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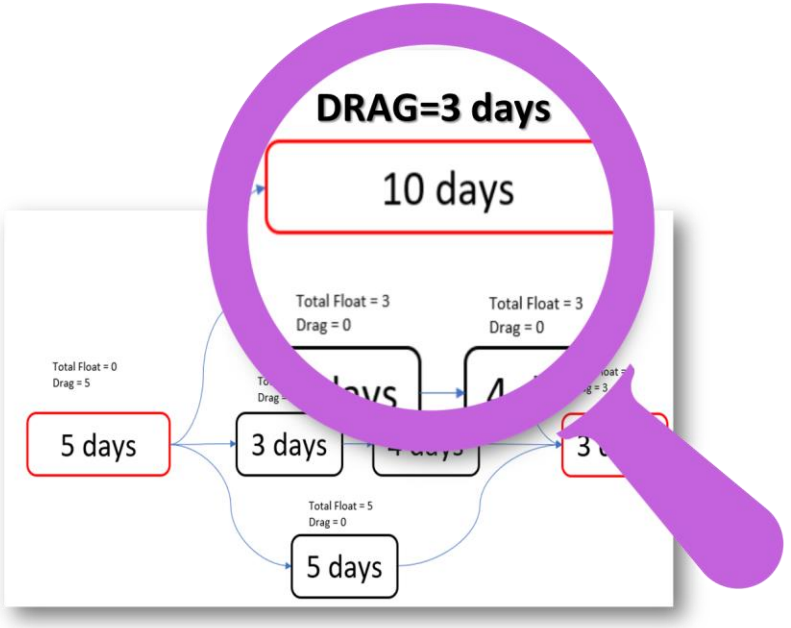
Critical Path Drag

Schedule Optimisation Metric



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Critical Path Method

Poll:

- I am using the Critical Path Method to plan my projects
- I am using the Critical Path Method to optimise my projects
- I am using the Resource Critical Path or Critical Chain method
- Critical Path Method is not applicable for my projects

- Many scheduling software can compute and visualise Critical Path, so it is a no-brainer to use it
- Usually, a project manager accepts the calculation as the schedule
- The Critical Path Method doesn't take resources, material and financial supply constraints into the consideration
- So, the next steps become to assign resources, baseline the schedule and start to manage project progress

- This is because the project managers have forgotten that the "M" in CPM stands for a method
- The reality is that the first network is only the tentative schedule, giving just the data to implement the method fully. Once the initial CPM schedule has been computed and a logic diagram produced, the project manager is in a position to use the critical path method to start project optimisation
- If, for instance, we want to shorten the project duration, we now know where to start: the current critical path!

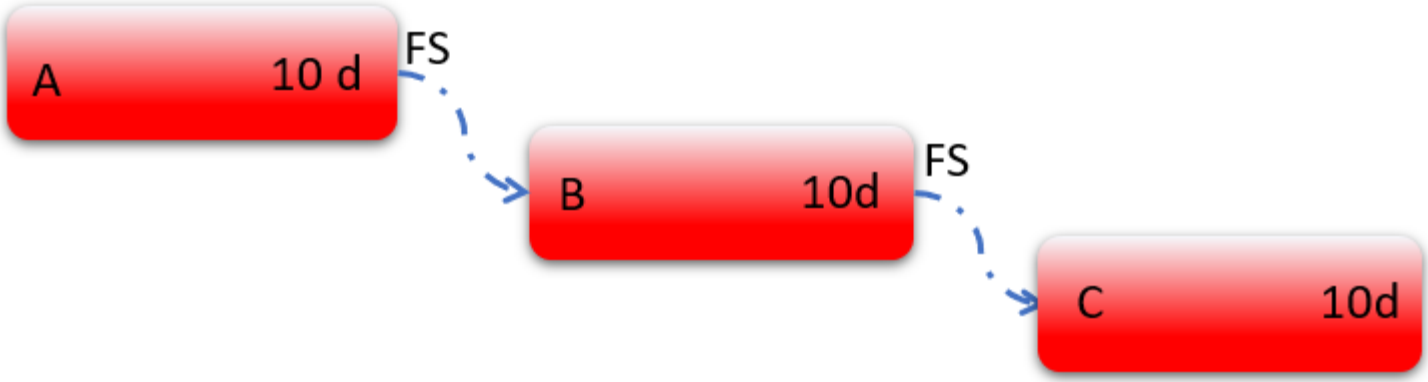
Schedule Optimisation Methods

There are three ways of trying to shorten the project:

- Shorten the duration of activity on the critical path
- Start critical activities earlier
- Change logic and remove activity from the critical path

