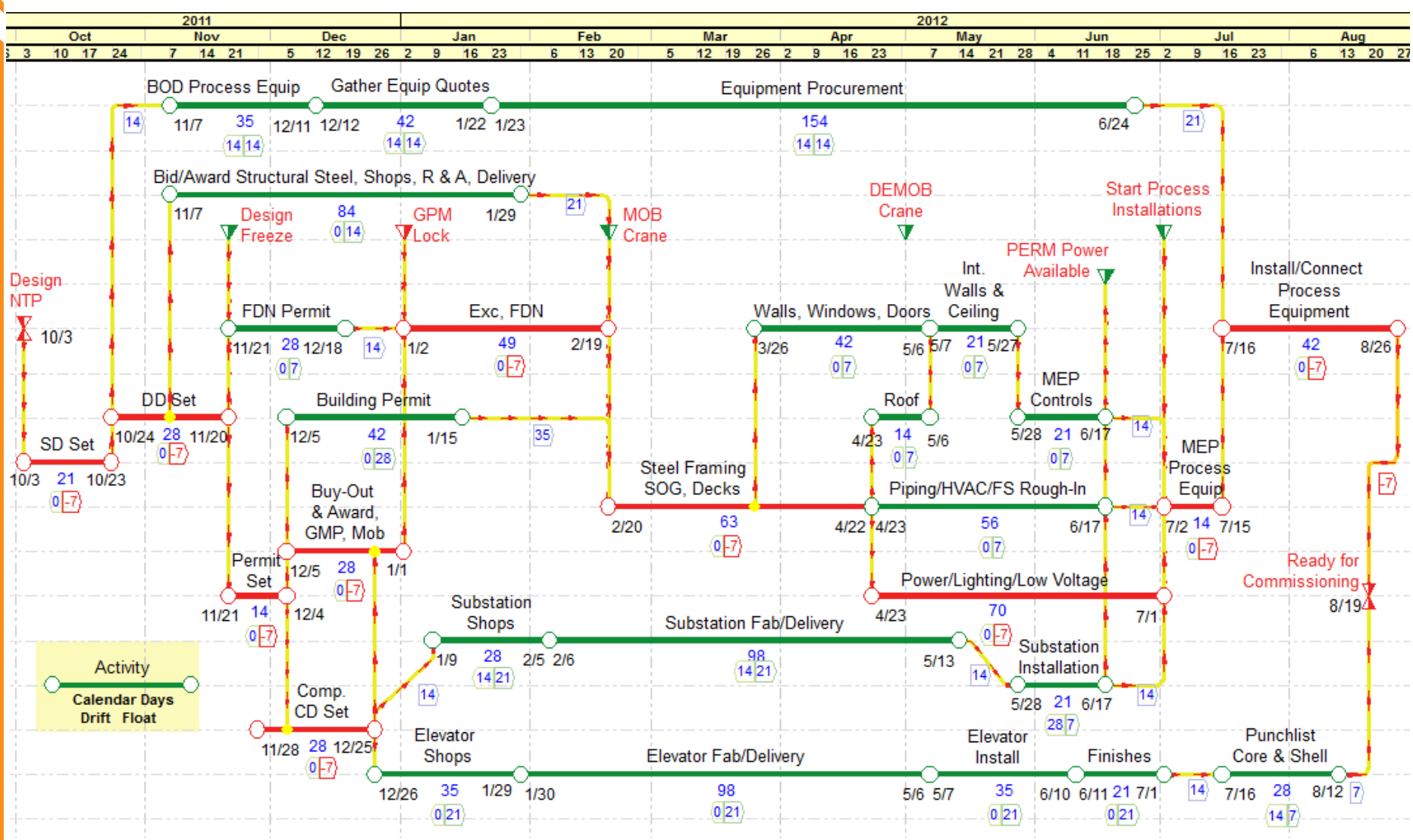
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GPM Alternative to the Prior *Logic* Gantt Charts



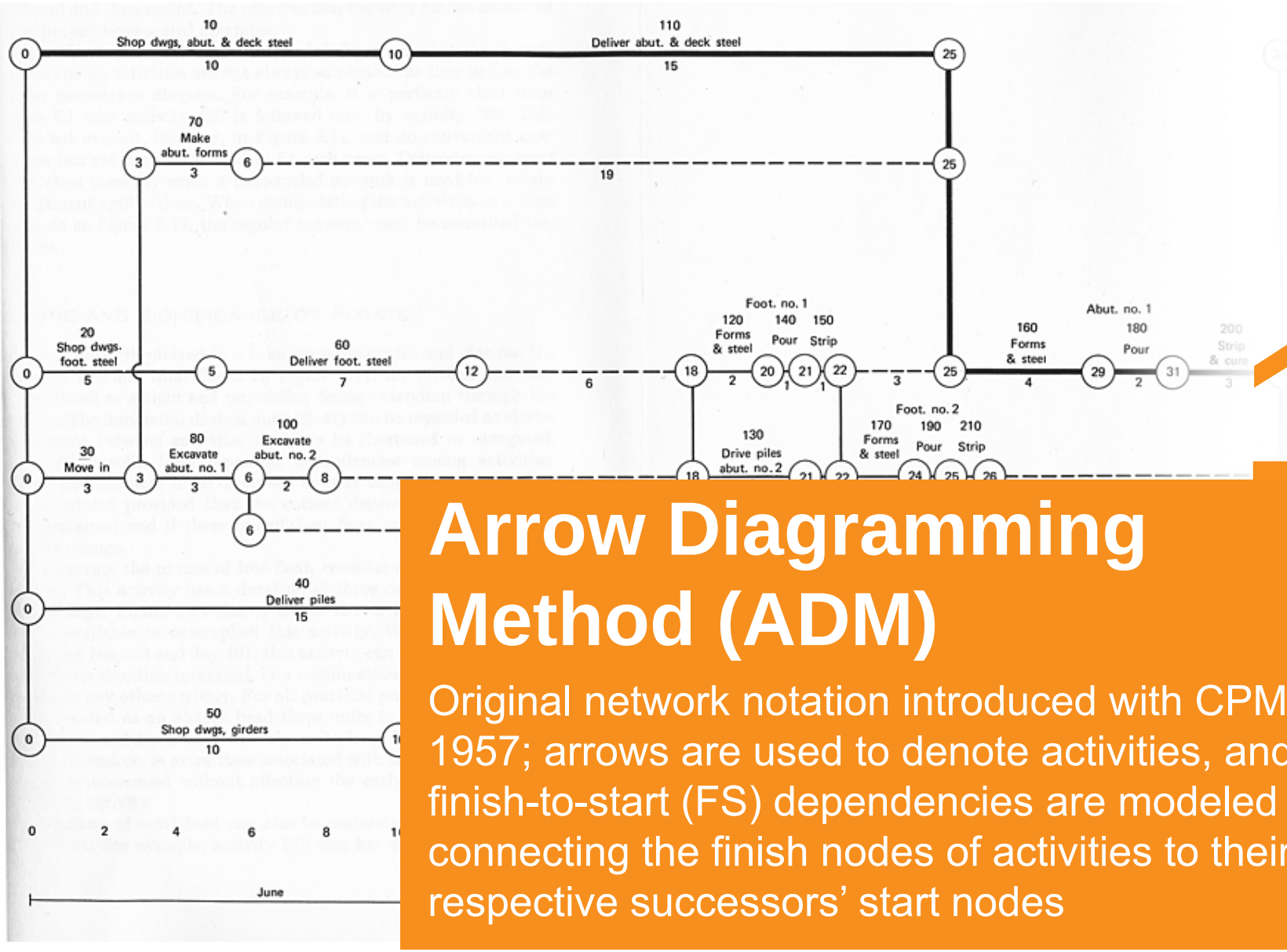
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GPM Alternative to the Prior *Logic* Gantt Charts *(cont'd)*



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Three Networking Alternatives
ADM, PDM, & LDM

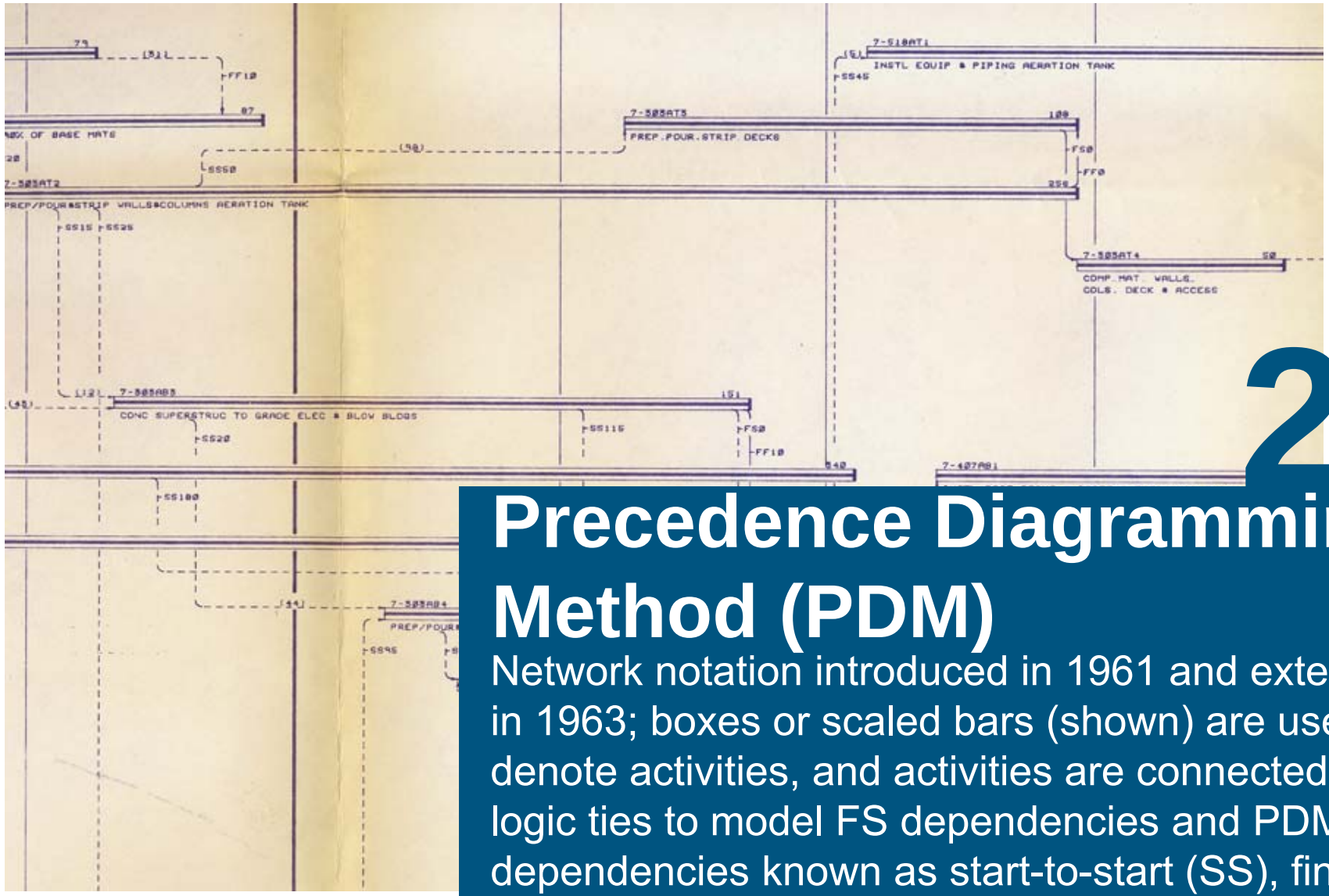


Arrow Diagramming Method (ADM)

Original network notation introduced with CPM in 1957; arrows are used to denote activities, and finish-to-start (FS) dependencies are modeled by connecting the finish nodes of activities to their respective successors' start nodes

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Three Networking Alternatives
ADM, PDM, & LDM *(cont'd)*

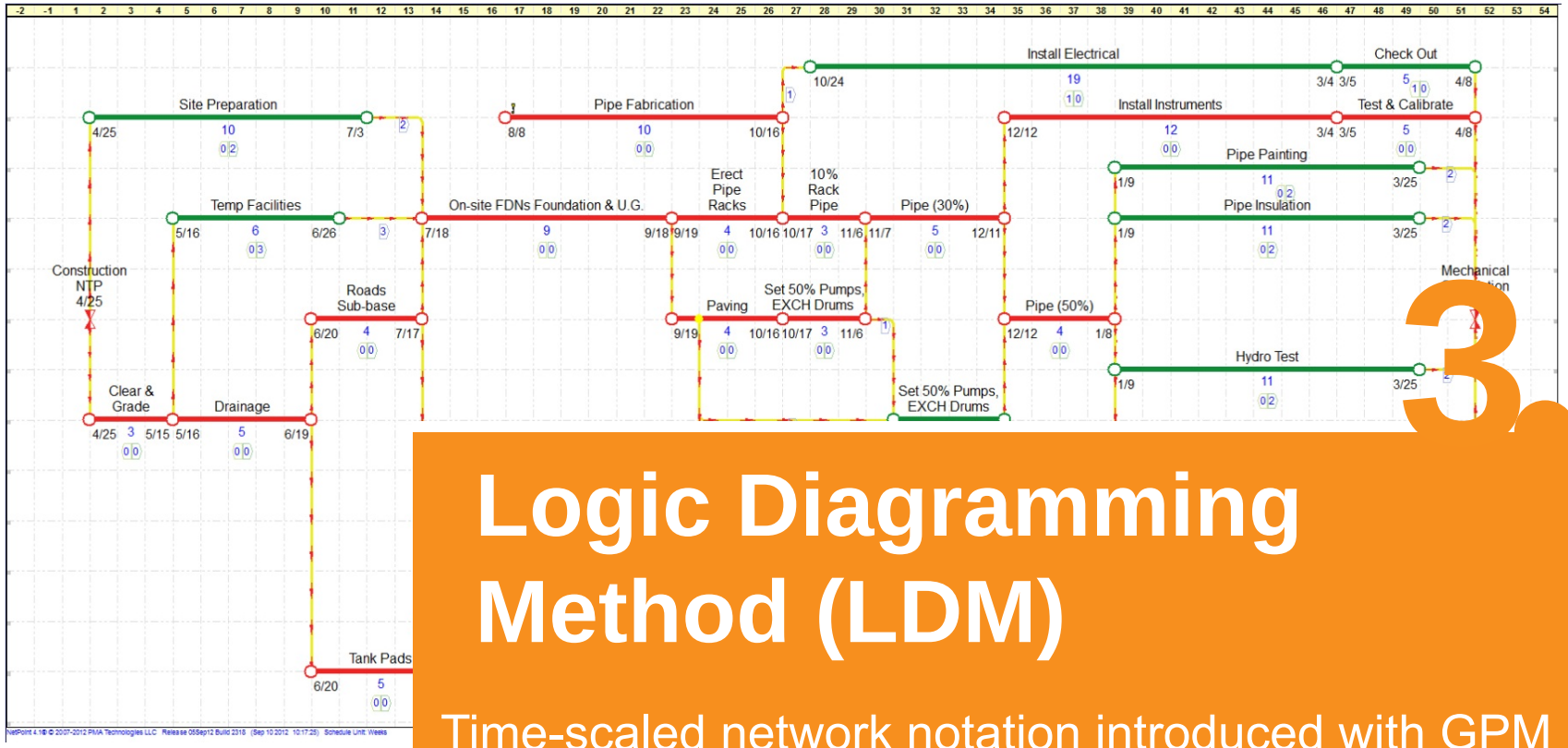


2. Precedence Diagramming Method (PDM)

Network notation introduced in 1961 and extended in 1963; boxes or scaled bars (shown) are used to denote activities, and activities are connected with logic ties to model FS dependencies and PDM dependencies known as start-to-start (SS), finish-to-finish (FF) & start-to-finish (SF)

