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Introducing RIFT to Protect Your Uncertain Schedule

The Story of the Risk-Informed Finish Threshold (RIFT)

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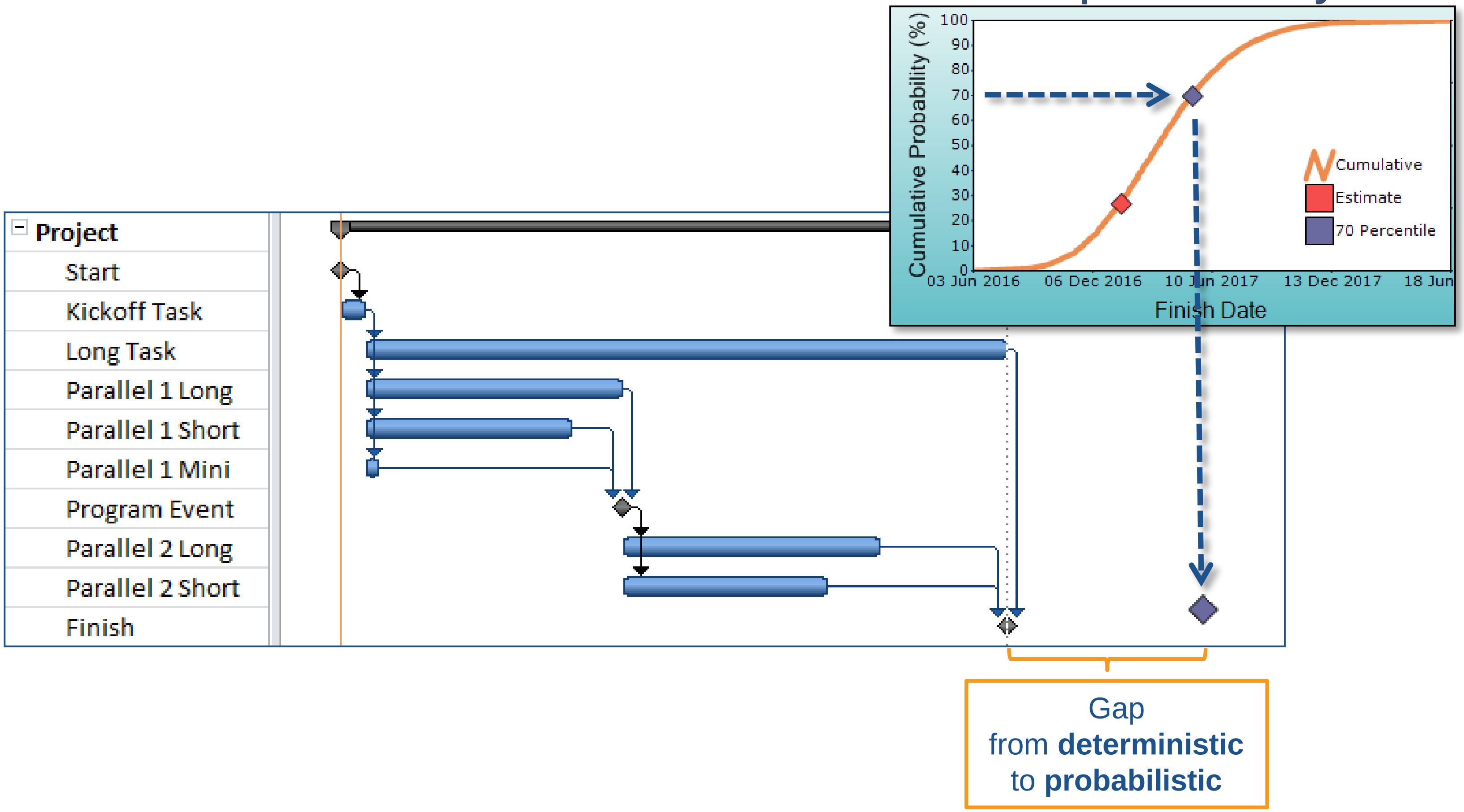
Introduction

- Setting: An uncertainty analysis conducted on a schedule
- Goal: Keep the project from slipping past a selected finish date
- Method: Innovative use of conditional probability

