Probabilistic Activity Drag [1]

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Abstract

Activity Drag is a relatively new schedule analysis metric used to assess opportunities for schedule optimisation. The metric analyses the impact of reducing activity durations on the project completion day. Although it was introduced over two decades ago, the metric is mainly known only to users of a few project delivery systems where it was implemented. In recent years, the metric has started gaining wider recognition.

In addition to the deterministic version of this metric, there is a probabilistic extension, Probabilistic Activity Drag, which estimates the level of Activity Drag uncertainty and measures the probability of achieving target optimisation, accounting for project uncertainty and risks.

This article describes the *Probabilistic Activity Drag* metric and outlines its advantages, limitations, and calculation specifics.

Activity Drag Metric

Although Activity Drag ("Drag" below), also known as **Critical Path Drag**, was introduced more than two decades ago by Stephen A. Devaux in his book *Total Project Control*[8], it remains familiar mainly to users of the few project delivery systems that implemented it. In recent years, however, the metric has gained broader recognition. Articles on its practical application have appeared in project management journals, and it is referenced in the 8th edition of *A Guide to the Project Management Body of Knowledge*, published by the Project Management Institute[5].

Activity Drag is the amount of time an activity directly contributes to the overall project duration. In other words, it represents how much earlier the project could be completed if that activity's duration is reduced to zero. Such perspective combined with shortest possible activity duration, known as crashed duration, provides practical schedule acceleration opportunity.

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For example, if an activity has a drag of 5 days, the project duration can be shortened by 5 days, assuming it is technically feasible to reduce the activity by that amount.

Definition N1: *Critical Path Activity Drag is the amount of time that could potentially be saved on the project by reducing the duration of the activity (or removing the activity completely).*

The author's recent paper explains the application of the metric in complex delivery modelling scenarios[2].

This measure is meaningful when the schedule is calculated with all real constraints in place, including technological logic, resource availability, material supply, and financial limits.

However, projects do not operate in a deterministic environment. Uncertainty and risk continuously influence outcomes. Before making acceleration decisions (and spending acceleration costs!), it is therefore beneficial to understand how activity behaves under these uncertainties and the probability of achieving the expected acceleration.

Probabilistic Activity Drag Metric

The Probabilistic Activity Drag ('Probabilistic Drag' below) metric measures the opportunity to accelerate activity in the context of project uncertainties and risks.

Definition N2: *Probabilistic Activity Drag is the amount of time that could potentially be saved on the project by reducing the duration of the activity (or removing the activity completely), considering project uncertainties and risk events.*

How Probabilistic Activity Drag is calculated

When an uncertainty-driven (including embedded risks) project delivery model is developed, *Monte Carlo Simulation* method can then be applied to assess how the drag of analysed activity varies across multiple scenarios.

A Monte Carlo Simulation system generates multiple versions of the schedule that account for uncertainties and risks by randomly sampling from distributions. Drag is calculated for each schedule iteration, and the results are aggregated.

Instead of a single fixed value, the result becomes a distribution. A curve showing the range of possible drag values, minimum to maximum achievable acceleration and the probability of achieving the deterministic drag target.

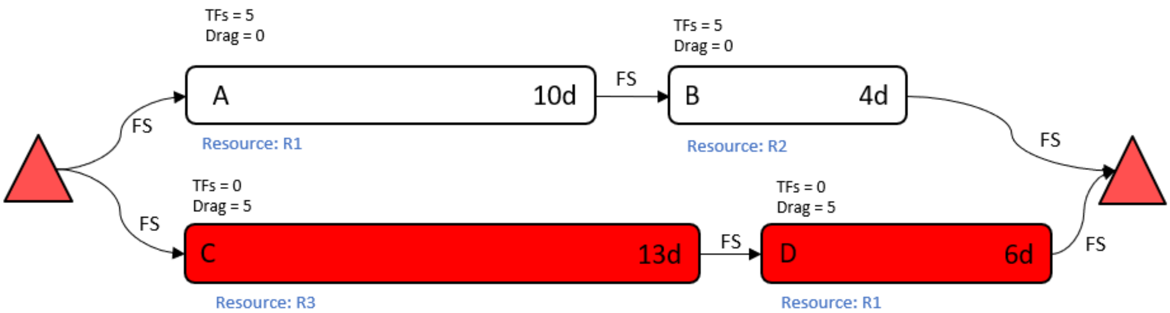
This metric provides a far more realistic and decision-relevant understanding of where acceleration efforts will deliver value under uncertainty.