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Three Networking Alternatives
ADM, PDM, & LDM *(cont'd)*



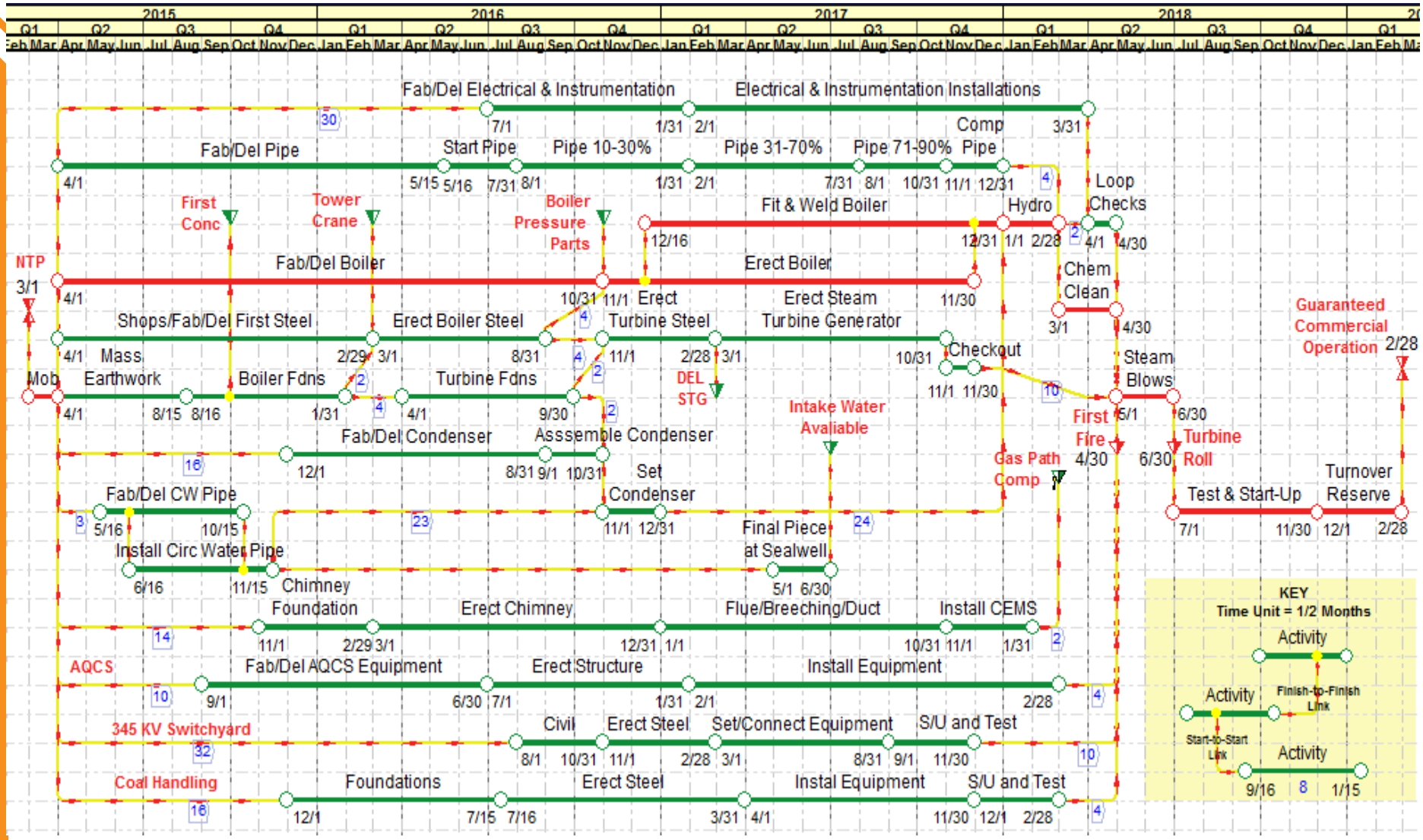
3.

Logic Diagramming Method (LDM)

Time-scaled network notation introduced with GPM in 2008; dimensioned bars with end nodes are used to denote activities, and activities are connected with multiple-arrow links through their end nodes or embedded nodes to model FS dependencies or PDM dependencies, respectively

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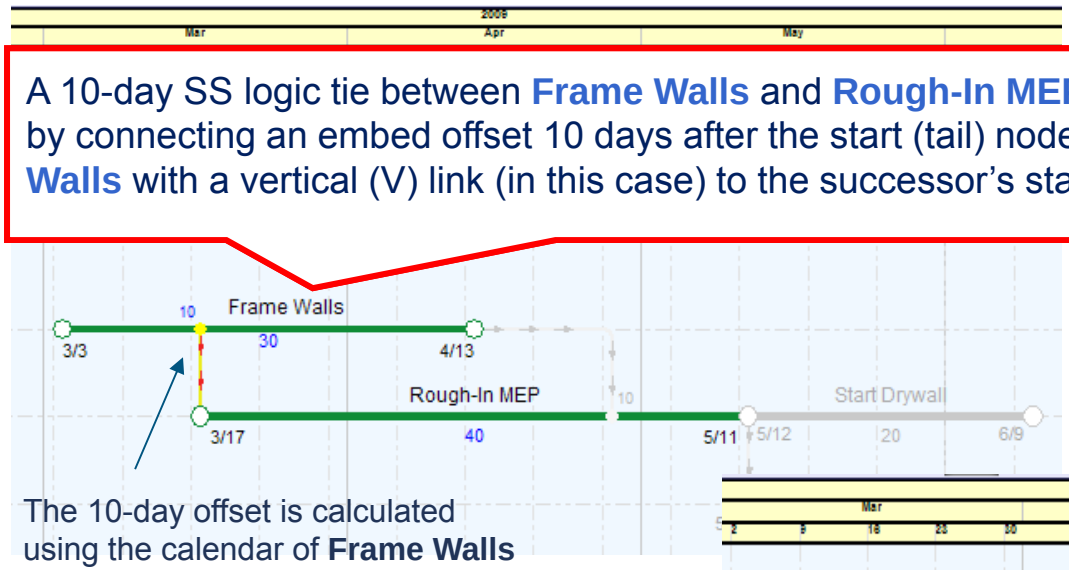
Breakthrough #1:
The LDM Approach to PDM Logic



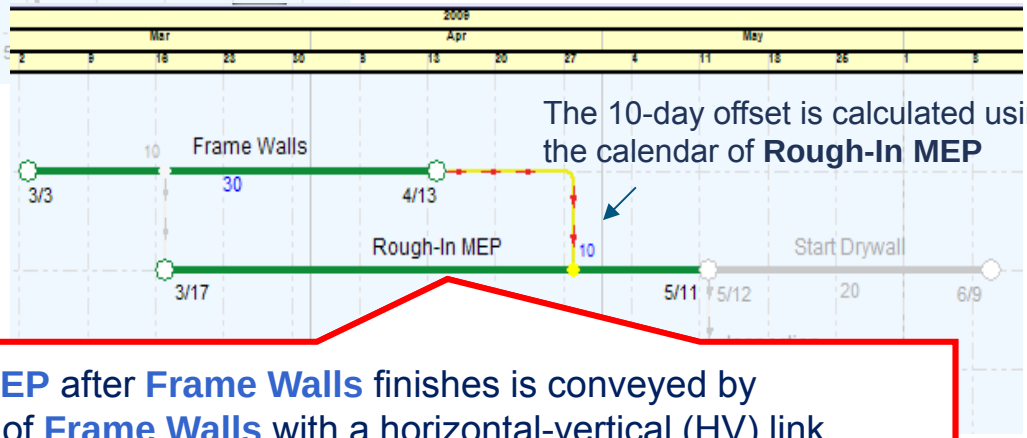
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LDM Start-to-Start and Finish-to-Finish Logic

A 10-day SS logic tie between **Frame Walls** and **Rough-In MEP** is conveyed by connecting an embed offset 10 days after the start (tail) node of **Frame Walls** with a vertical (V) link (in this case) to the successor's start (tail) node



The 10-day offset is calculated using the calendar of **Frame Walls**

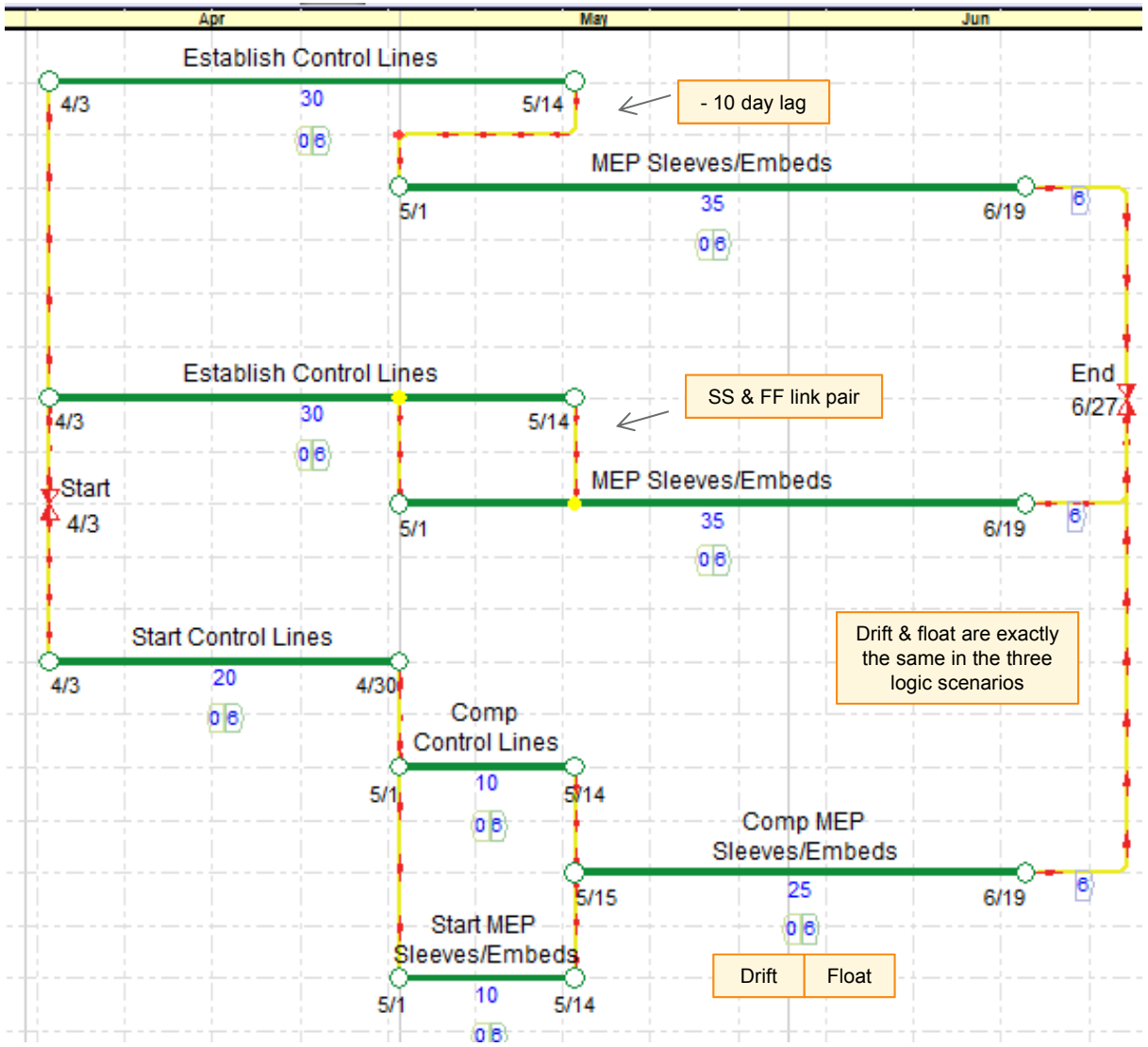


The 10-day offset is calculated using the calendar of **Rough-In MEP**

10 days remaining in **Rough-In MEP** after **Frame Walls** finishes is conveyed by connecting the finish (head) node of **Frame Walls** with a horizontal-vertical (HV) link (in this case) to an embed offset 10 days before the finish (head) node of **Rough-In MEP**