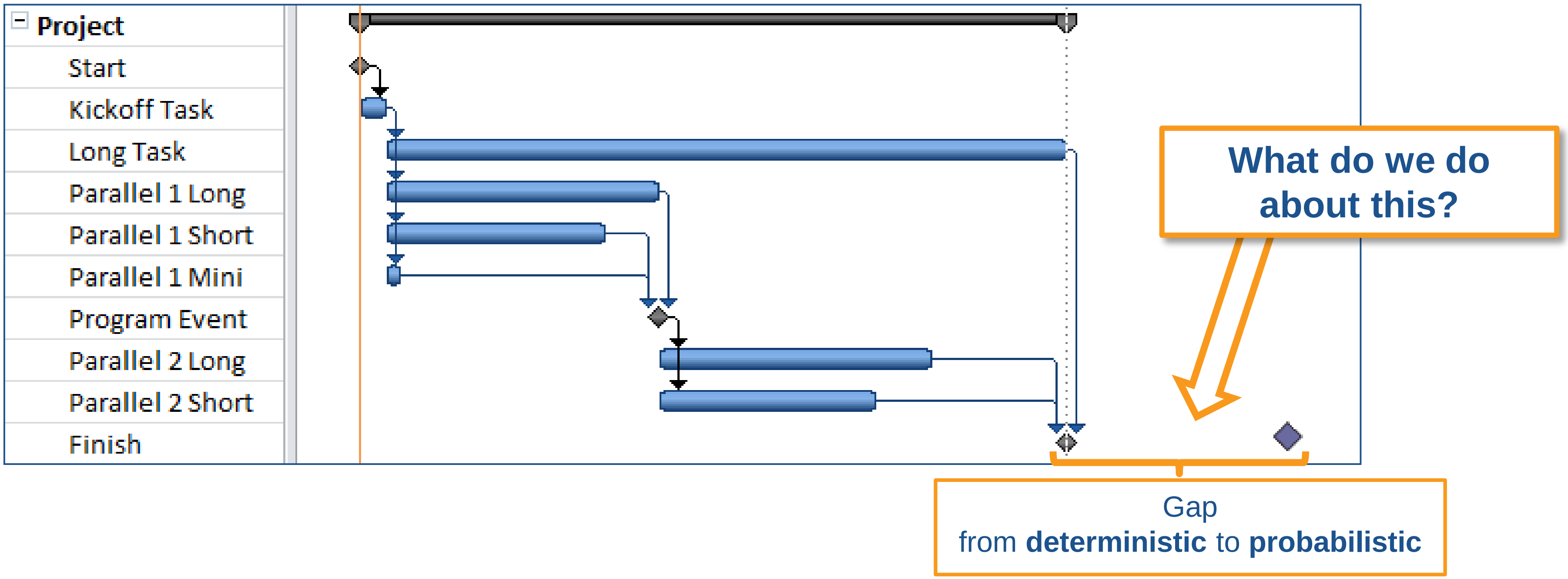


Prologue

- Before our story started:
  - "How do we manage a schedule once we select the probabilistic project finish date from the uncertainty results?"
- Where our story begins:
  - Realizing that the goal of keeping a project on track does not require allocating margins/reserves along the critical path
  - Defining two new distributions that arise out of uncertainty applied to task durations
  - Analyzing the relationship between a task finish date and the project finish using a different approach than commonly attempted