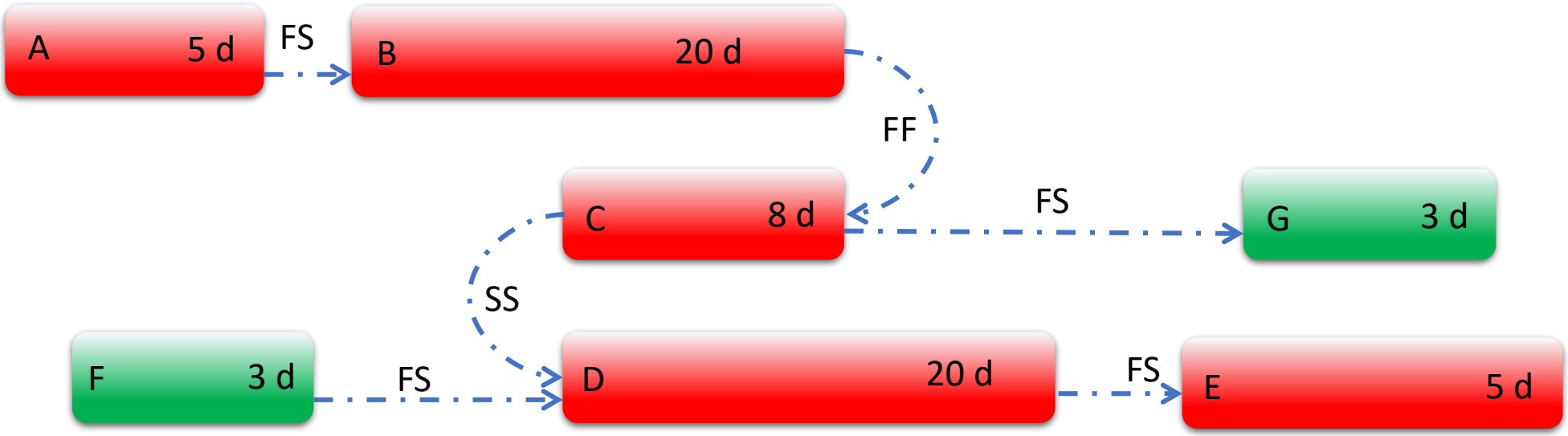
Shorten the duration of activity on the critical path by:

- Adding extra resources
- Assigning resources with better productivity
- Ask resources to work more hours
- Change delivery method
- Prune scope



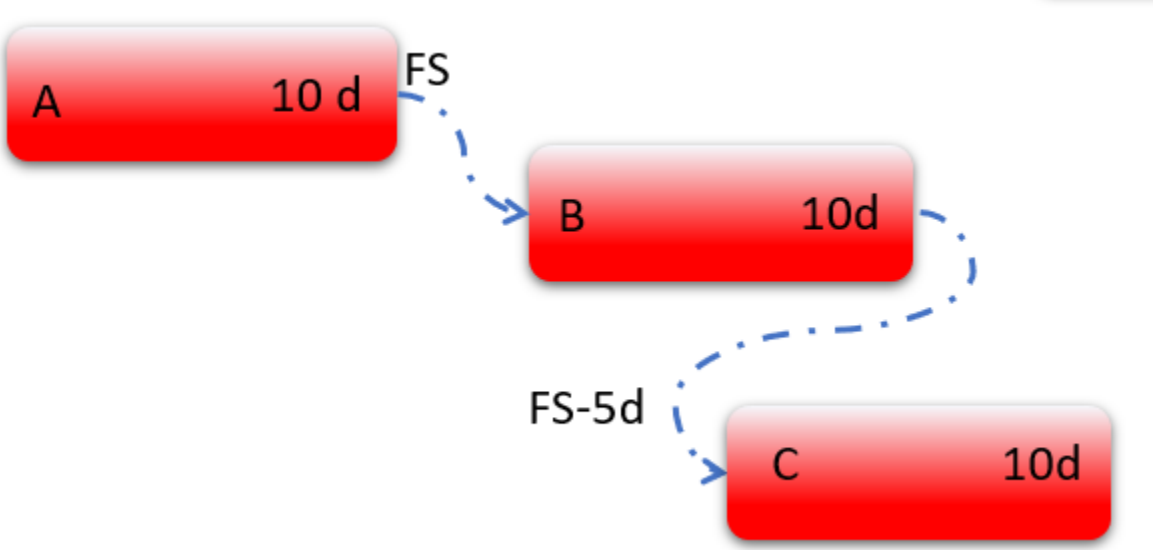
Start critical activities earlier:

- applying anti-crashing method



Change logic and remove activity from the critical path by:

- Applying fast-tracking method



The critical path is a great place to start optimisation:

- Add/remove project resource
- Review the scope
- Review project logic

But the question is:

What will the effect be of such actions on the schedule and cost?

For the answer, we need a Critical Path Metric metric!!!

Critical Path Drag

- One of the CPM metrics that could help us find the answers to the question was proposed by Stephen A. Devaux and explained in his "Total Project Control" book called Critical Path Drag.
- In 1st edition, published in 1999, Stephan used the term DRAG (Devaux's Removed Activity Guide), but since the 2nd edition, it was written as "Drag". In his book, Stephan described the Critical Path Drag metric as:

Critical path drag is the quantification of the amount of time each activity is adding to the project

This metric could be considered as an opposite to the **Total Float** metric

Total Float is the amount of time an activity can be delayed before it's path becomes the longest path

by contrast, drag is:

- *usually on the critical path*
- *the amount of time by which an activity duration can be shortened before its drag is reduced to zero*

Further decrease in the duration of the activity would not reduce the duration of the project as another path became critical

Critical Path Drag is the:

Amount of time that could potentially be saved on the project by reducing the duration of the activity or **removing an activity completely**

- Most of the software that computes Critical Path also could calculate Total Float, but just a few can calculate Critical Path Drag, so this metric is still not well known
- However, this computation is very important. Without understanding activity drags, well too often, implemented project optimisation measures don't give the expected effect