Drag and Probabilistic Drag can be applied to both:

- Task-Driven Network Analysis (also called Duration-Driven CPM, DCPM), and
- Resource-Driven Network Analysis (also known as Resource Critical Path Method, RCPM).

Let's review how the method works in practice based on a simple scenario.

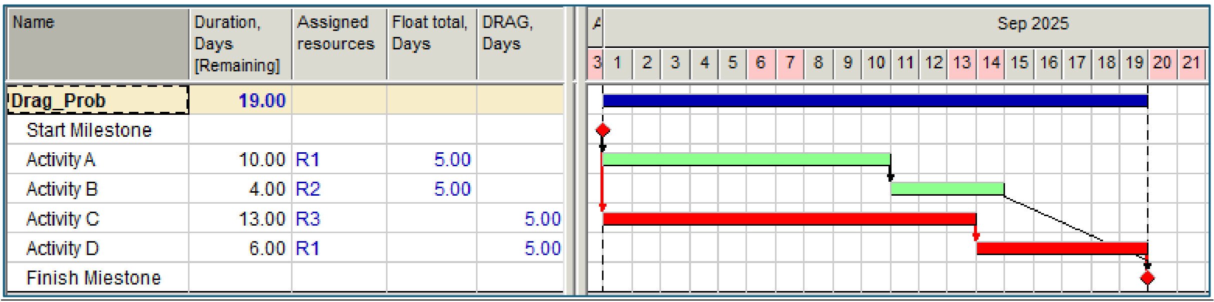
Scenario 1: Probabilistic Drag



Picture 1.1

In this scenario, all dependencies are Finish-to-Start. Each activity has an assigned resource. We can recalculate this scenario with DCPM and RCPM. DCPM assume unlimited resource supply, but RCPM consider supply limitations.

Critical Path Method



Name	Duration, Days [Remaining]	Assigned resources	Float total, Days	DRAG, Days
Drag_Prob	19.00			
Start Milestone				
Activity A	10.00	R1	5.00	
Activity B	4.00	R2	5.00	
Activity C	13.00	R3		5.00
Activity D	6.00	R1		5.00
Finish Miestone				

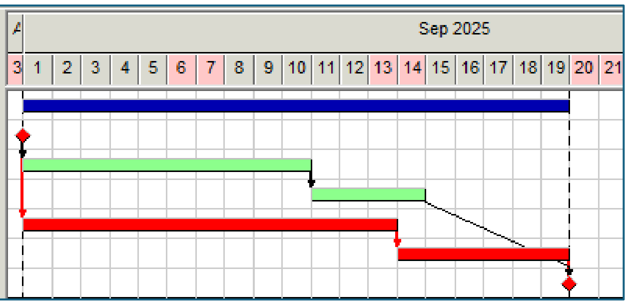
Picture 1.2

Based on CPM, the two activities with positive Drag are Activity A (5 days) and Activity B (5 days).

Resource Critical Path Method

Only one resource of each type is available.

Name	Duration, Days [Remaining]	Assigned resources	Float total, Days	DRAG, Days
Drag_Prob	19.00			
Start Milestone				
Activity A	10.00	R1	3.00	
Activity B	4.00	R2	5.00	
Activity C	13.00	R3		3.00
Activity D	6.00	R1		5.00
Finish Miestone				



Picture 1.3

The project's critical and resource-critical paths are the same (Activities C & D), but Total Float and Drag differ for some activities. This is due to a hidden resource dependency. Resource R1 is required for Activities A & D, so a delay of more than 3 days in Activity A would delay the project.