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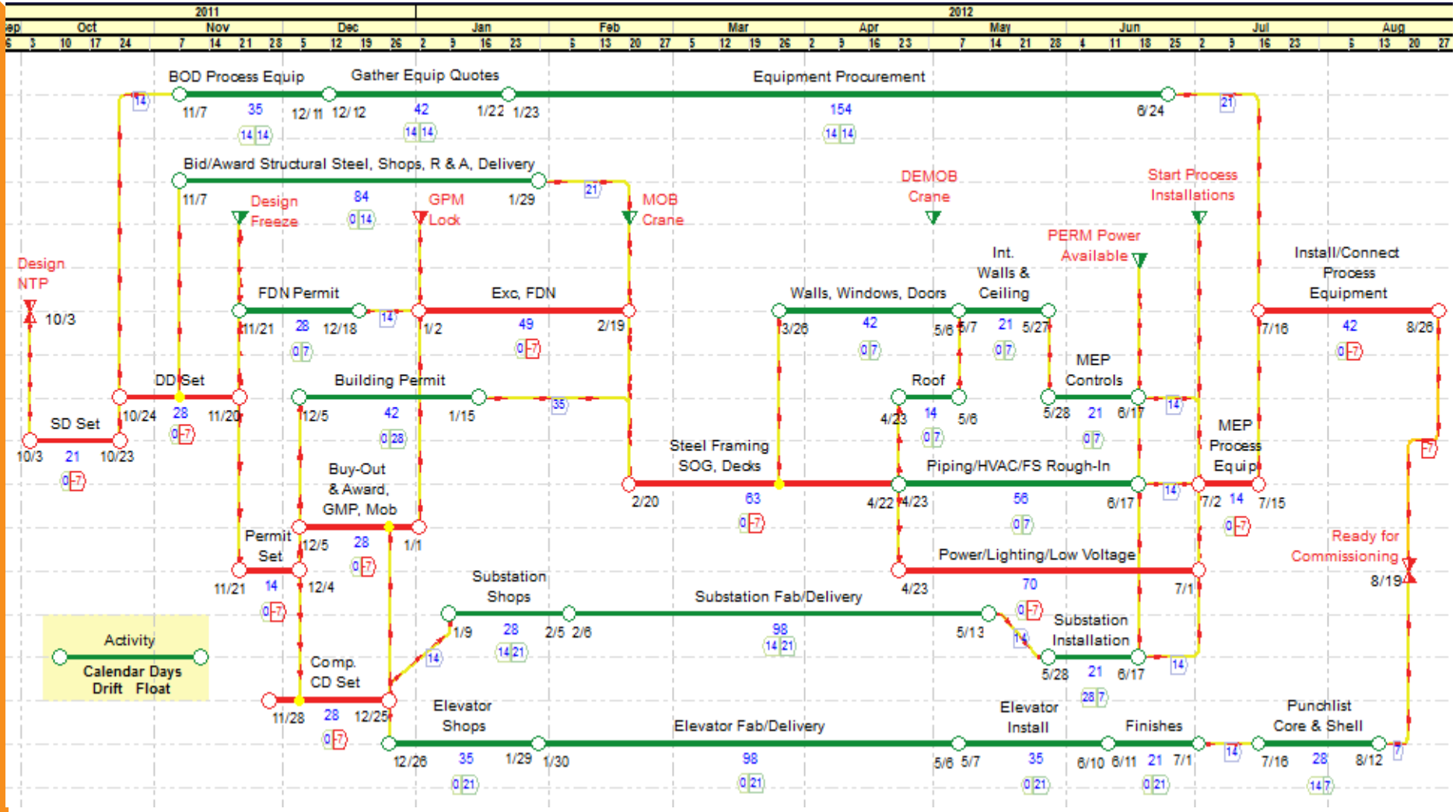
LDM Leads in Finish-to-Start Logic



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Breakthrough #2:

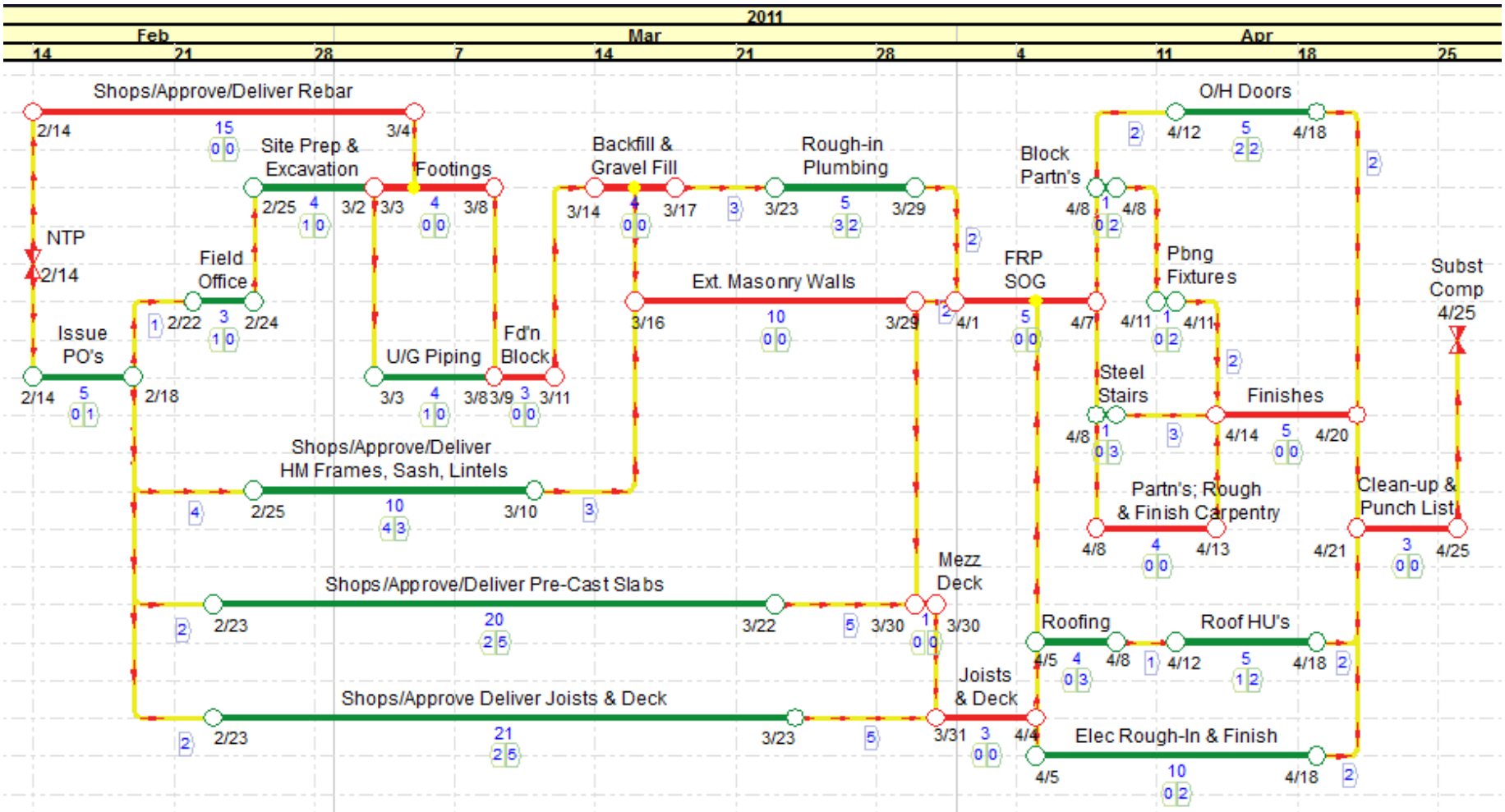
Planners Can Drive Activity Dates After Early Dates Without Using Start Constraints



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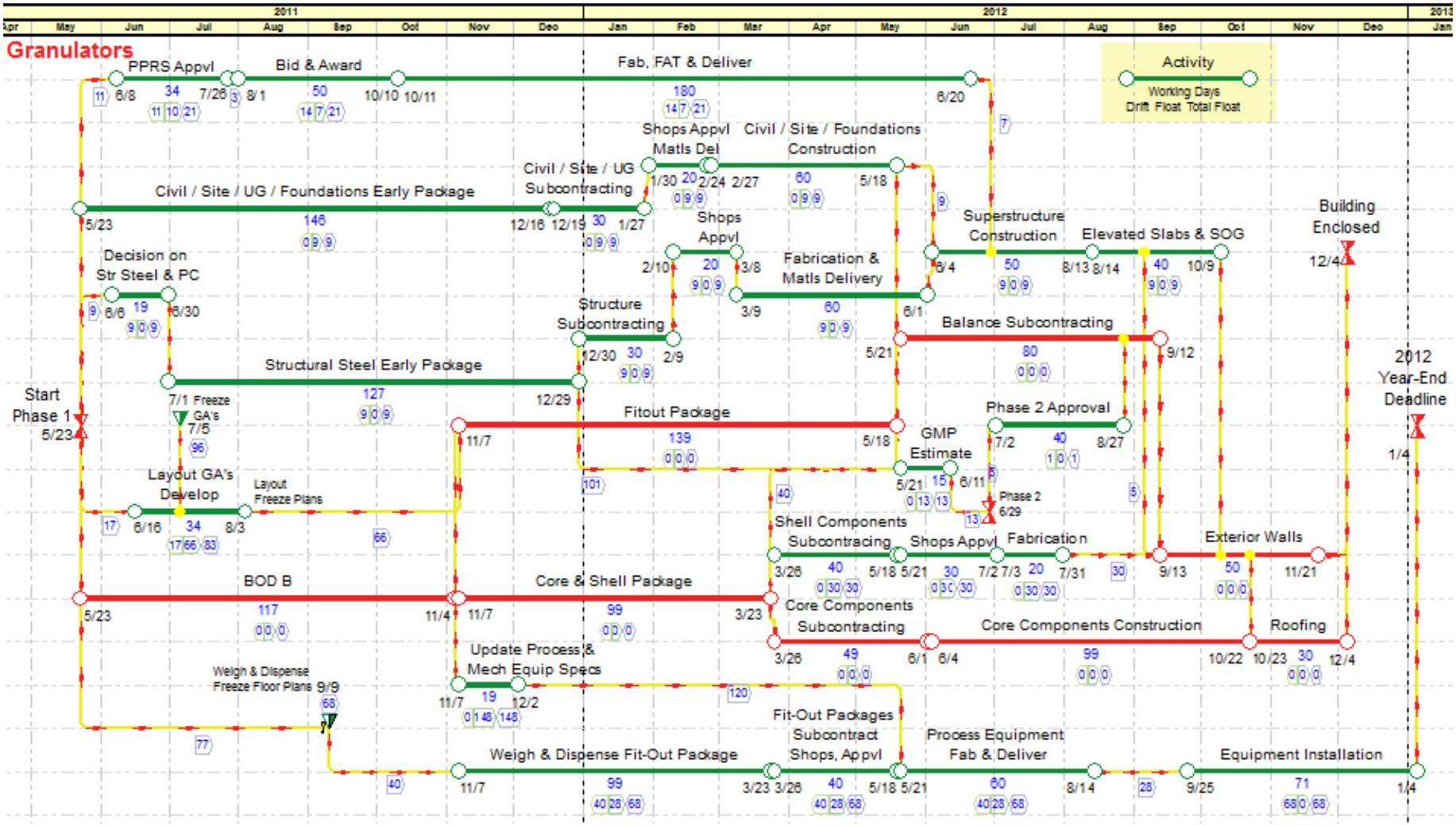
Breakthrough #3:

If Planned Start > Early Start, Activity Has Drift (May Revert to Earlier Dates)



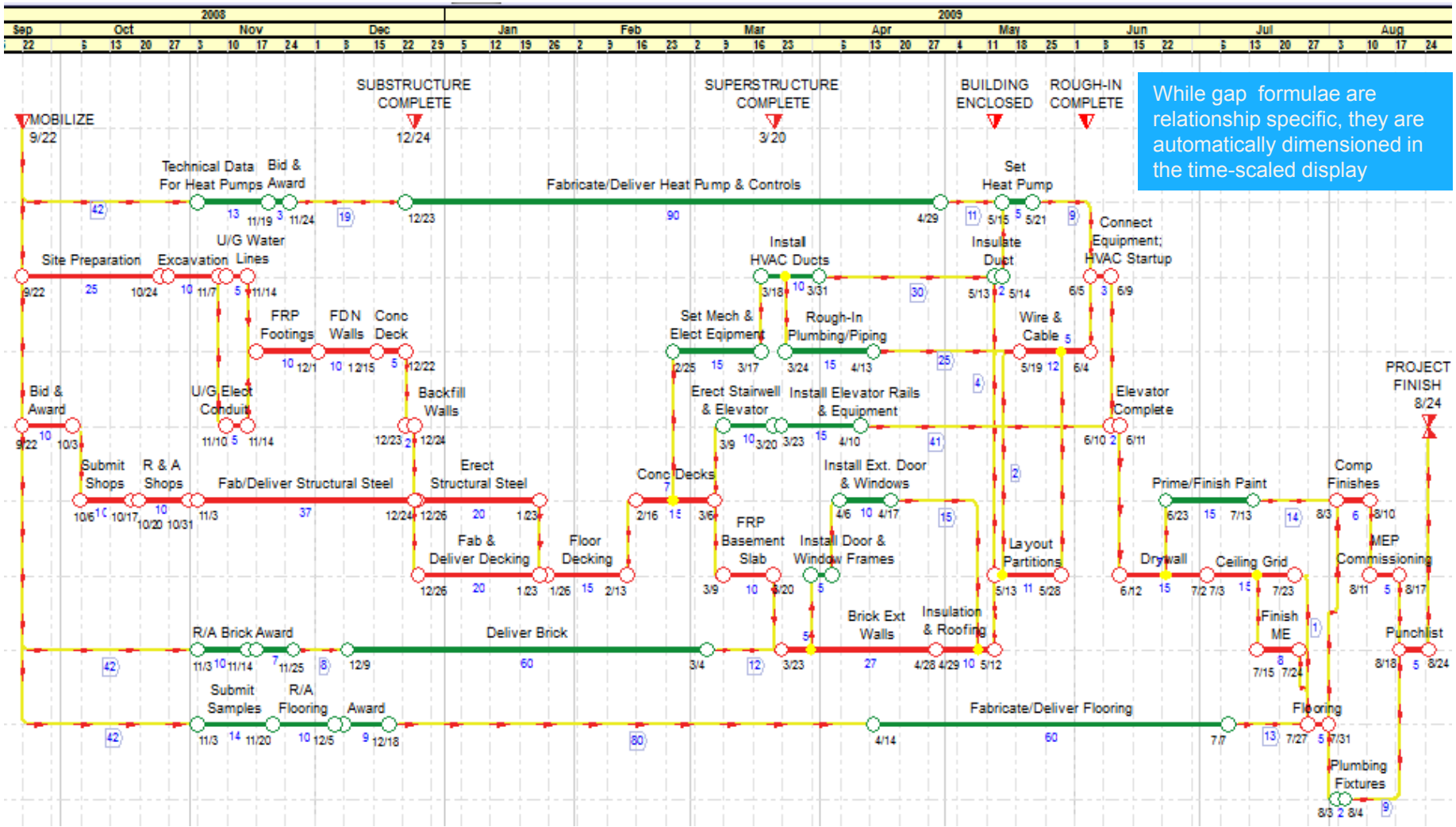
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Breakthrough #4:
Drift + Float = Total Float