The formula for computing drag on a **simple** critical path network schedule is as follows:

a) If an activity is off the critical path, its drag = 0

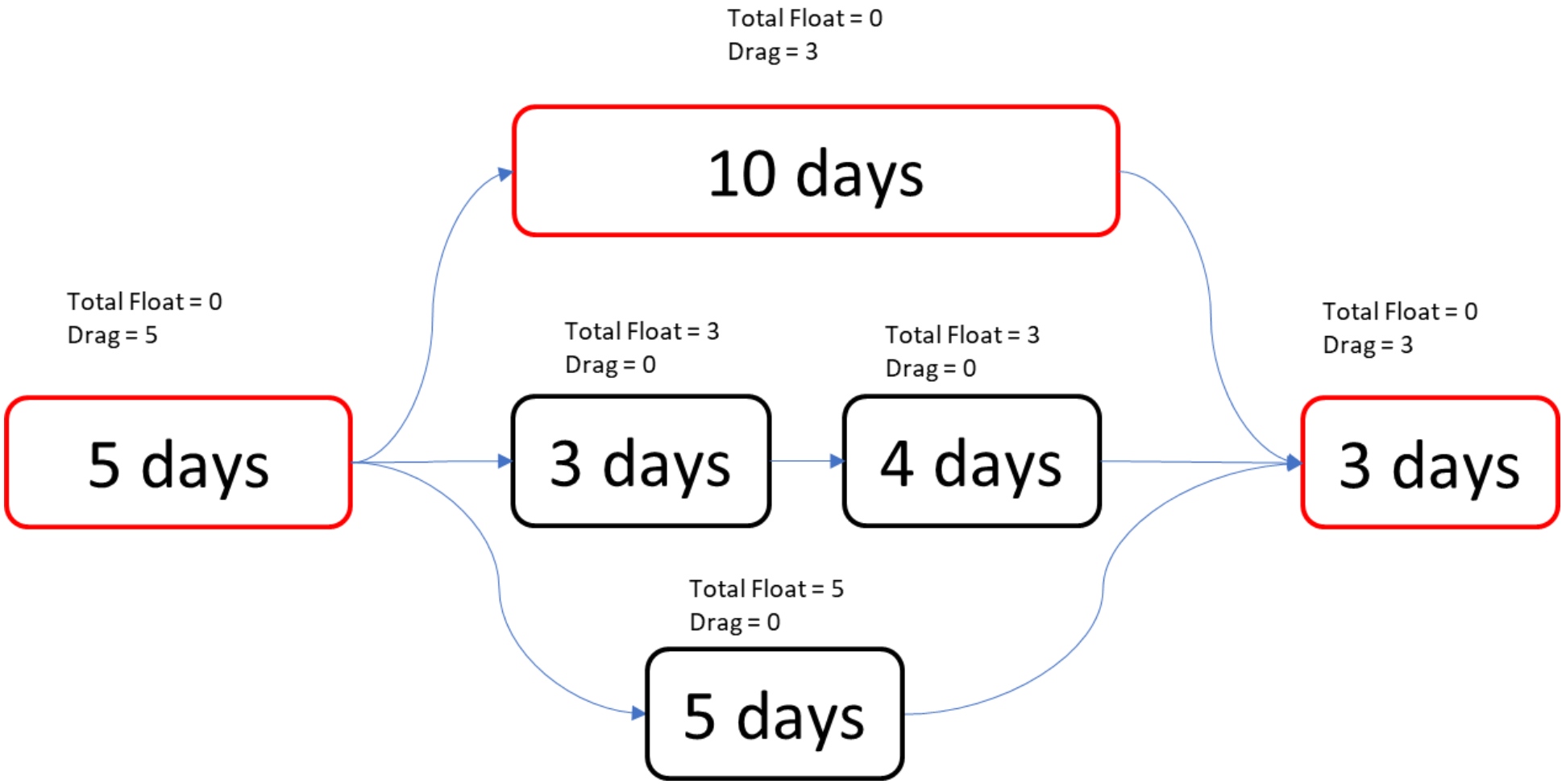
b) If an activity is on the critical path and has nothing else in parallel

its drag = its duration

c) If an activity is on the critical path and has other activities in parallel, its drag is the lowest number between:

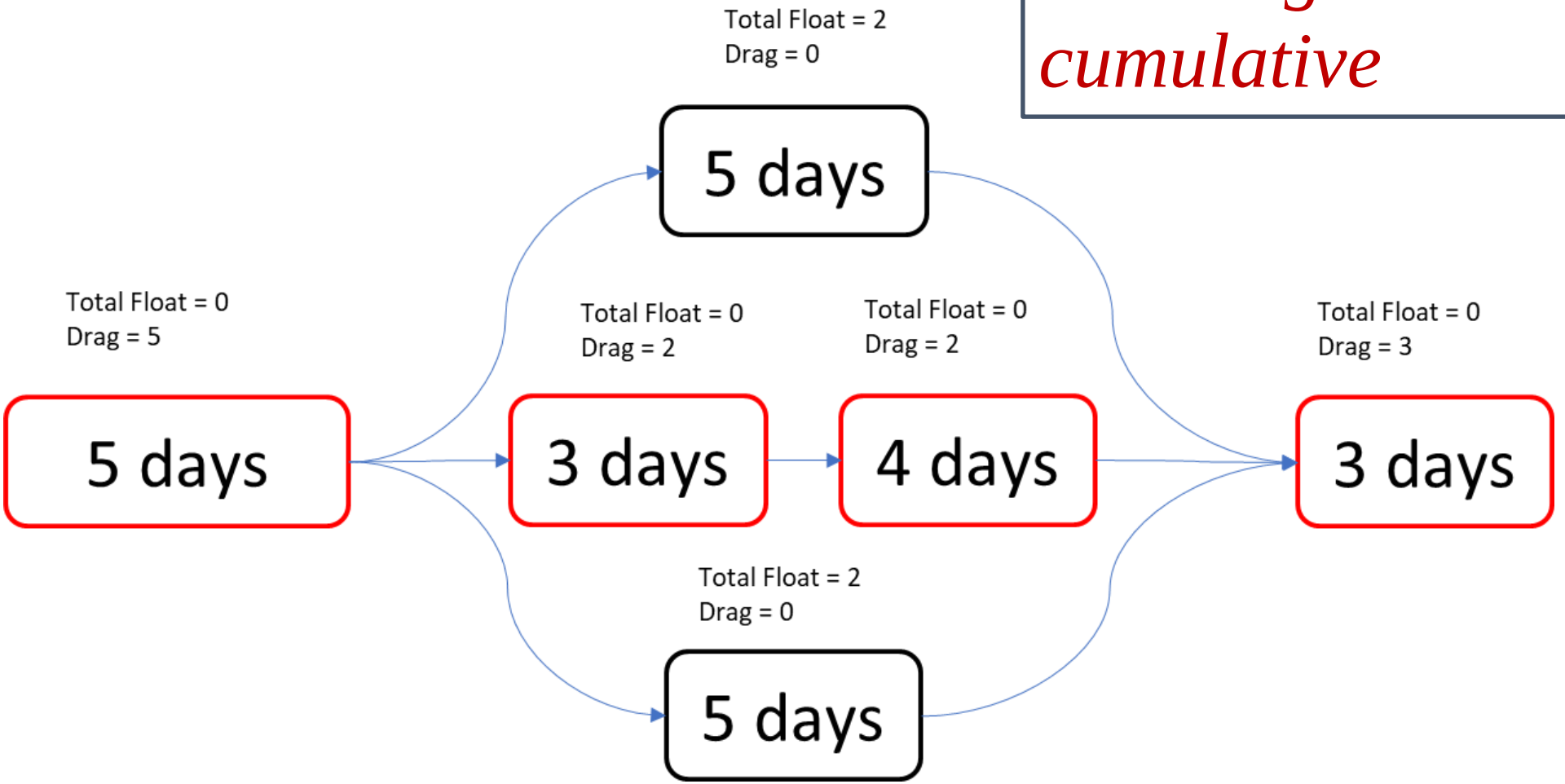
- activity duration
- total float of the parallel activity with the least total float

Lets' review the following simple project:



Lets' review the following simple project:

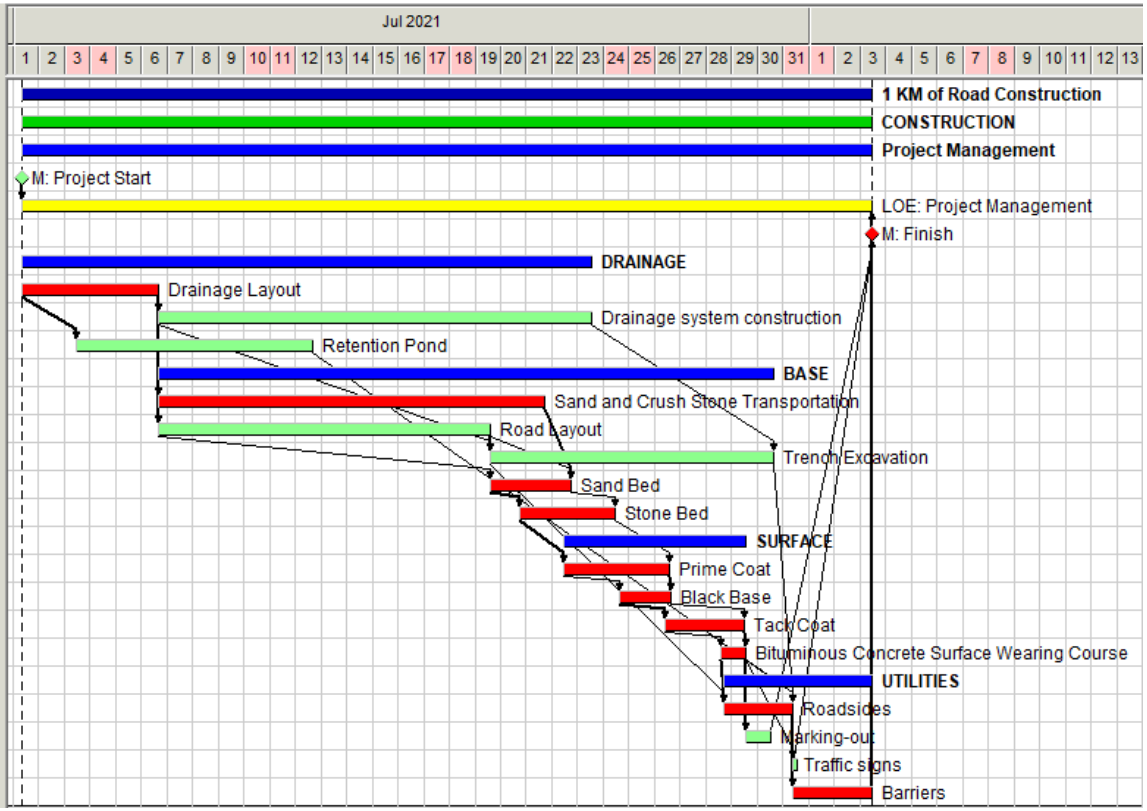
The drag is not cumulative

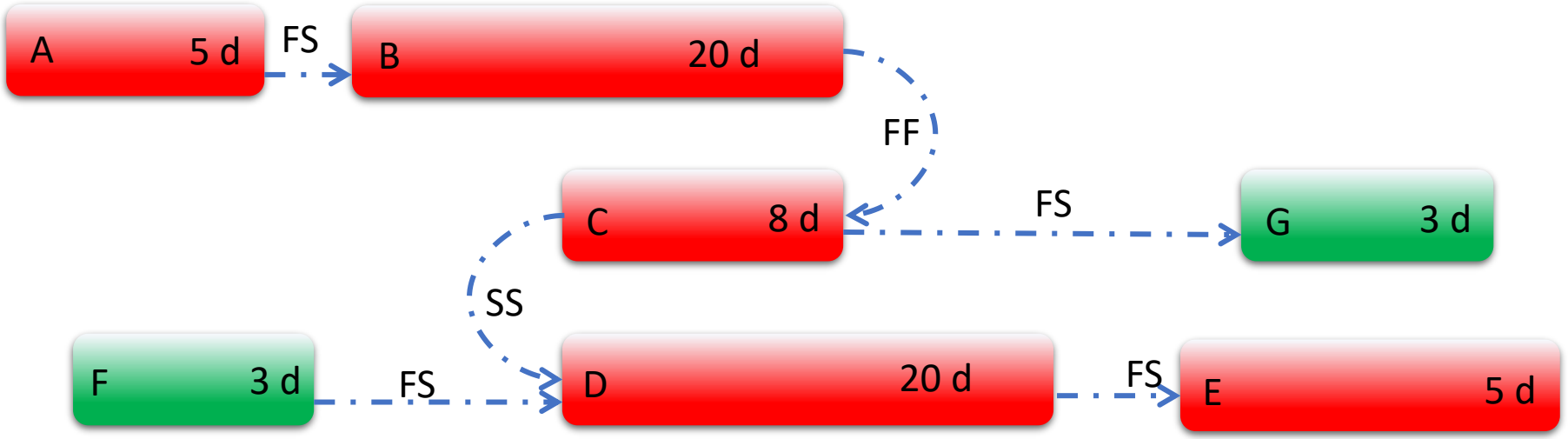


Negative Critical Path Drag

Negative Critical Path Drag

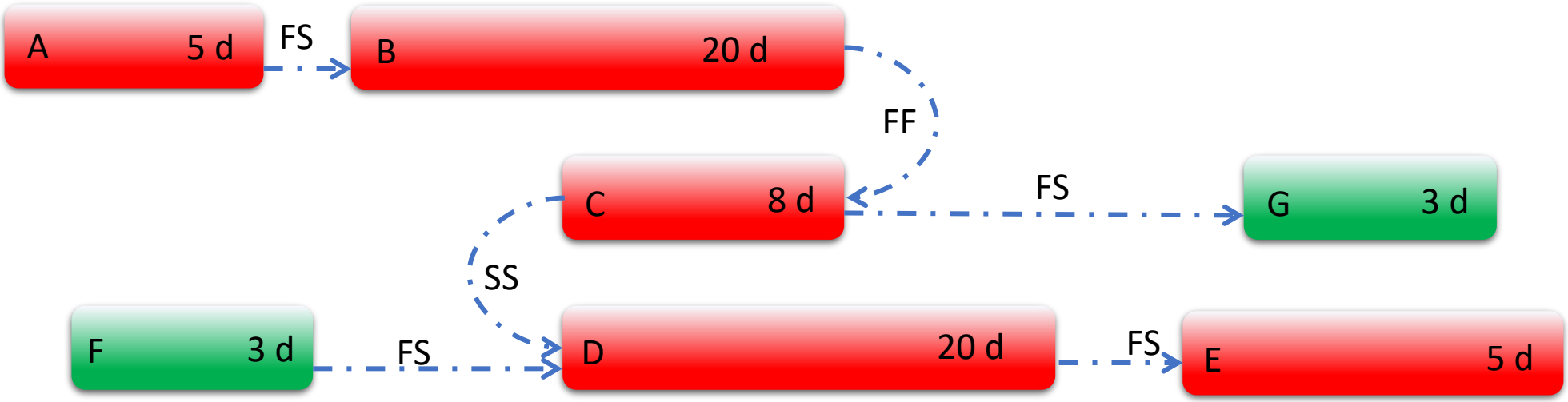
Code	Name	DRAG, Days	Duration, Days [Remaining]	Start	Finish
01km	1 KM of Road Construction		28.35	01/07/21	03/08/21
CNS	CONSTRUCTION		28.35	01/07/21	03/08/21
2	Project Management		28.35	01/07/21	03/08/21
pst	M: Project Start			01/07/21	01/07/21
pmt	LOE: Project Management		28.35	01/07/21	03/08/21
fin	M: Finish			03/08/21	03/08/21
DRN	DRAINAGE		19.58	01/07/21	23/07/21
drl	Drainage Layout	4.76	4.76	01/07/21	06/07/21
drc	Drainage system construction		14.81	06/07/21	23/07/21
pnd	Retention Pond		7.41	03/07/21	12/07/21
BAS	BASE		20.91	06/07/21	30/07/21
str	Sand and Crush Stone Transportation	0.18	13.20	06/07/21	21/07/21
rlt	Road Layout		10.91	06/07/21	19/07/21
trn	Trench Excavation		10.00	19/07/21	30/07/21
snb	Sand Bed	-1.97	3.28	19/07/21	22/07/21
stb	Stone Bed	-0.66	3.28	20/07/21	24/07/21
SRF	SURFACE		6.28	22/07/21	29/07/21
ct1	Prime Coat	0.18	3.24	22/07/21	26/07/21
blb	Black Base	-0.42	1.04	24/07/21	26/07/21
ct2	Tack Coat	0.18	3.24	26/07/21	29/07/21
srf	Bituminous Concrete Surface Wearing Cours	-0.52	1.04	28/07/21	29/07/21
UTL	UTILITIES		4.49	28/07/21	03/08/21
rds	Roadsides	0.40	2.22	28/07/21	31/07/21
mrk	Marking-out		0.91	29/07/21	30/07/21
trs	Traffic signs		0.25	31/07/21	31/07/21
brr	Barriers	2.02	2.27	31/07/21	03/08/21