The drag metric suggests an opportunity to accelerate the project by reducing the durations of Activities C or D.

Note: Drag is not a commutative metric. It doesn't mean that the overall acceleration is 8 days. By reducing the duration of one activity, we may also reduce drag on another activity.

Project uncertainty

Let's add duration uncertainties for each activity:

- Activity A: +/-2 days
- Other activities +/-1 day

Name	Duration, Days [Remaining]	Assigned resources	Float total, Days	DRAG, Days	Opt -Duration, Days [Remaining]	Exp -Duration, Days [Remaining]	Pes -Duration, Days [Remaining]
Drag_Prob	19.00						
Start Milestone							
Activity A	10.00	R1	3.00		8.00	10.00	12.00
Activity B	4.00	R2	5.00		3.00	4.00	5.00
Activity C	13.00	R3		3.00	12.00	13.00	14.00
Activity D	6.00	R1		5.00	4.00	5.00	6.00
Finish Miestone							

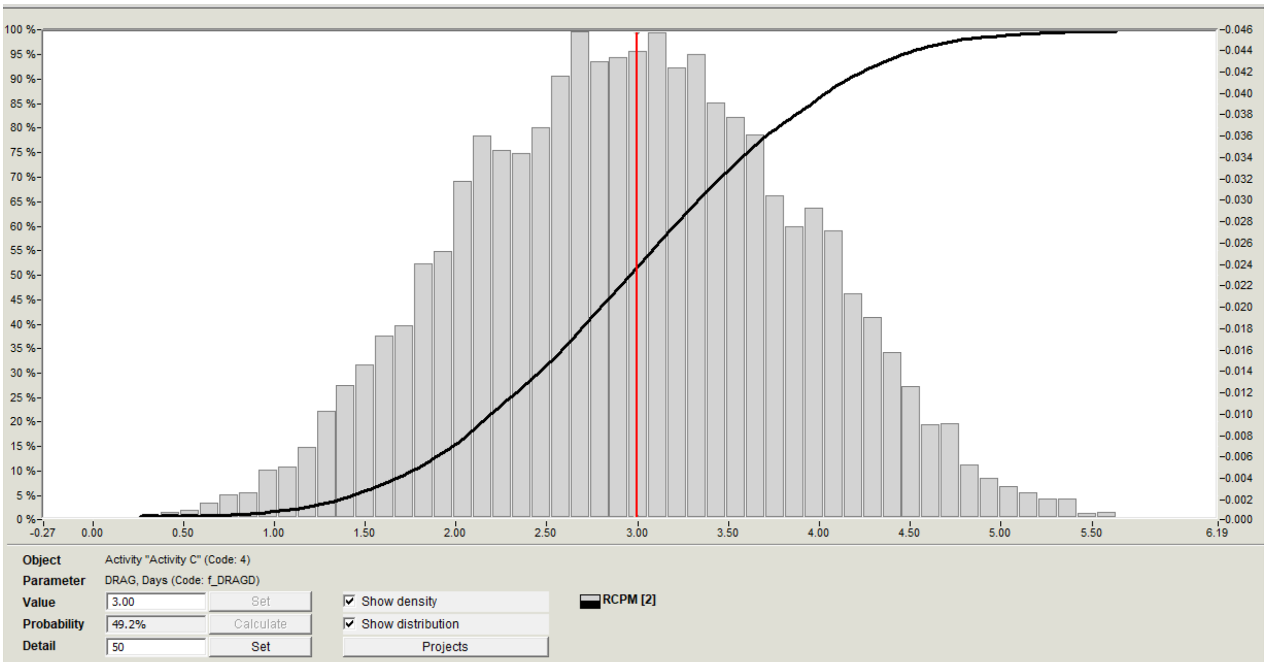
Picture 1.4

Monte Carlo Simulation

Let's calculate Probabilistic Drag for Activities C & D by applying the Monte Carlo Simulation Method. Applied parameters:

- RCPM
- Triangle distribution
- Drag Calendar: Activity Calendar
- Iterations: 10,000

Activity C Probabilistic Drag

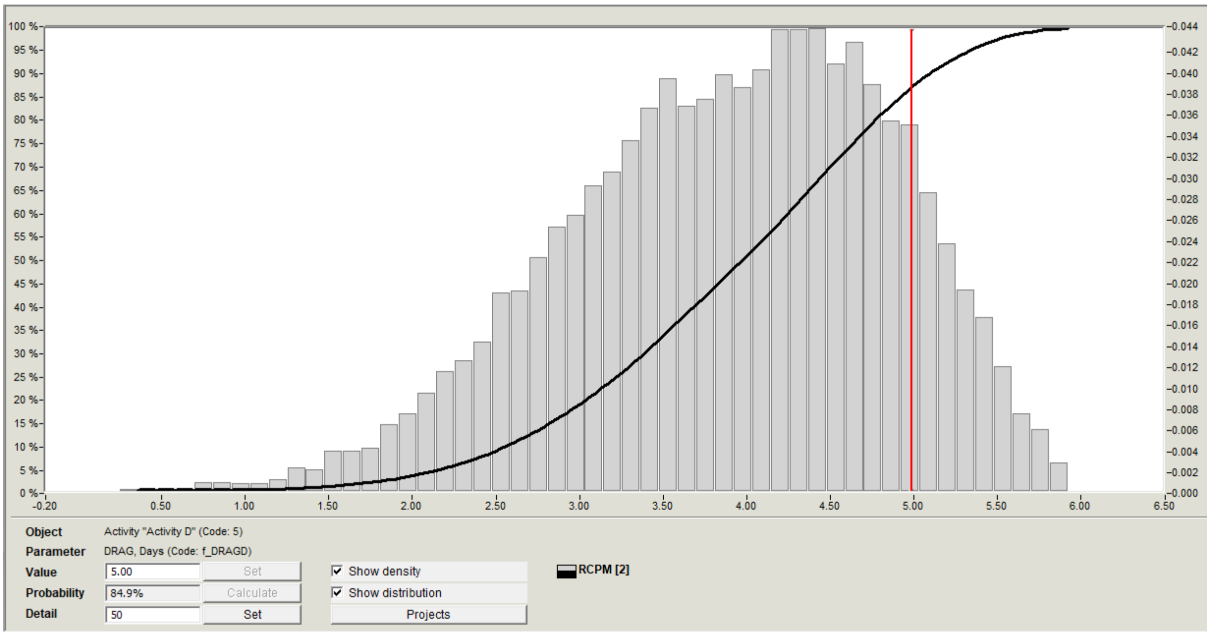


Picture 1.5

Observations:

- Minimum Drag: 0.5 days
- Maximum Drag: 5.6 days
- Probability to achieve target acceleration (3 days): 50.8%

Activity D Probabilistic Drag



Picture 1.6

Observations:

- Minimum Drag: 0.5d
- Maximum Drag: 5.9 days
- Probability to achieve target acceleration (5 days): 15.1%

The deterministic Drag for Activity D is 5 days, but there is only a 15% chance of achieving such acceleration. Still, there's around 50% chance that a 4-day acceleration is achievable.

Additionally, we can calculate Probabilistic Drag based on CPM. It provides insight into the theoretical acceleration effect when all resource limitations are removed.

In a real project scenario, it is possible that:

- Pessimistic Drag (minimum acceleration) is much lower than expected
- Optimistic Drag (maximum acceleration) is much higher than expected
- The probability of achieving the target acceleration is very high or very low.

It is also possible that an activity with zero Drag practically holds an optimisation opportunity when uncertainties are considered. Such an opportunity would be hard to identify without running a schedule simulation analysis and calculating Probabilistic Drag.