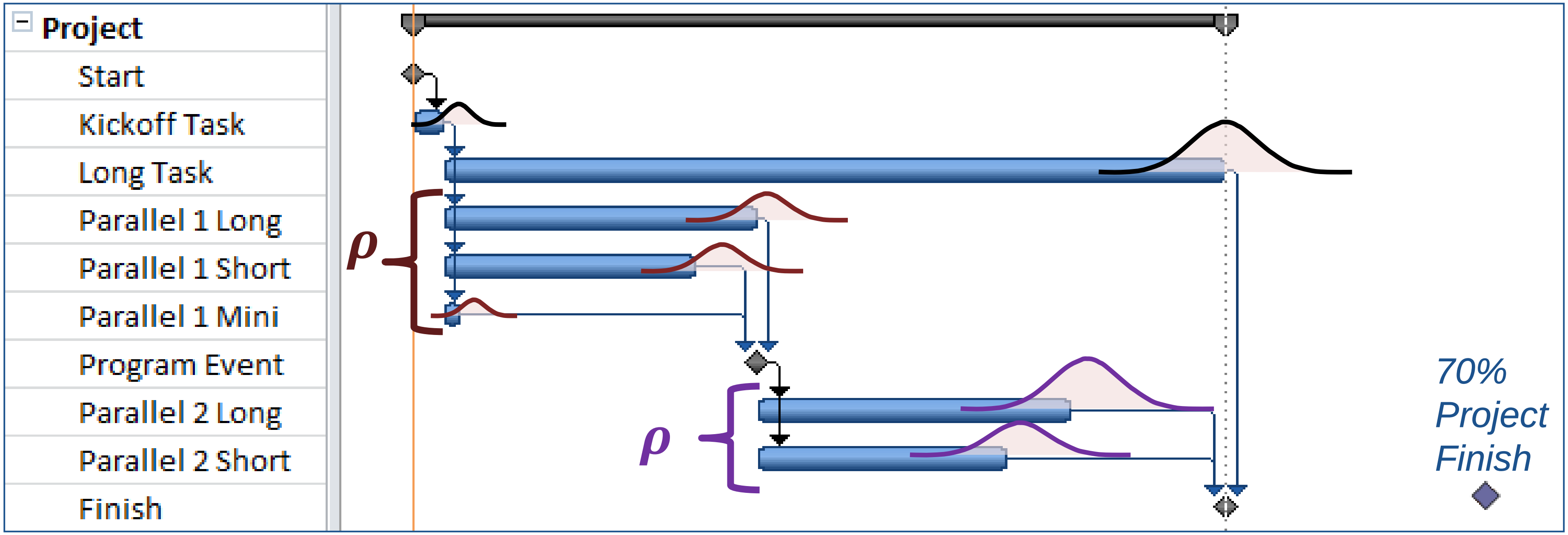
The Plot

- The gap between the deterministic finish date and a probabilistic finish date
  - Management uses this gap to allow some tasks to slip without jeopardizing the success of the overall project
- Cost risk and uncertainty allocation methods have no place in schedules
  - We are not attempting to spread this gap
- This story is about a new way to analyze and manage probabilistic schedules by understanding how far **any specific task (or milestone)** can slip