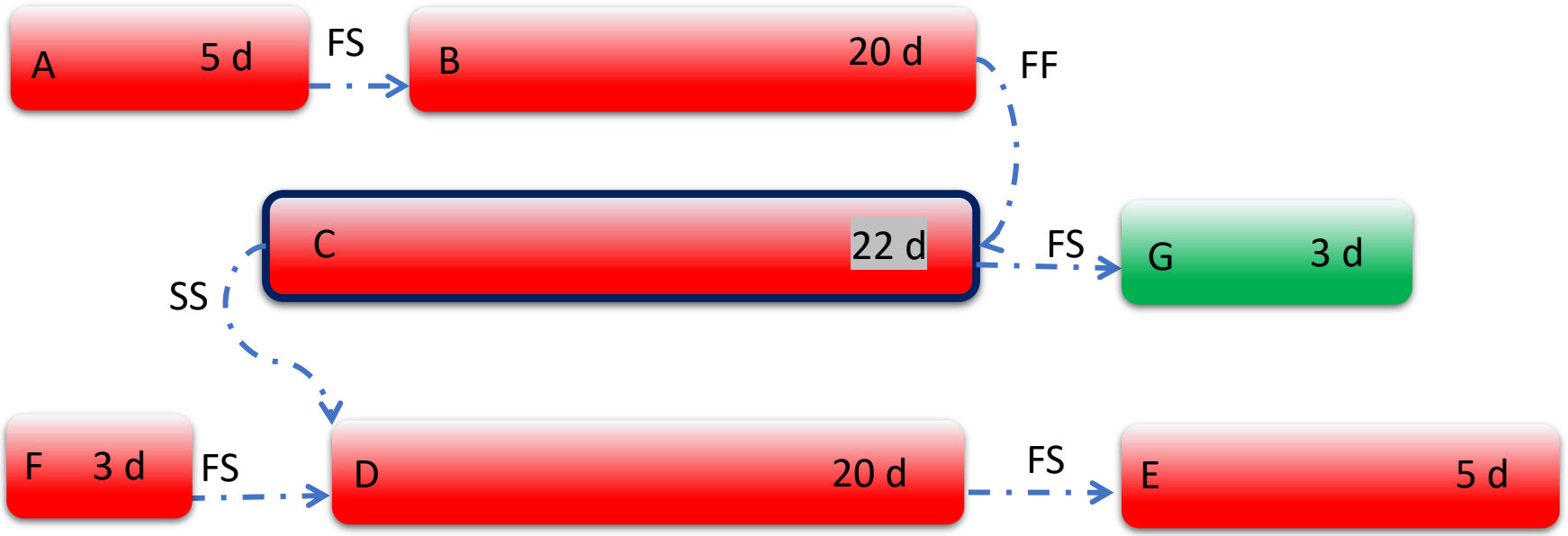


- In this example, CP drag of the activity "C" will be negative
- If the duration of this activity is reduced to zero, the duration of the project will be increased from 42 to 50 days
- CP drag of activity “C” will be -8 days

How duration of this project will be changed if we increase the duration of activity “C”?



If it is possible to increase the duration of activity "C" by 14 days, the duration of the project will be decreased from 42 to 28 days (!)