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Breakthrough #5:
Logic Tie Float aka Link Gap

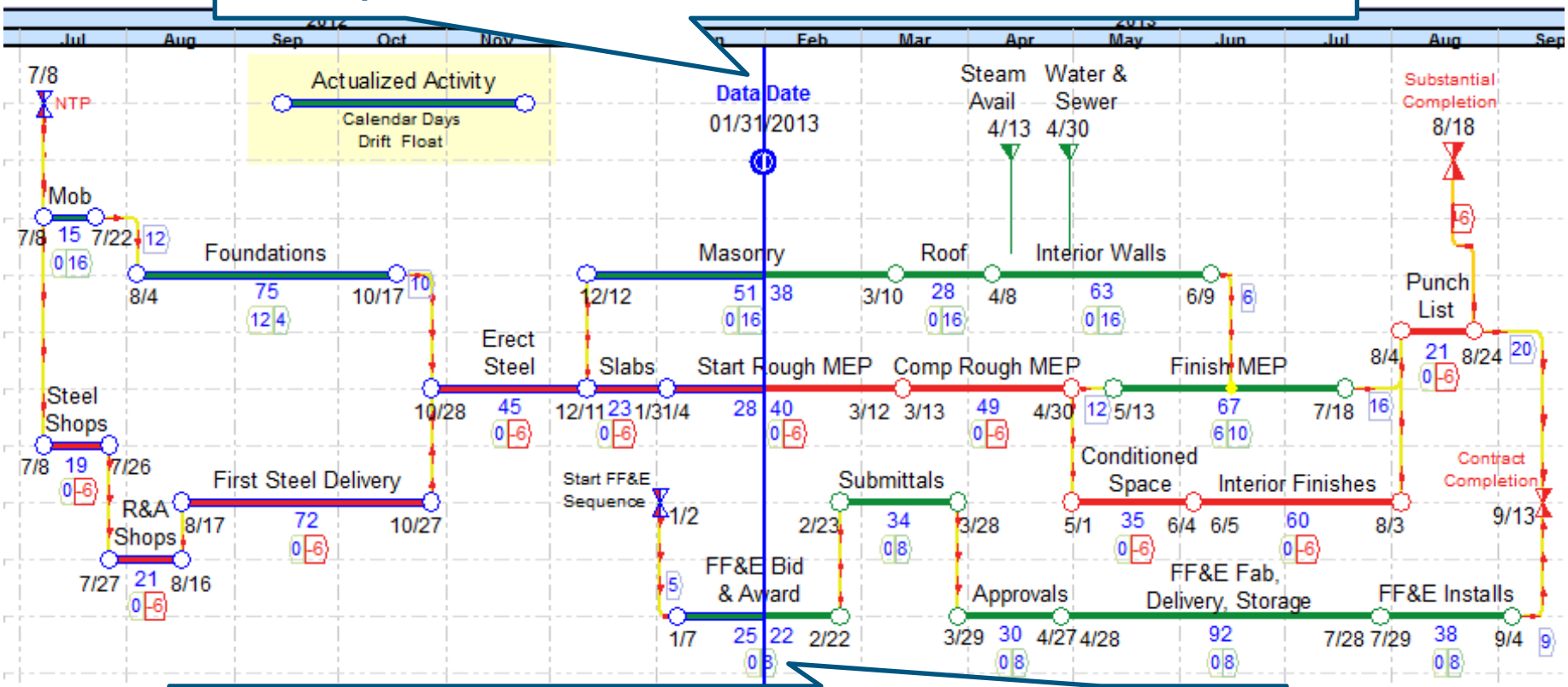


While gap formulae are relationship specific, they are automatically dimensioned in the time-scaled display

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Breakthrough #6:
Total Floats Left of the Data Date

Because GPM calculates total floats as of 31 Jan 13 both before and beyond the data date, GPM algorithmically identifies the critical path left of the data date

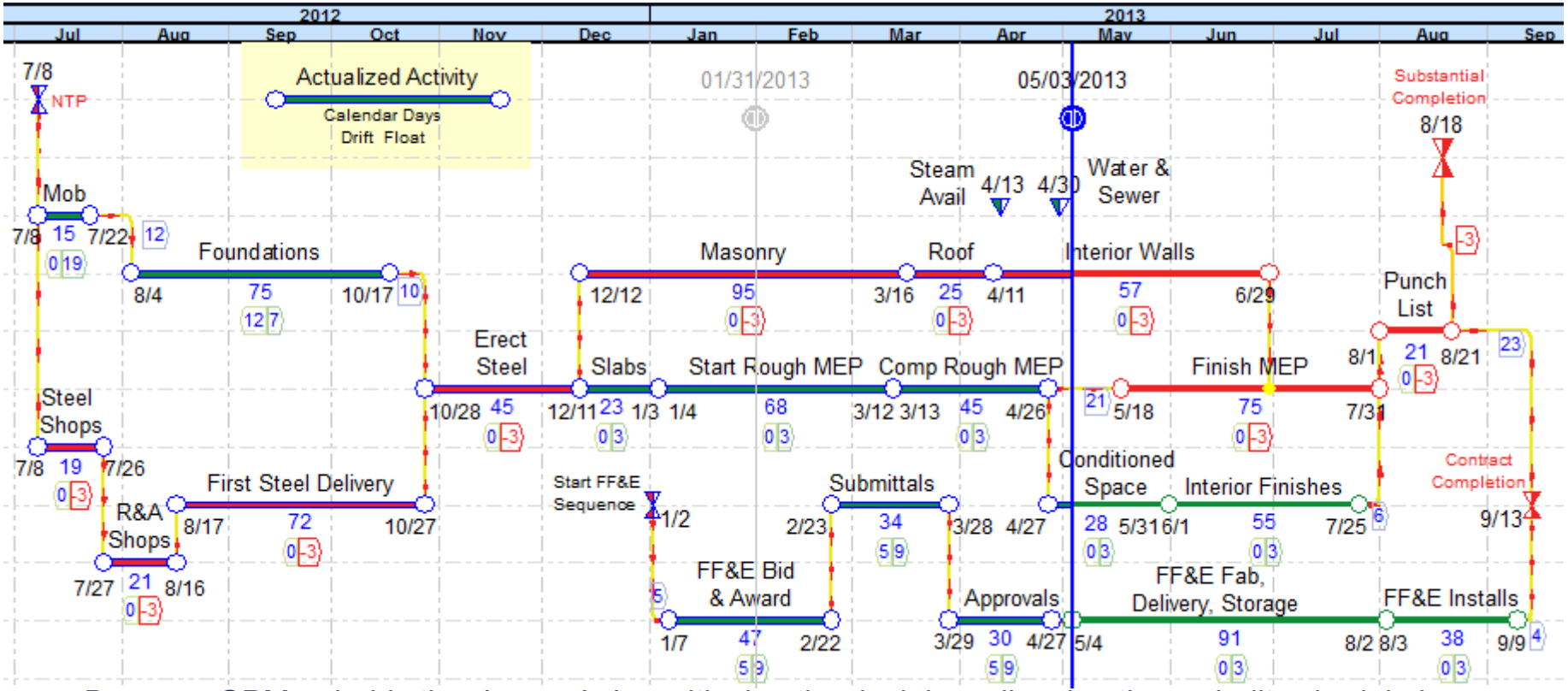


Data date (DD), the update closing date, splits the updated schedule between the progressed (as-built) portion left of the DD and the forecast portion right of the DD

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Breakthrough #7:
Total Floats Left of the DD May Change as Total Floats Right of the DD Change

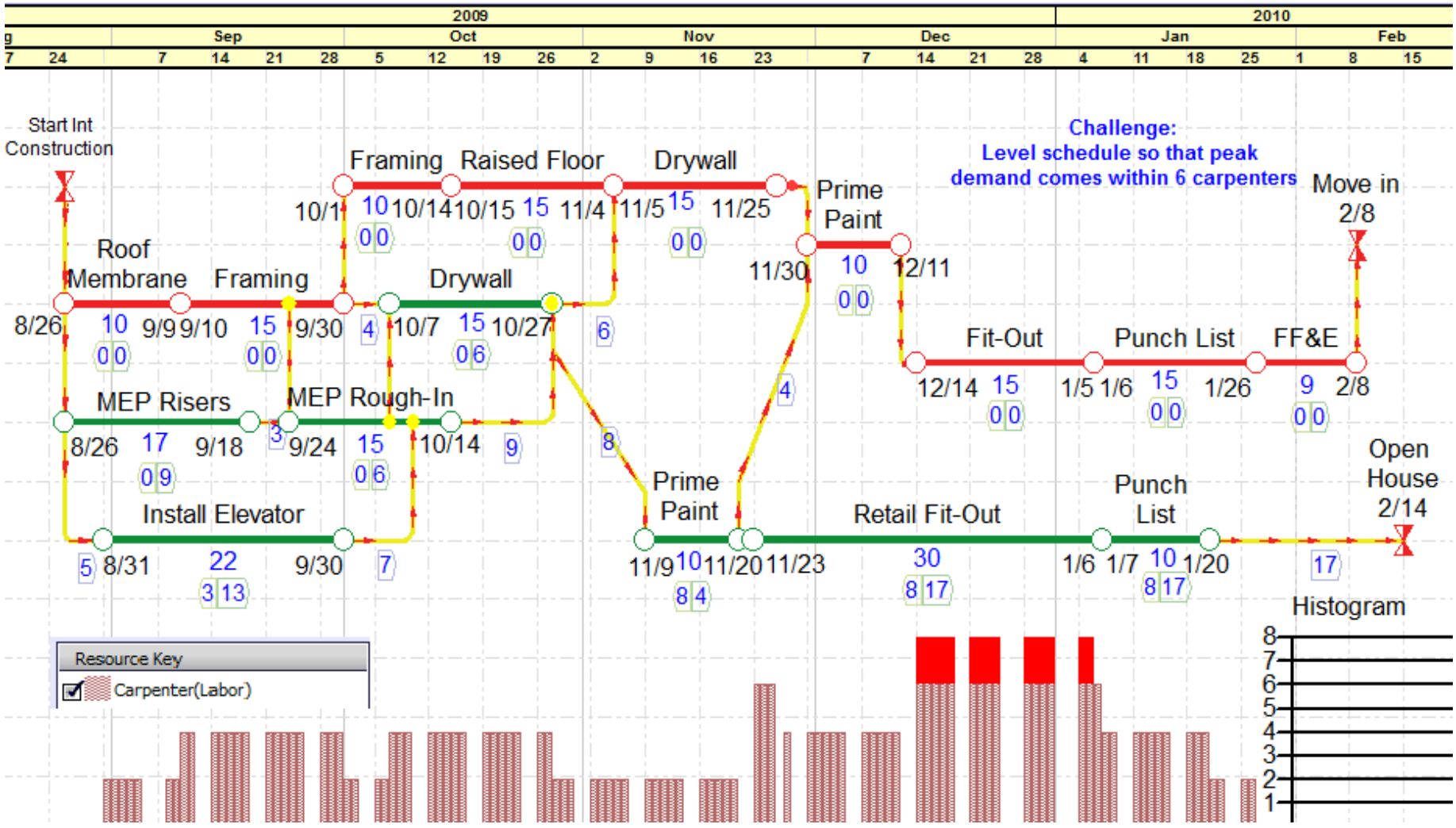
As total floats and the critical path change right of the data date, so do correspondingly change forensic total floats, and the as-built critical path left of the data date is the critical path existing for that update



Because GPM upholds the *then-existing* critical path principle, collapsing the as-built schedule in segments yields a solution that is symmetric with the retrospective time impact analysis counterpart

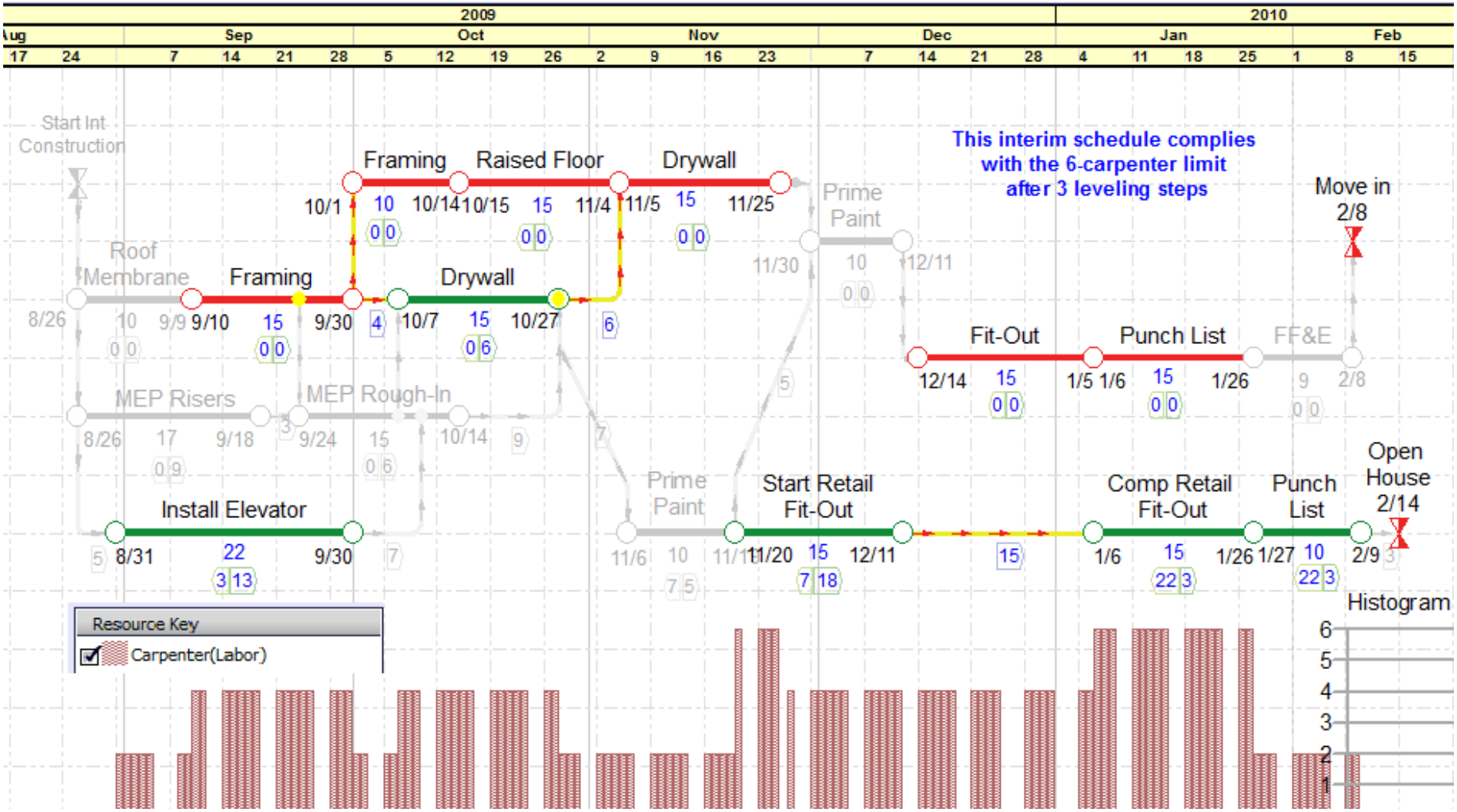
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Breakthrough #8:
Context is the Key to Resource Leveling