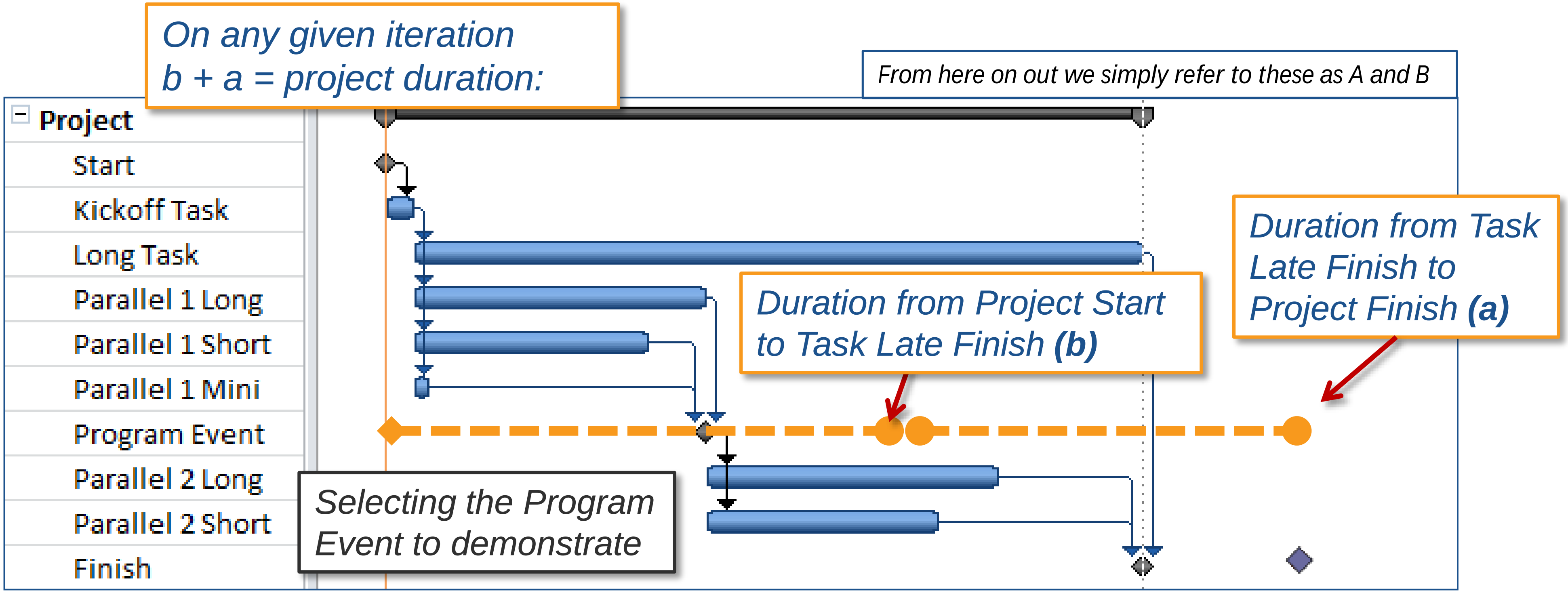
Introducing Key Players - The Schedule

- Uncertainty distributions on all task durations with two correlation groups
- Complex enough to demonstrate a non-trivial example; simple enough to understand at a glance
  - Standard Finish/Start logic linking tasks together
  - Varying slack and critical path during the simulation
  - Serial and parallel tasks (enabling merge bias)



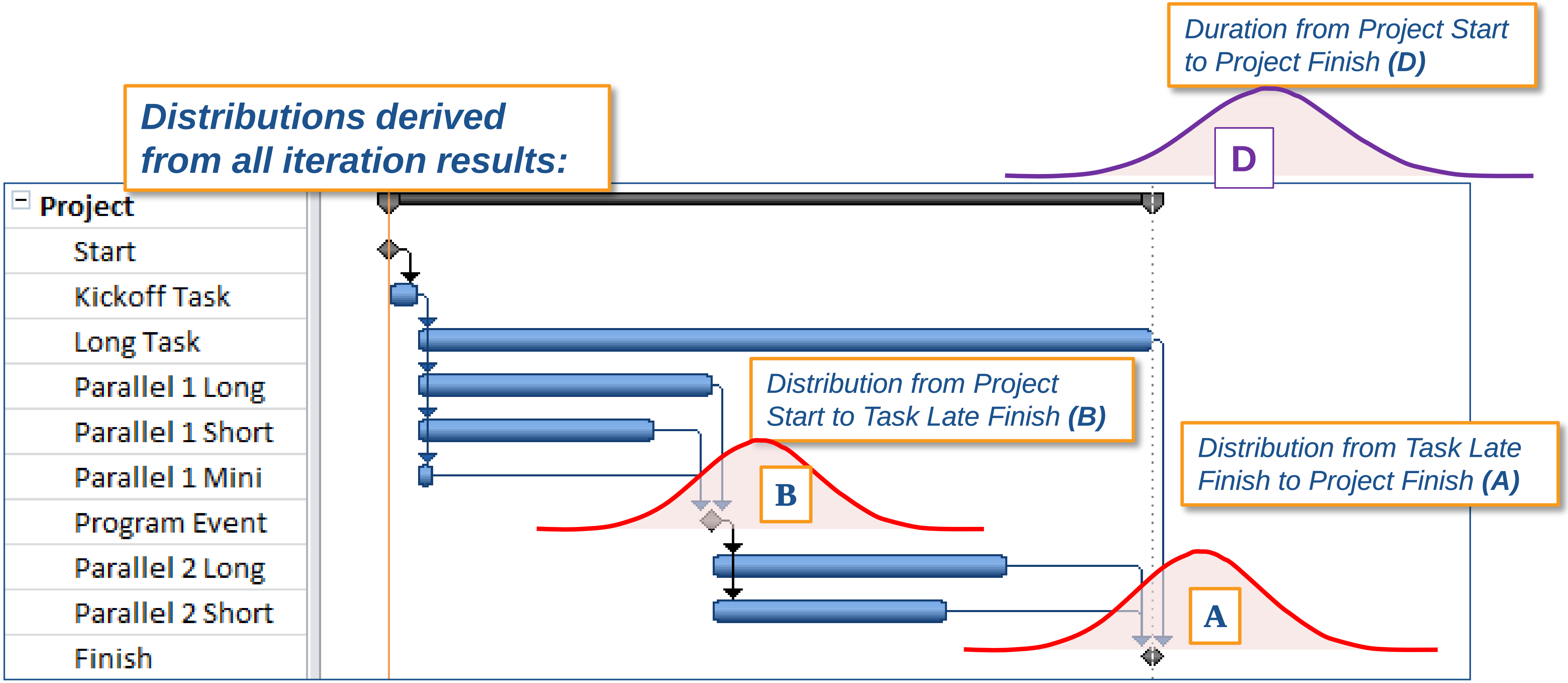
Introducing Key Players - New Distributions