Activity Drag Target

In the example, we measure the probability of meeting the target acceleration, where the target is a deterministic value calculated using the RCPM method. However, it is usually not the right target.

The Activity Drag concept assumes the activity's duration can be reduced to zero. This is practically impossible for most activities. Instead, each activity has a technologically achievable minimum duration, known as *Crashed Activity Duration*.

Crashed duration is often a better target for probabilistic activity Drag analysis.

Method application

Application of the method to the full extend can be challenging without specialised system that support probabilistic planning and modelling, and Drag calculation.

As an alternative to the full analysis the project can develop optimistic, expected, and pessimistic versions of the schedule and calculate Drag for each version. Even if a scheduling system does not support automatic Drag calculation it possible to reduce duration of analysed activity to zero days and analyse changes in project duration. It provides a range of acceleration possibilities considering project uncertainties and risks. It may be sufficient to support the acceleration decision.

Method limitations

The method currently has several known limitations.

Popularity and system limitations

The Drag family of methods is still not widely known in the project management community yet. At present, only one project delivery system, Spider Project, supports the Probabilistic Drag method.

Calculation Time

Calculating Drag is more complex than calculating other network analysis metrics, such as Total Float and Free Float. As a result, assessing Drag for all activities requires additional time. Under this method, Drag for the analysed activities must be recalculated and stored in each simulation iteration.

The computation time for Probabilistic Drag could be significant. It depends on:

- Size and complexity of the project delivery model
- Power of the computer system
- Other simulated metrics
- Number of iterations

Delivery Model

The reliability of the metric depends on the quality and maturity of the delivery model developed. A DCPM-based schedule is a common base for Monte Carlo Simulation analysis. However, it may easily lead to misleading results for the analysed parameters, including Activity Drag, by ignoring critical resource limitations.

Developing a dynamic, reliable model is a complex task that requires deep knowledge of scheduling and risk management, mature project management within the organisation, and access to advanced data modelling systems.

When a simplified model is used, the results may be less accurate and, in some cases, even misleading. While the level of accuracy may still be sufficient to support project decisions, misleading results can lead to poor decision-making.

Optimisation Cost

Activity Drag and Probabilistic Drag help identify acceleration opportunities by showing which activities have the greatest impact on overall project duration, but they do not consider the cost required to reduce durations for those activities.

In practice, acceleration cost is often a critical factor. The best project optimisation strategy may therefore be to focus on activities that do not necessarily have the highest Drag values. The preference should be towards activities that can be accelerated at a lower cost and deliver better overall value.

Summary

The Probabilistic Activity Drag metric evaluates acceleration opportunities for the analysed schedule activities and measures the probability of achieving the target optimisation, accounting for project uncertainty and risks.

The metrics utilise the mechanics of Monte Carlo Simulation analysis. Drag is calculated for each generated randomised scenario, and the overall result is aggregated into a distribution curve that shows the range of opportunities.

It provides better insights into potential acceleration opportunities.

References

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About the Author

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Alex Lyaschenko is a planning and delivery consultant with over 25 years of experience in project portfolio management across different industries and countries. He holds a Master's degree in Mathematics from Odesa Mechnikov National University and began his career in the technology sector, and was at the origins of project management in Ukraine. He worked at Ukraine's first project management consulting firm, where he helped establish project delivery offices across different industries and trained future project consultants.

After relocating to Australia, Alex contributed to multiple portfolio and program offices, supporting organisations in defining their vision, enhancing project delivery practices, developing standards, implementing PPM tools, and upskilling teams.

Passionate about merging data with actionable strategies, Alex continues to shape the project management field by delivering insightful presentations and practical solutions that empower organisations to make data-driven decisions. As a speaker, Alex has presented at numerous project management conferences, contributed to the 8th edition of the PMBOK Guide, and had his articles featured in leading industry publications.

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