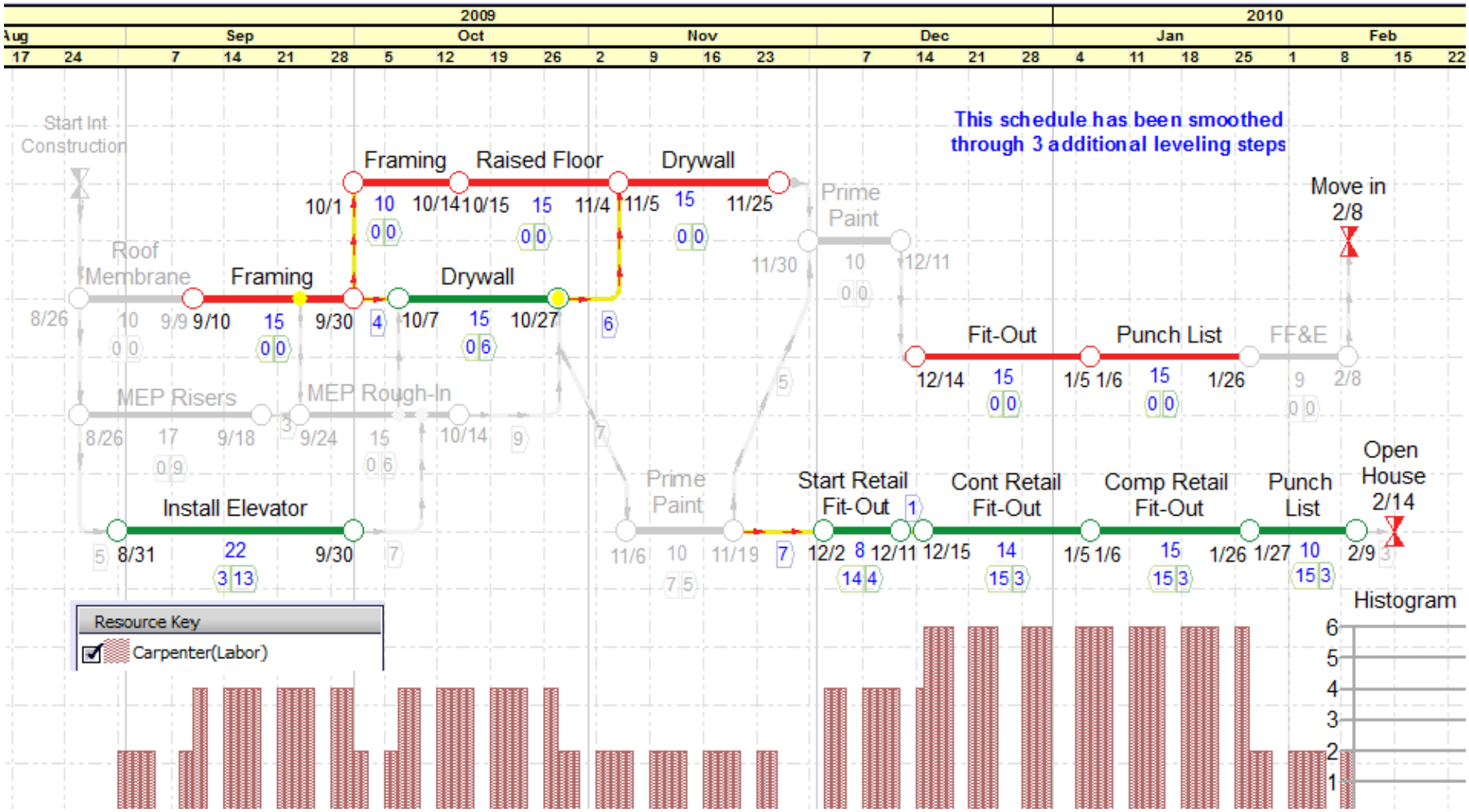
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NetPoint-Aided Resource Leveling Exercise



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GPM-Aided Resource Leveling Exercise (cont'd)



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Sequence in the Resource Leveling Exercise

Split Retail Fit-Out (on 14 Dec 09) into two 15-day activities

Drift back Start Retail Fit-Out 1 day; its drift reduces to 7 days and its float increases to 18 days (TF remains 25 days)



Float Comp Retail Fit-Out 14 days, gap reduces to 3 days

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Sequence in the Resource Leveling Exercise

Resource loading is further smoothed by doubling the duration of Start Retail Fit-Out and reducing the crew to 2 carpenters



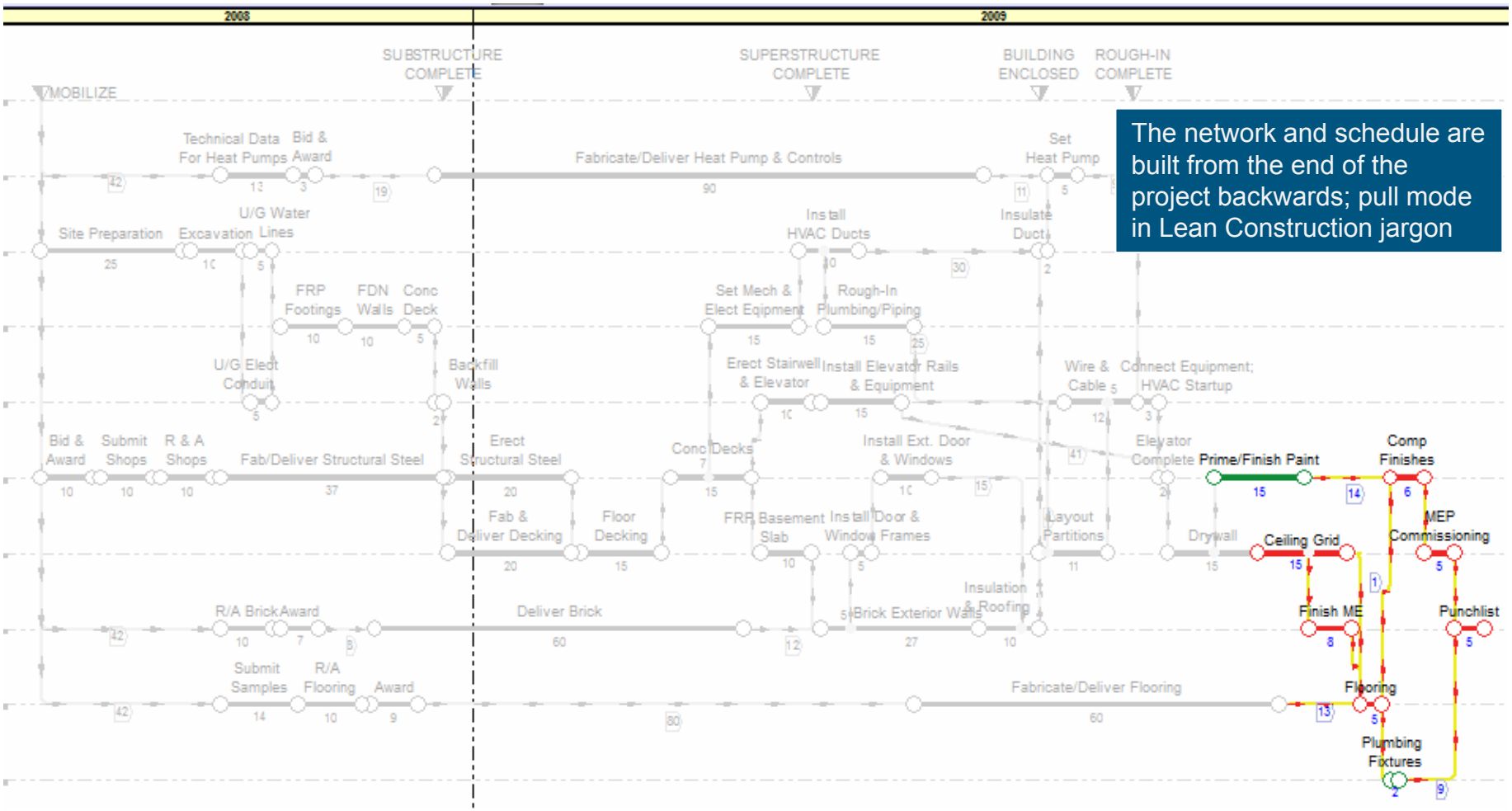
Schedule is leveled to a headcount limit of 6 carpenters; total float of the leveled logic chain is 25 days

Resource loading is further smoothed through the following sequence: Split Start Retail Fit-Out (on 14 Dec 09) into 14-day and 16-day activities, turn 'Logic' off, crash the 'Start' activity to 8 days from its start node and double its crew to 4 carpenters, drift the 8-day 'Start' activity by 1 day and turn 'Logic' back on

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Breakthrough #9:

Planners Can *Pull* the Schedule (Build the Network Backward from Completion)



The network and schedule are built from the end of the project backwards; pull mode in Lean Construction jargon

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Summarizing the GPM Scheme of Thought

Relies on LDM, a visualization of time that combines ADM with PDM, and that has the potential to render Gantt charts with or without logic ties redundant

Activities are scheduled on early dates or user-selected planned dates without start-no-earlier constraints and without forfeiting drift or reducing total float



GPM software architecture relies on objects (i.e., activities, links, embedded nodes, milestones, etc.) that contain embedded rules and GPM algorithms

Gaps are used to calculate drifts & floats; total floats are less useful than the combination of drifts & floats

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Summarizing the GPM Scheme of Thought

In response to manipulation by the planner, GPM software in real time reschedules only activities that are manipulated or affected by the manipulated activities

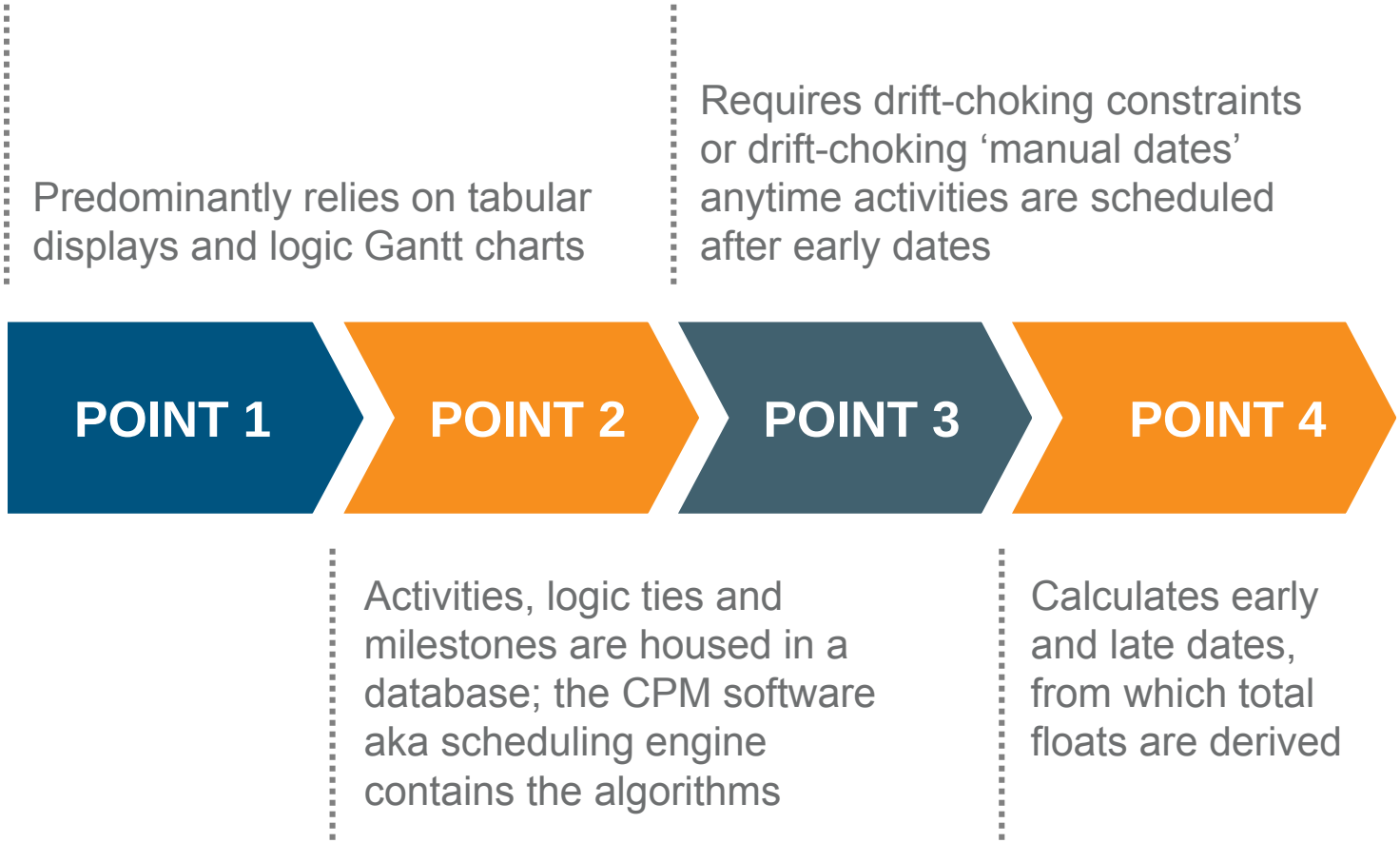
Offers the flexibility of backward or pull planning, essential on some projects as well as to lean construction and critical chain planners

POINT 5 **POINT 6** **POINT 7**

When the goal is to level resources for the project, GPM software is a computer-aided process that, at each junction, amalgamates schedule context and planner's judgment

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The Contrast: Summarizing CPM Principles



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The Contrast: Summarizing CPM Principles

In response to user input (e.g., change a non-critical activity duration by one day), CPM recalculates both the forward pass and backward pass in their entirety (i.e., the *CPM engine* recalculates all dates, total floats, etc.)