- Distribution **B-LF**: The duration from project start to selected task late finish
  - Value **b** (lowercase) – A value from distribution **B**
- Distribution **A-LF:** The duration from selected task late finish to project finish
  - Value **a** (lowercase) – A value from distribution **A**
- Any task/milestone can be selected and used to define distribution **A** and **B**
  - **B** for "before late finish date" and **A** for "after late finish date"



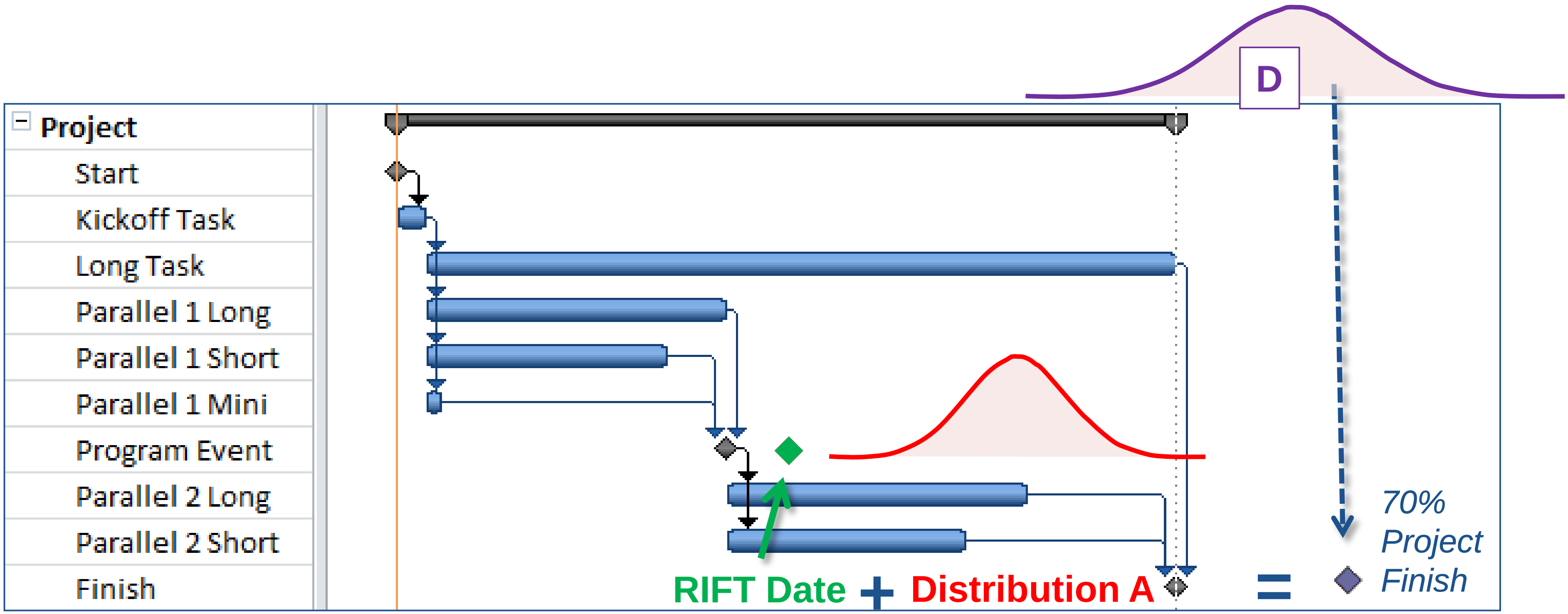
Introducing Key Players - New Distributions

- Distribution **B** defines the finish dates that span from the earliest possible finish date to the latest possible late finish date of the selected task
- The RIFT date is the value **b** (somewhere in its distribution **B**) that when added to Distribution **A**, results in the probabilistic date selected as the project finish
  - Probabilistic project finish lies in distribution **D**: all possible durations from project start to finish