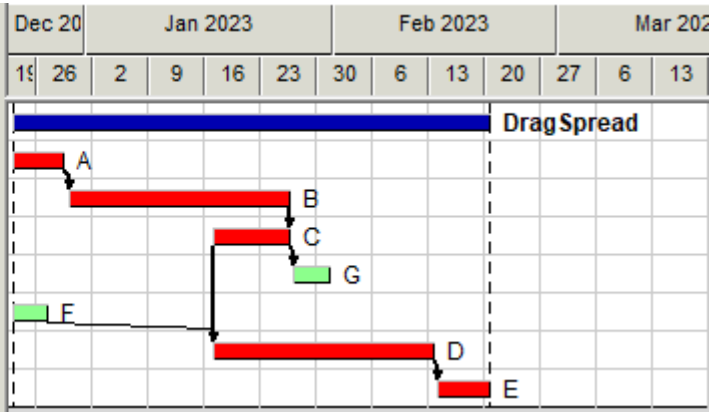
Duration

Path 1: 5 + 20 – 22 + 20 + 5 = 28 days

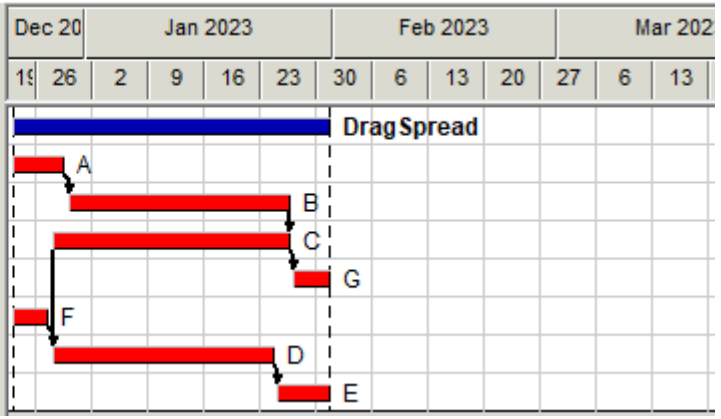
Path 2: 3 + 20 +5 =28 days

If it is possible to increase the duration of activity "C" by 14 days, the duration of the project will be decreased from 42 to 28 days (!)

Name	Duration, Days [Remaining]	DRAG, Days	Start FLEX, Days	Finish FLEX, Days
Drag Spread	**42**			
A	5	5		
B	20	14		
C	8	-8	17	
G	3			14
F	3			14
D	20	14		
E	5	5		



Name	Duration, Days [Remaining]	DRAG, Days	Start FLEX, Days	Finish FLEX, Days
Drag Spread	**28**			
A	5			
B	20			
C	22	-22	3	
G	3			
F	3			
D	20			
E	5			



I am proposing a new Critical Path metric:

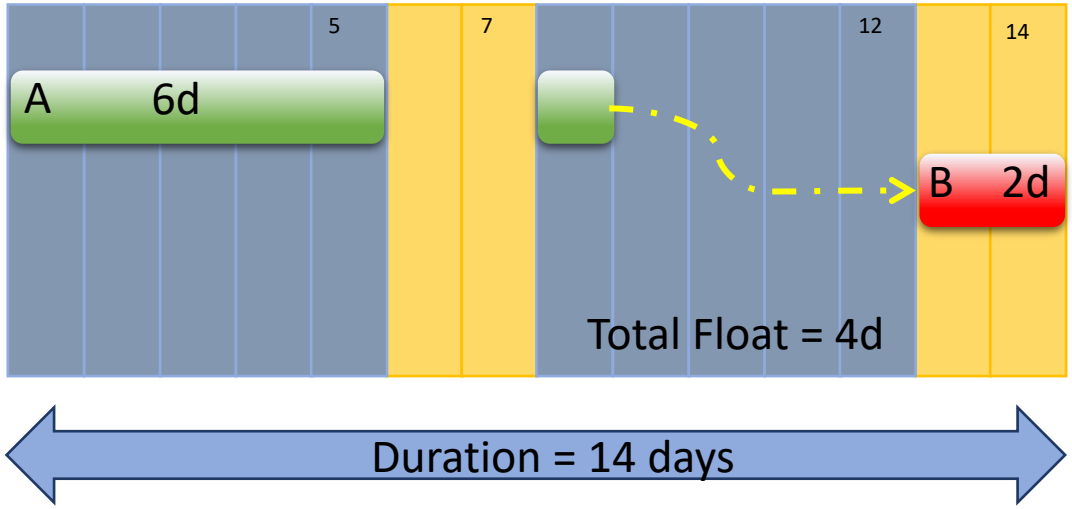
Critical Path ACTIVITY SPREAD is the amount of time that could potentially be saved on the project by increasing the duration of the activity

Some activities may potentially be speeded up by decreasing resources or by assigning resources with less productivity.