Hinders use by lean construction practitioners due to lack of backward planning capability



Levels resources through software heuristics that apply rules in a pre-established order/priority regardless of whether or not in context

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Is CPM with Gantt Charts Outmoded by GPM?

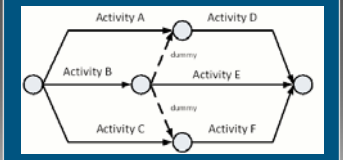
GPM	CPM with *Logic* Gantt Charts
Time-scaled LDM networks innately convey PDM logic	Gantt charts with logic ties fail to convey logical flow
Stakeholders, not the algorithm, drive activity dates	Reliance on CPM algorithms biases activities to early dates
Constraints ***are not needed*** to start activities on planned dates	Constraints ***are required*** to start activities on planned dates
GPM planned dates do not supersede early dates	SNE* constraints supersede CPM early dates, forfeiting drift
If planned start > early start and < late start, drift and float exist	Drift is always 0; If early start < late start, total float exists
Link gap measures logic tie leeway (different from free float)	Logic tie leeway is not a concept in CPM
SNE constraints are reserved for contractually-imposed dates	Does not distinguish planned dates from constrained dates
The schedule can be generated either forward or backward, or both	The schedule can only be generated forward from the project start event
Total floats are algorithmically calculated left of the data date	Total floats are only available forward of the data date
The as-built critical path is calculated left of the data date	As-built critical path cannot be calculated by CPM alone
Stakeholder strategies in context are key in resource leveling	Automated software heuristics drive resource leveling
Capable of modeling floating & pacing risks in simulation	Early dates bias does not allow modeling of floating or pacing risks

*SNE is initialism for a start-no-earlier (flexible) constraint date

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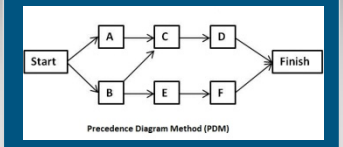
Timeline of Network-Based Schedule Display Platforms

1957-1997
Schematic arrow diagramming method (ADM)



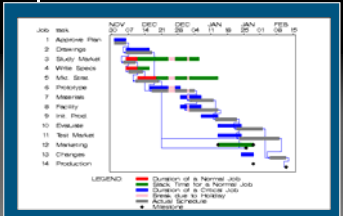
1957-1997

1963-2003
Schematic precedence diagramming method (PDM)



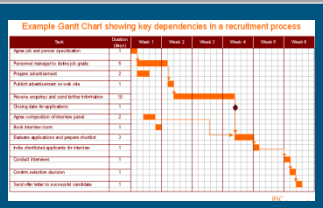
1963-2003

1983-2023
CPM-to-Gantt charts with PDM logic ties



1983-2023

1983-2023
Logic Gantt charts with simple dependencies



1983-2023

2008-Indefinitely
Logic diagramming method (LDM)



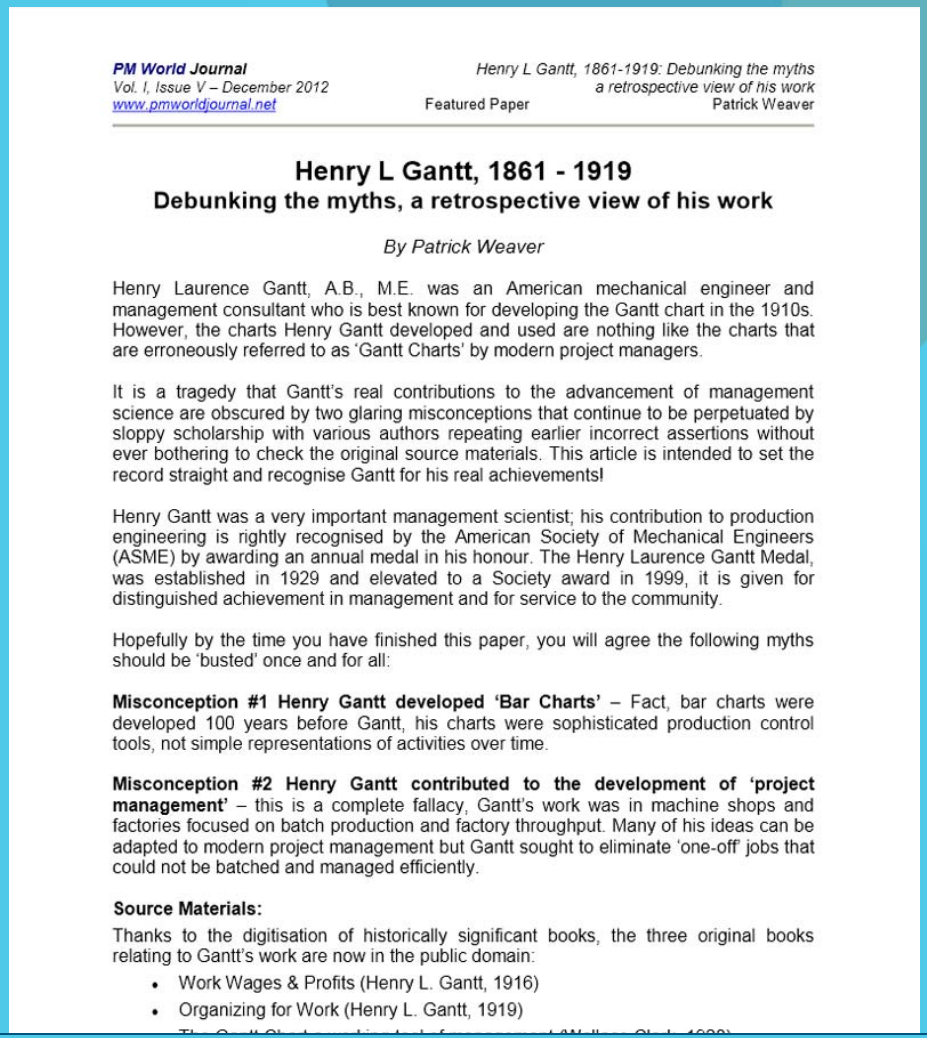
2008-Indef.

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Post script: Bar Charts Erroneously Referred to as Gantt Charts

Recently, Patrick Weaver published a retrospective view of Gantt's work, where he exposes the notion that Henry Gantt developed 'Bar Charts' as nothing other than myth*

Weaver's research traces the origin of modern bar charts to 1765, and he, along with others, acknowledges that Karol Adamiecki's Harmonogram (or Harmonygraph) is a closer precurser to modern bar charts than the charts developed and used by Gantt for production control



PM World Journal
Vol. I, Issue V – December 2012
www.pmworldjournal.net
Featured Paper

Henry L Gantt, 1861 - 1919
Debunking the myths, a retrospective view of his work

By Patrick Weaver

Henry Laurence Gantt, A.B., M.E. was an American mechanical engineer and management consultant who is best known for developing the Gantt chart in the 1910s. However, the charts Henry Gantt developed and used are nothing like the charts that are erroneously referred to as 'Gantt Charts' by modern project managers.

It is a tragedy that Gantt's real contributions to the advancement of management science are obscured by two glaring misconceptions that continue to be perpetuated by sloppy scholarship with various authors repeating earlier incorrect assertions without ever bothering to check the original source materials. This article is intended to set the record straight and recognise Gantt for his real achievements!

Henry Gantt was a very important management scientist; his contribution to production engineering is rightly recognised by the American Society of Mechanical Engineers (ASME) by awarding an annual medal in his honour. The Henry Laurence Gantt Medal, was established in 1929 and elevated to a Society award in 1999, it is given for distinguished achievement in management and for service to the community.

Hopefully by the time you have finished this paper, you will agree the following myths should be 'busted' once and for all:

Misconception #1 Henry Gantt developed 'Bar Charts' – Fact, bar charts were developed 100 years before Gantt, his charts were sophisticated production control tools, not simple representations of activities over time.

Misconception #2 Henry Gantt contributed to the development of 'project management' – this is a complete fallacy, Gantt's work was in machine shops and factories focused on batch production and factory throughput. Many of his ideas can be adapted to modern project management but Gantt sought to eliminate 'one-off' jobs that could not be batched and managed efficiently.

Source Materials:

Thanks to the digitisation of historically significant books, the three original books relating to Gantt's work are now in the public domain:

- Work Wages & Profits (Henry L. Gantt, 1916)
- Organizing for Work (Henry L. Gantt, 1919)

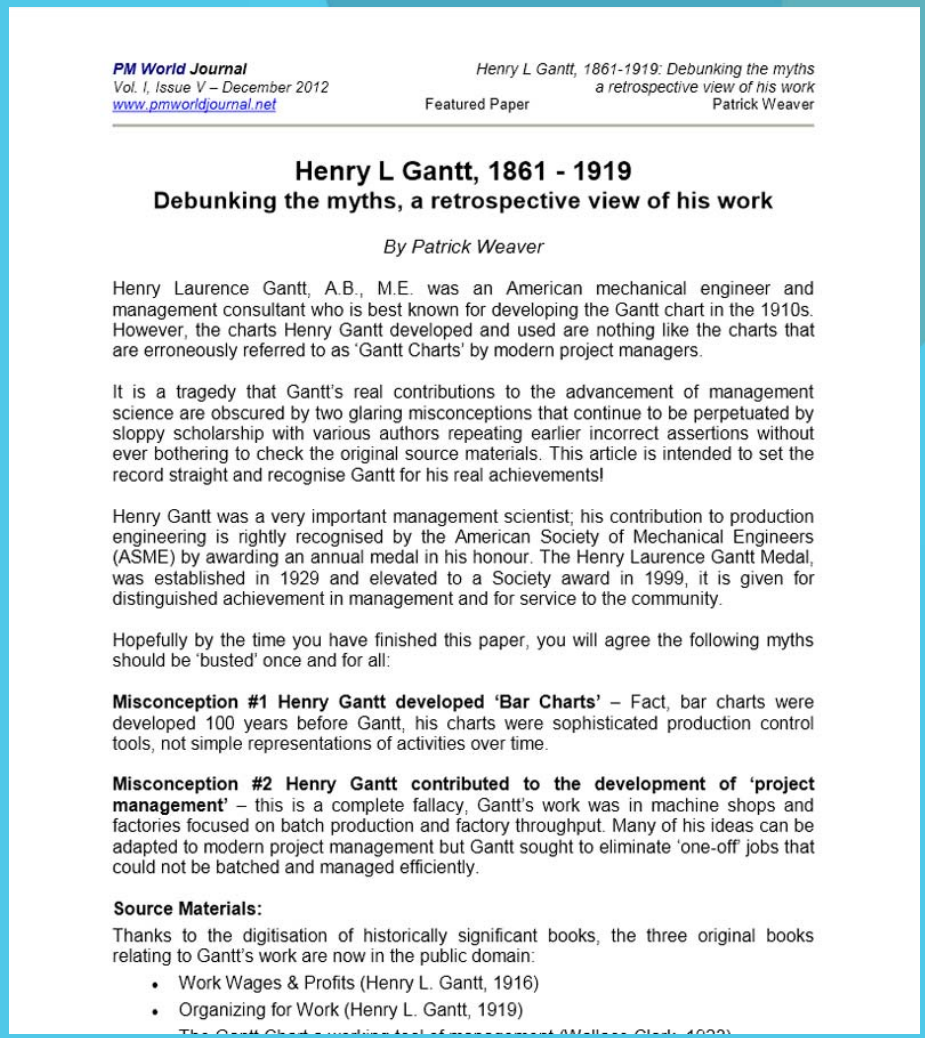
* Weaver, P. (2012). Henry L. Gantt, 1861 – 1919 A retrospective view of his work PMWORLDJournal

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Post script: Bar Charts Erroneously Referred to as Gantt Charts

The name ‘Gantt Chart’ can be traced directly to the title of *The Gantt Chart a working tool of management*, a book authored by Wallace Clark, a colleague of Gantt, that was published in 1923

Because the “Gantt chart myth” has become ubiquitous in the world of planning and scheduling, we are continuing to refer to bar charts as Gantt charts regardless of the apocryphal nature of the reference



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- Organizing for Work (Henry L. Gantt, 1919)

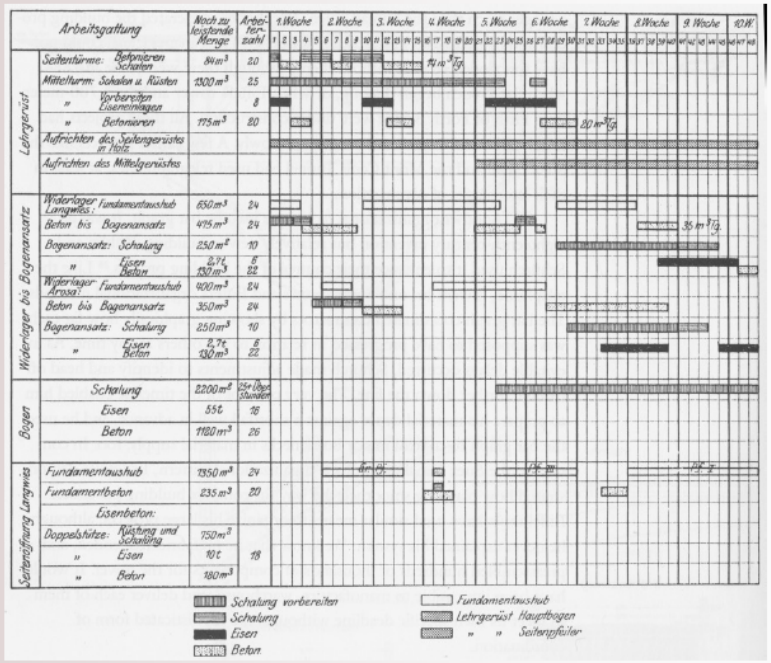
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The real Gantt Charts were smarter than you think

Barcharts

time	From	–	–	–	A-1	B-1	...
	To	A-2	B-2,C	D-2	A-3	E-1	..
	activity	A-1(4)	B-1(4)	D-1(2)	A-2(4)	B-2(3)	...
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							

Karol Adamiecki 1896
Harmonogram or Harmonygraph



From Schurch 1916: p35
Project date 1912

Henry Gantt published:
Work, Wages, & Profits
in 1910

9

Henry L. Gantt

mosaic

Source: http://www.mosaicprojects.com.au/PDF_Papers/P158_Henry_Gantt_PPT.pdf

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"I have wondered how, given the diverging routes that planners, schedulers, project managers, owners, and educators are taking, we will ever again bring to projects the kind of synergistic creativity known in the early days."