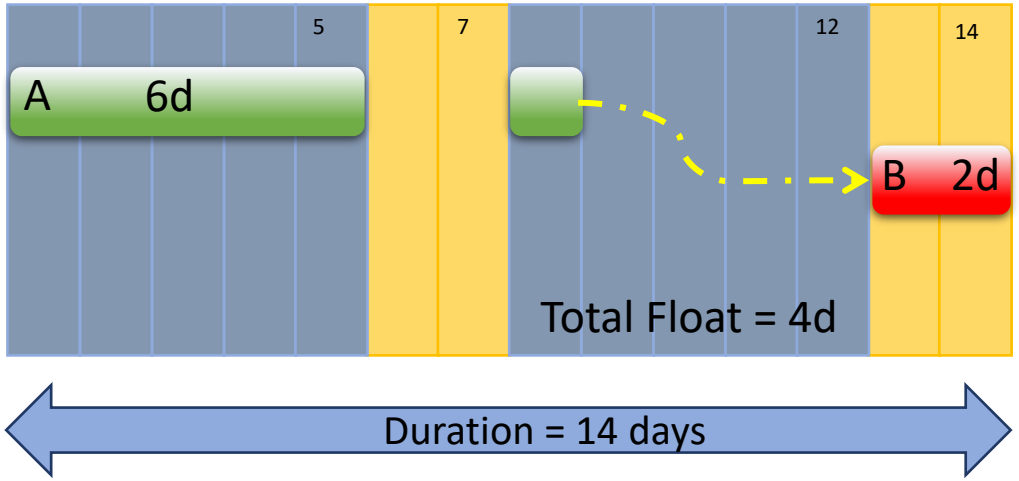
Critical Path Drag on non-critical activities

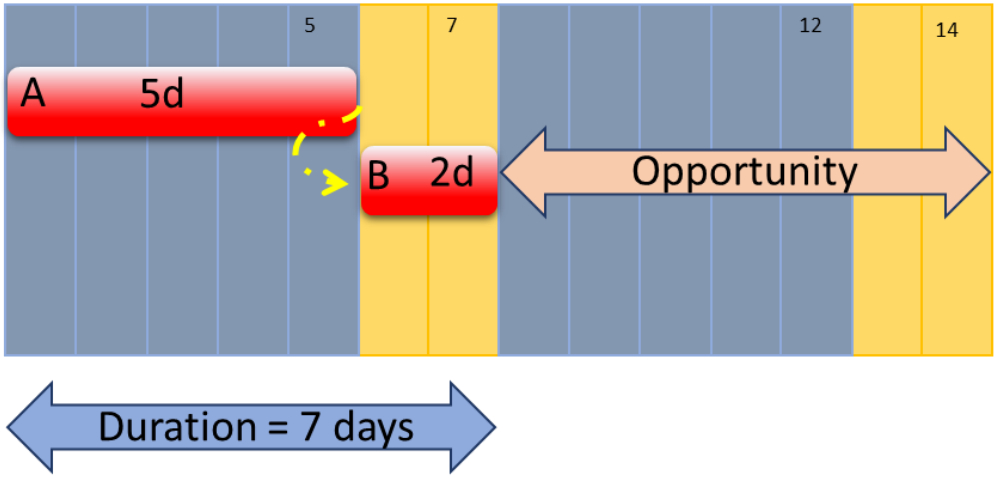
- It is logical to think that project duration could be reduced by optimising activities on a critical path only
- However, there are project scenarios when decreasing the duration of the non-critical activity could reduce the overall duration of the project!!!
- Most of the software that computes Critical Path also could calculate Total Float (TF), but just a few can calculate Critical Path Drag, so this metric is still not well known. However, this computation is very important. Without understanding activity drags, well too often, implemented project optimisation measures don’t give the expected effect.

- Let's review a fragment when activities have different calendars
- Activity "A" only could be performed on weekdays and activity "B" only could be performed on weekends



- Activity "A" has 4 days of the total float, so it is not on the critical path.
- However, if we reduce the duration of this activity to 5 days, the overall duration also will be reduced from 14 days to 7 days
- The CP drag of activity non-critical "A" will be > 0





Conclusions

Summary

- Critical Path network gives us a clue where project duration could be shortened
- Critical Path Drag metric allows understanding an amount of time that could potentially be saved on the project by reducing the duration of the activity
- Computation of Critical Path Drag is very important. Without understanding it project optimisation measures may not give the expected effect

Summary

A project schedule is not always a list of activities linked by finish-to-start dependencies. Schedules also may contain other types of dependencies, activity lags, different calendars and constraints. This adds complexity in the understanding of the project Critical Path

There are project scenarios when projects duration could be reduced by:

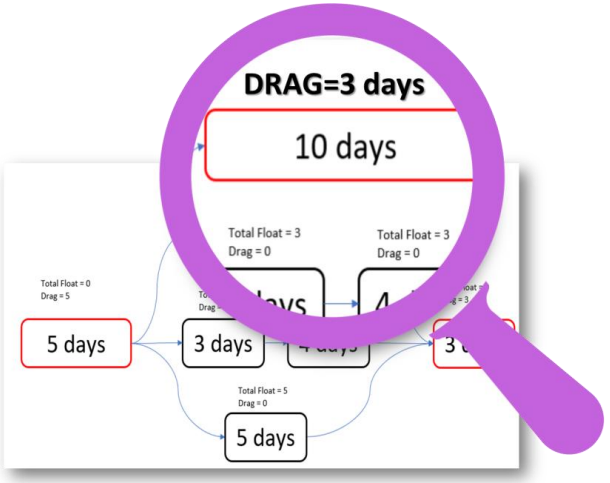
- increasing the duration of critical activity
- decreasing the duration of the non-critical activity

These scenarios could be identified by calculating the Critical Path Drag.

Summary

A new Critical Path metric: ACTIVITY SPREAD

Activity spread the amount of time that could potentially be saved on the project by increasing the duration of the activity



Thank you

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