James J. O'Brien, Foreword to *Faster Construction Projects with CPM Scheduling*, by Murray B. Woolf. (New York: McGraw-Hill, 2007).

I really believe that optimism for your GPM let me say the unthinkable.

From: Jimobriendd527@aol.com [mailto:Jimobriendd527@aol.com]
Sent: Wednesday, uary 23, 2008 7:27 PM
To: Gui Ponce de Leon
Subject: Re: Peer Review of Your Paper for COS 2008

Gui,

I am pleased that our thoughts were on parallel tracks. As to the "rise and fall of CPM" p e handle it either way that works for you.

I will admit that the easily said phrase surprised me as I said it. I really believe that optimism for your GPM let me say the unthinkable.

A quote is fine, but giving credit to both of us would also be fine.

To me, the loss of the logic diagram has been the unrecognized tragedy in the evolution of CPM scheduling and your GPM brings it back full circle.

As to the additional GPM treatises, it w hat more than two would be necessary and I believe that the list would best come from you it through.

I agree that LDM would b both of them.

Regards,

Jim

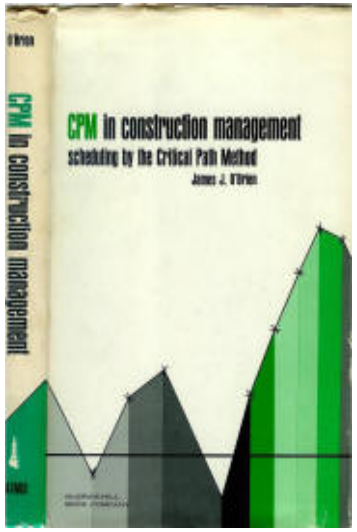
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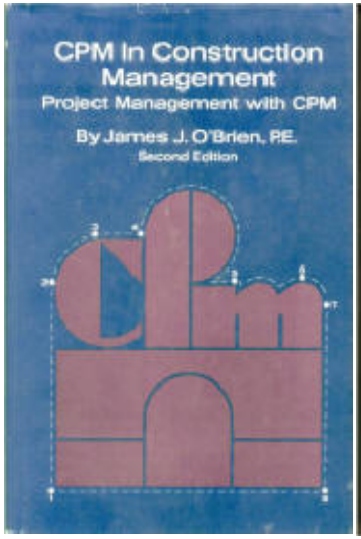
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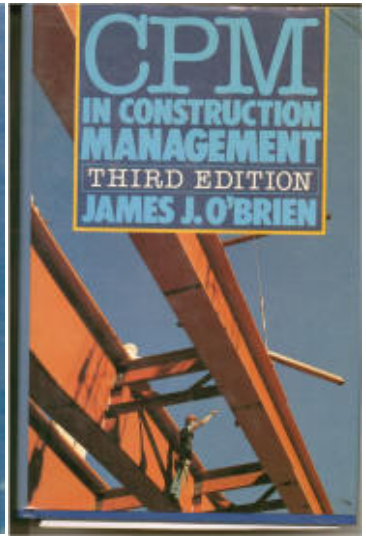
CPM in Construction Management
James J. O'Brien, PE

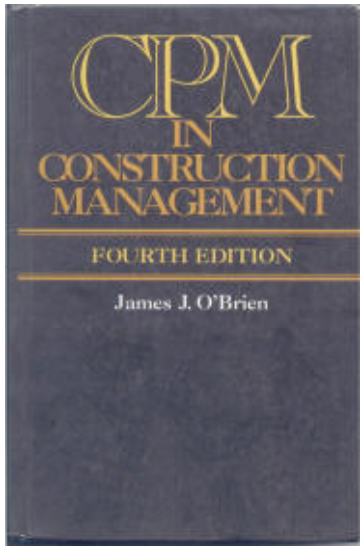


PHOTO FROM 1983

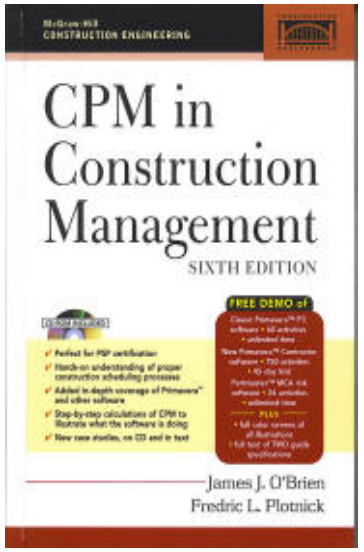


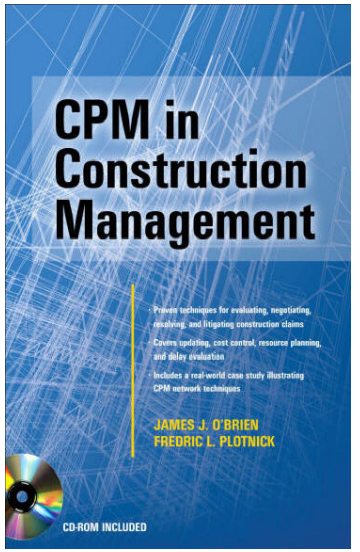




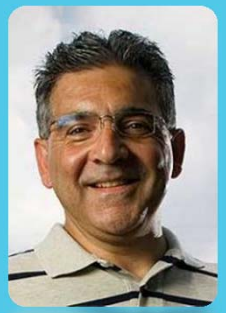








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Testimonial from Virginia Tech Prof. de la Garza

"I have been using NetPoint and GPM in my project controls classes for a few years now. NetPoint is intuitive for the students and they don't have to struggle with the tool in order to build quality network schedules. In fact, NetPoint's combined time scale and Logic Diagramming Method (LDM) create a much clearer graphical representation of the schedule than other scheduling tools. Students can concentrate on learning quality scheduling rather than learning a scheduling software tool."

Jesus M. de la Garza, PhD

Vecellio Professor of Construction Engineering & Management
Department of Civil & Environmental Engineering
Virginia Tech - Civil and Environmental Engineering

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Early GPM Adopters

Organization		Since
GC/CM	Gilbane Building Company	2009
Electric Utility	Manitoba Hydro	2009
Pharmaceutical	Merck & Company	2009
Owner/Governmental	US Army Corps of Engineers	2009
Academic	Virginia Tech University	2009
GC/CM	Walbridge	2010
Owner	Walt Disney Company	2010
EPC Contractor	Bechtel	2010
Pharmaceutical	Medimmune	2011
Pharmaceutical	Johnson & Johnson	2011
EPC Contractor	Jacobs Engineering	2011
Supplier	Invensys	2011
A/E Consultant	Stantec Consulting	2011
PM/CM Consultant	ORCAS Project Controls	2011
Fusion Development	ITER Organization	2011
Biofuels	Butamax	2011
GC/CM	Kenny Construction	2012
GC/CM	Hoffman Construction	2012
Producer Oil & Gas	MEG Energy	2012
Owner	Port Authority of New York & New Jersey	2013

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NetPoint Development Path:
2013 - 2015

1. Schedule Numerati
2. High-priority User Requests
3. Computer-Aided Resource Leveling
4. Auto Draw (Imported Schedules)
5. Vertically-Integrated Schedules
6. Earned Value
7. NetPoint 5

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Q & A

Graphical Path Method–The Elevator Pitch	
10	Immediate visual feedback of the effect of an activity shift on the resource histogram
9	Having ***drift*** allows schedules with realistic activity dates vs. all early-date schedules
8	Transparent planning and scheduling (logic overrides are visible)
7	Calculation of total floats left of the data date reveals the *then-existing* as-built critical path
6	*Compact* activity placement yields neat Level 1 and Level 2 Schedules (*no more waterfalls*)
5	Schedule can be easily understood by stakeholders who are not schedulers
4	Better suited for tablets and touch screens due to interactivity and graphical nature
3	Immediate visual feedback of the effect of each revision on the schedule
2	Immediate availability of the schedule upon completion of full-wall planning
1	Stakeholders are back in the planning and scheduling game

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GPM Literature by Dr. Gui	
Mitigating the Planning Fallacy Risked Schedules, the New Normal	2013 NetPoint User Conference, new Orleans, LA (PowerPoint)
Scheduling, Fast and Slow, Algorithms and intuitions	2012 NetPoint User Conference, Orlando, FL (PowerPoint)
GPM Deep Dive, Master the Algorithms	2012 NetPoint User Conference, Orlando, FL (PowerPoint)
Scheduling a Project at Different Levels	2011 PMI College of Scheduling Conference, San Francisco, CA
Guide to the Forensic Scheduling Body of Knowledge Part I	2010 with G. Jentzen, D. Fredlund, D. Field & P. Spittler
GPM® and Forensic Total Float	Selected by PMI College of Scheduling for presentation at 2010 PMI Global Congress, Washington, DC
GPM® and Forensic Total Float	2010 PMI College of Scheduling Conference, Calgary, CAN
Graphical Planning Method™	July 2009 in the *CM eJournal*
GPM®: A Networking Method Anchored on Objectbase Principles	2009 PMI College of Scheduling Conference, Boston, MA
Project Planning Using Logic Diagramming Method	2008 AACE International Conference, Toronto, CAN
Graphical Planning Method (A New Network-Based	2008 PMI College of Scheduling Conference, Chicago, IL
GPM Literature by Other Authors	
An Algorithmic Dissection of Graphical Path Method (GPM®) Float, Drift and Total Float in Comparison to CPM Total Float	Mather, T. & Liu, L. (2011). PMI College of Scheduling Conference, San Francisco, CA
From Asymmetry to Transparency in Project Planning	Mather, T. (2010). PMI College of Scheduling Conference, Calgary, CAN
History and Future of Time-Scaled Planning	Zann, J. & Mather, T. (2009). PMI College of Scheduling Conference, Boston, MA

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APPENDIX

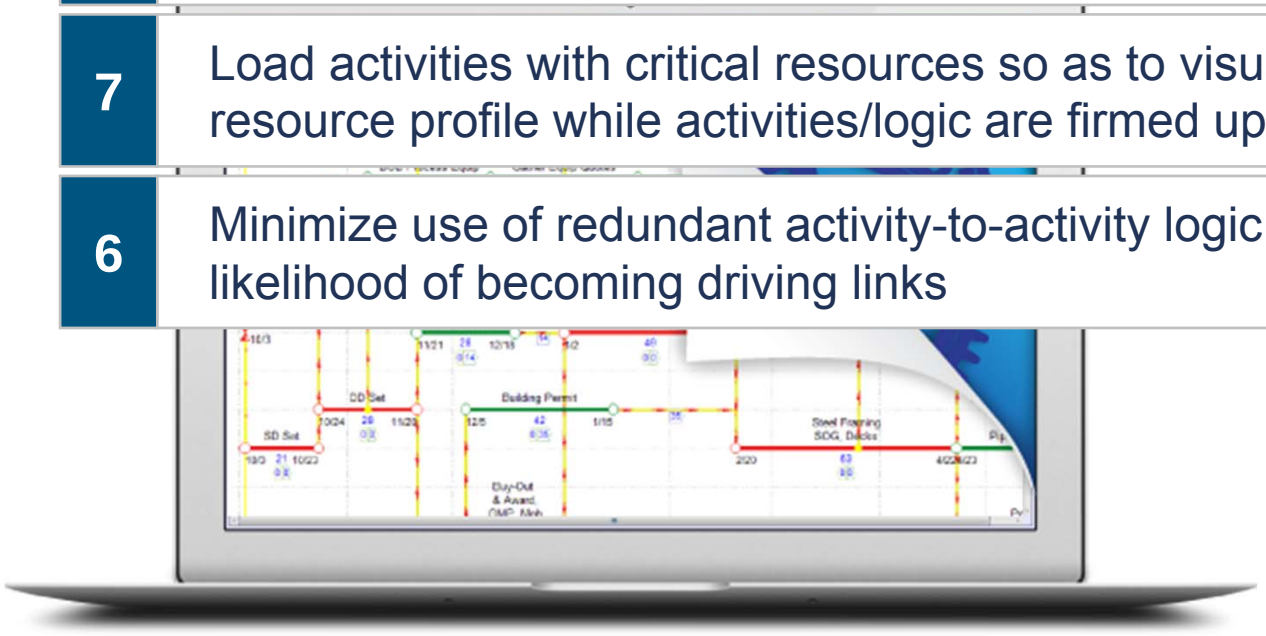


- GPM Network Development—Basic Rules
- Tips for Superior NetPoint Graphics

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GPM Network Development
Basic Rules

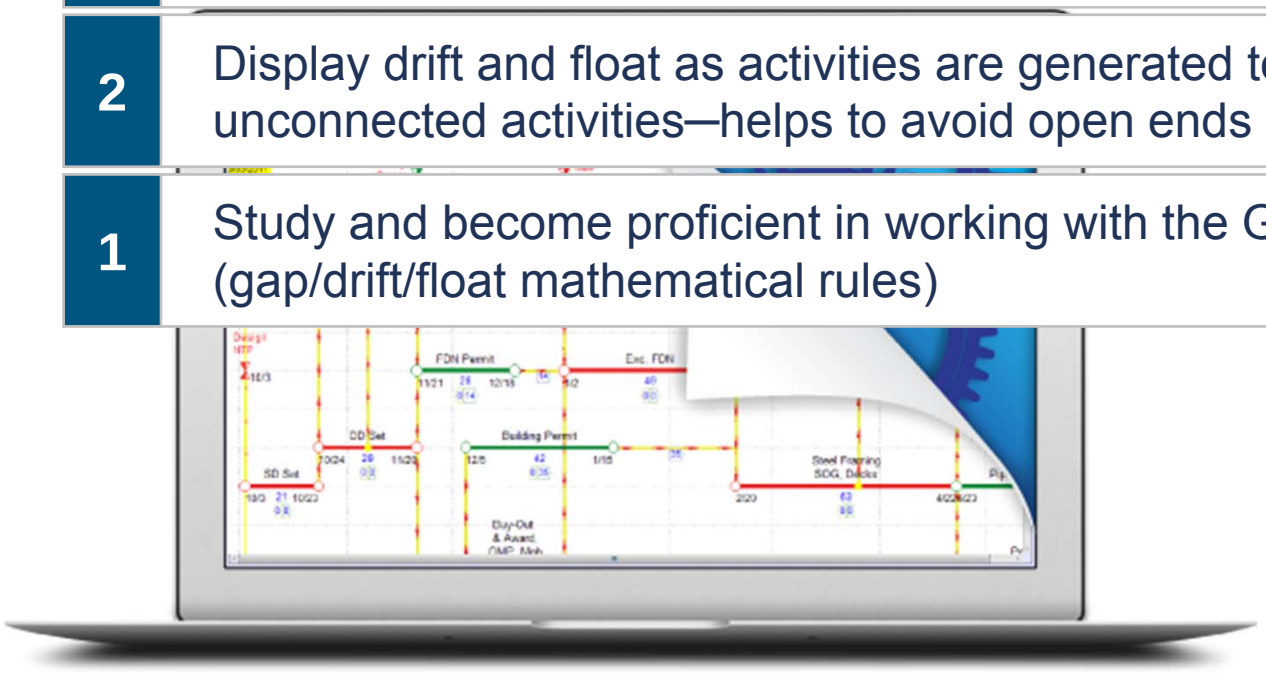
10	Use planned dates instead of SNE constraints as well as when resource leveling or other considerations render early dates moot
9	Use benchmarks to allocate total float to the various stages of the schedule (e.g., foundations, rough-in, interior finishes, etc.)
8	Use milestones sparingly and only for the purpose of calling out status of important activity start and completion events
7	Load activities with critical resources so as to visualize the evolving resource profile while activities/logic are firmed up
6	Minimize use of redundant activity-to-activity logic ties that have no likelihood of becoming driving links



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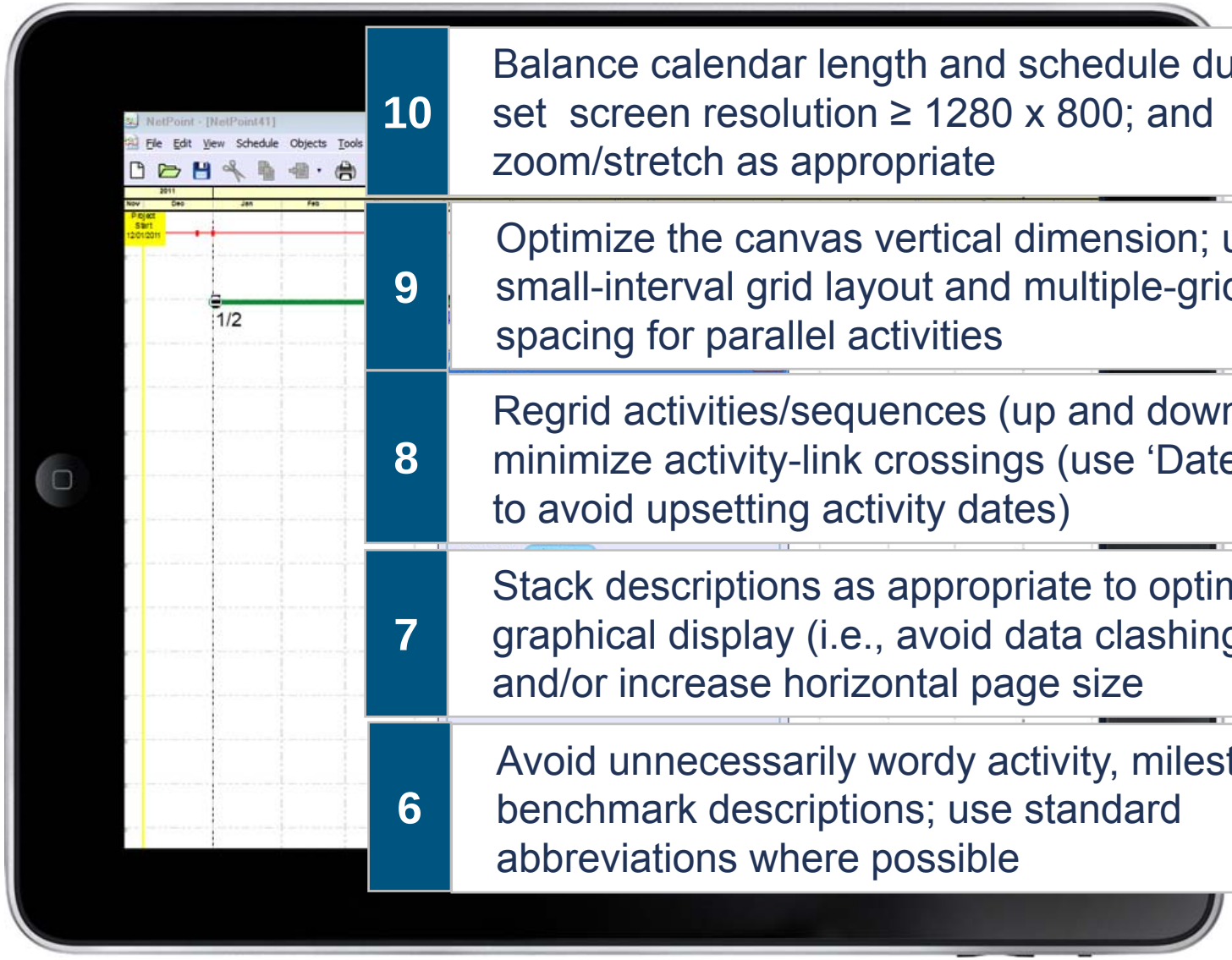
GPM Network Development
Basic Rules (cont'd)

5	Connect open ends and *orphaned ends* (e.g., an activity without an FS or SS predecessor has an orphaned start node)
4	Avoid mixing calendar-day durations and working-day durations unnecessarily (breaks-up chain total float pattern)
3	Maintain total float and critical path integrity left of the data date by appropriately restating out-of-sequence logic ties
2	Display drift and float as activities are generated to better detect unconnected activities—helps to avoid open ends
1	Study and become proficient in working with the GPM algorithms (gap/drift/float mathematical rules)



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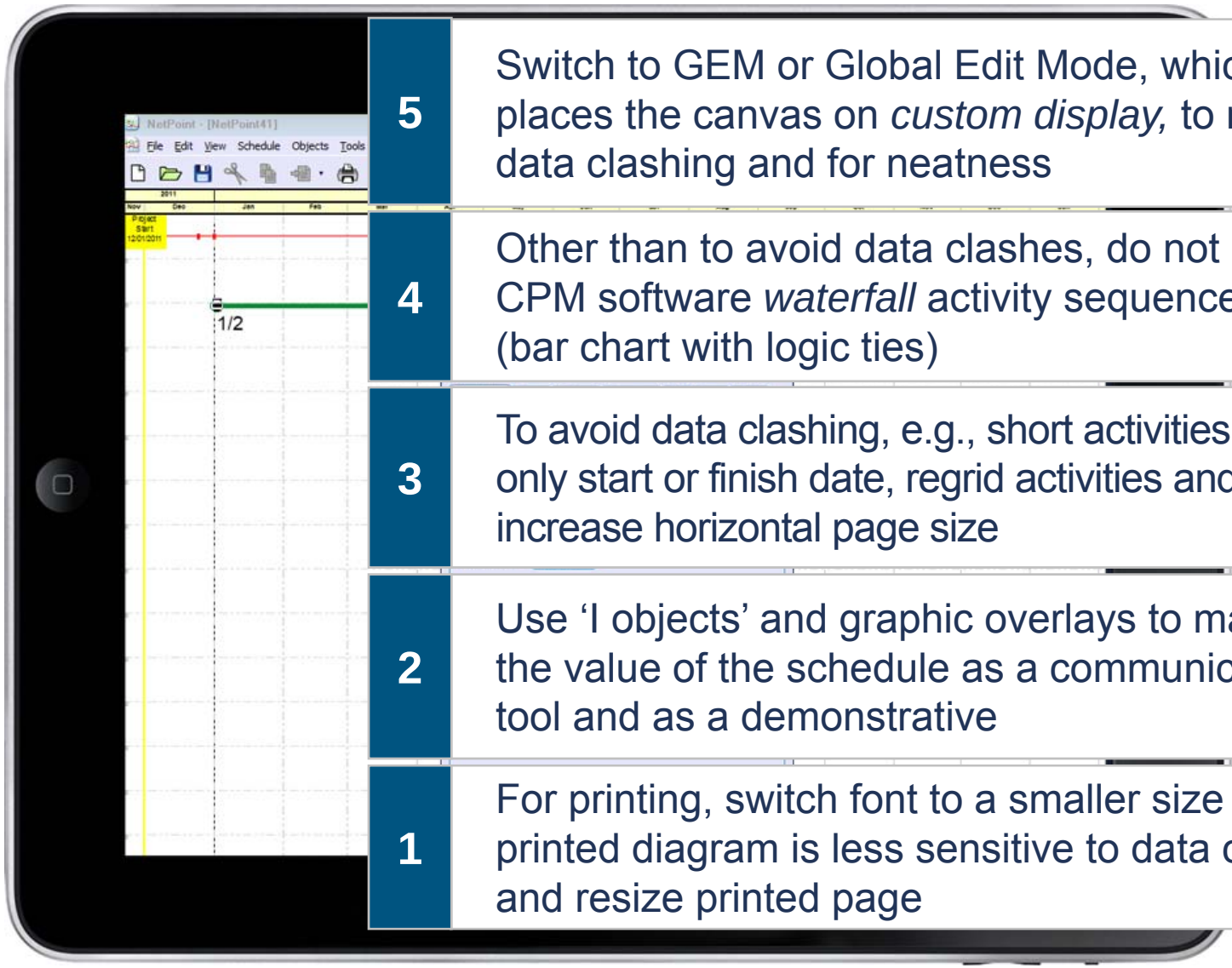
Tips for
Superior NetPoint Graphics



10	Balance calendar length and schedule duration; set screen resolution ≥ 1280 x 800; and zoom/stretch as appropriate
9	Optimize the canvas vertical dimension; use a small-interval grid layout and multiple-grid spacing for parallel activities
8	Regrid activities/sequences (up and down) to minimize activity-link crossings (use 'Date Lock' to avoid upsetting activity dates)
7	Stack descriptions as appropriate to optimize graphical display (i.e., avoid data clashing) and/or increase horizontal page size
6	Avoid unnecessarily wordy activity, milestone or benchmark descriptions; use standard abbreviations where possible

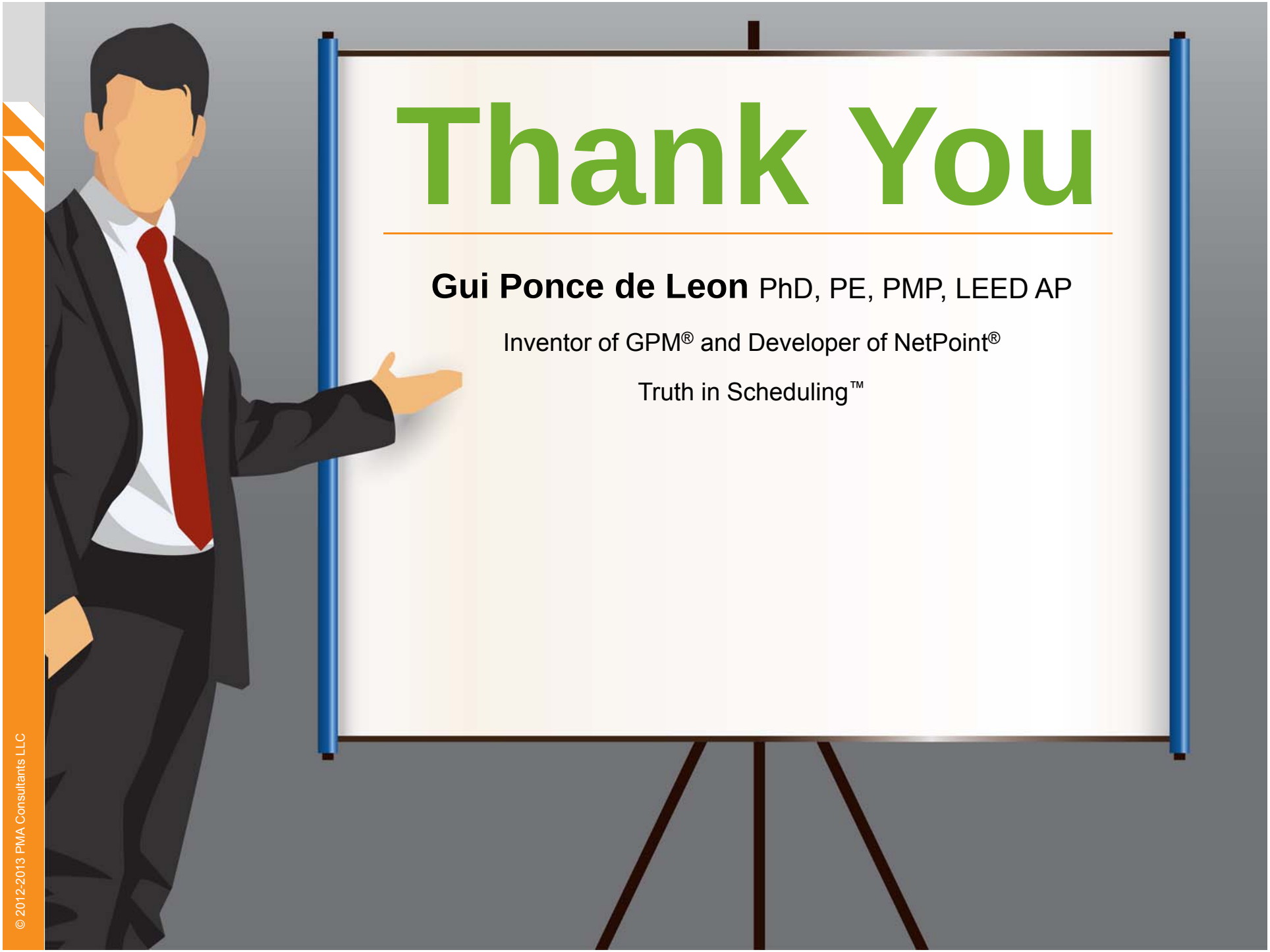
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Tips for
Superior NetPoint Graphics (cont'd)



5	Switch to GEM or Global Edit Mode, which places the canvas on *custom display,* to minimize data clashing and for neatness
4	Other than to avoid data clashes, do not use CPM software *waterfall* activity sequence layout (bar chart with logic ties)
3	To avoid data clashing, e.g., short activities, display only start or finish date, regrid activities and/or increase horizontal page size
2	Use 'I objects' and graphic overlays to maximize the value of the schedule as a communication tool and as a demonstrative
1	For printing, switch font to a smaller size (the printed diagram is less sensitive to data clashes) and resize printed page

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