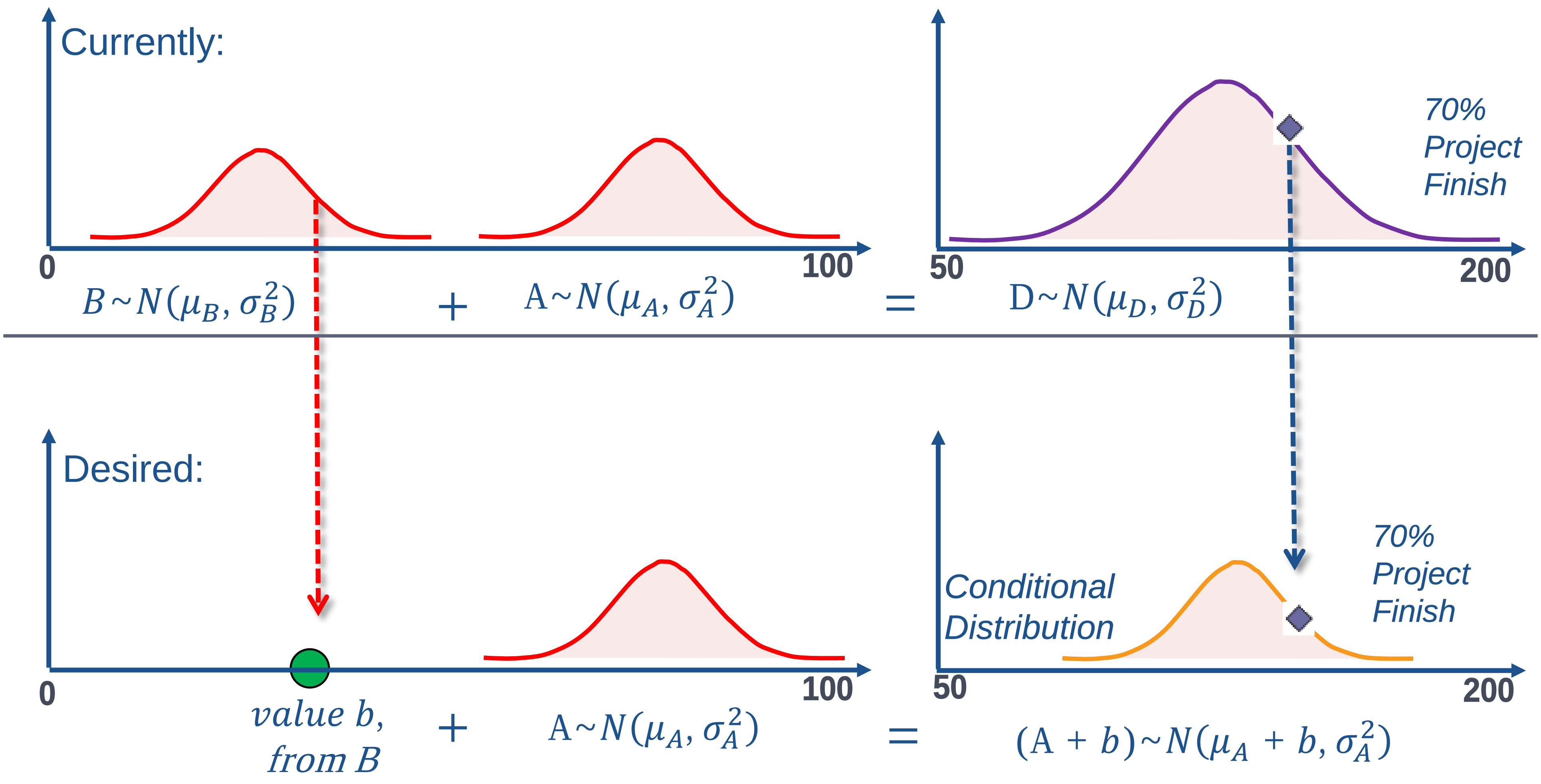


Main Character – Conditional Probability

- Conditional probability is a way to calculate the outcome of two related random variables once a value from one of them is given
  - Formulas exist to describe the distribution $(A + \boldsymbol{b}|B = b)$
  - Assumptions need to be made about the shape (normal/lognormal) of the distributions in order to derive the conditional formulas

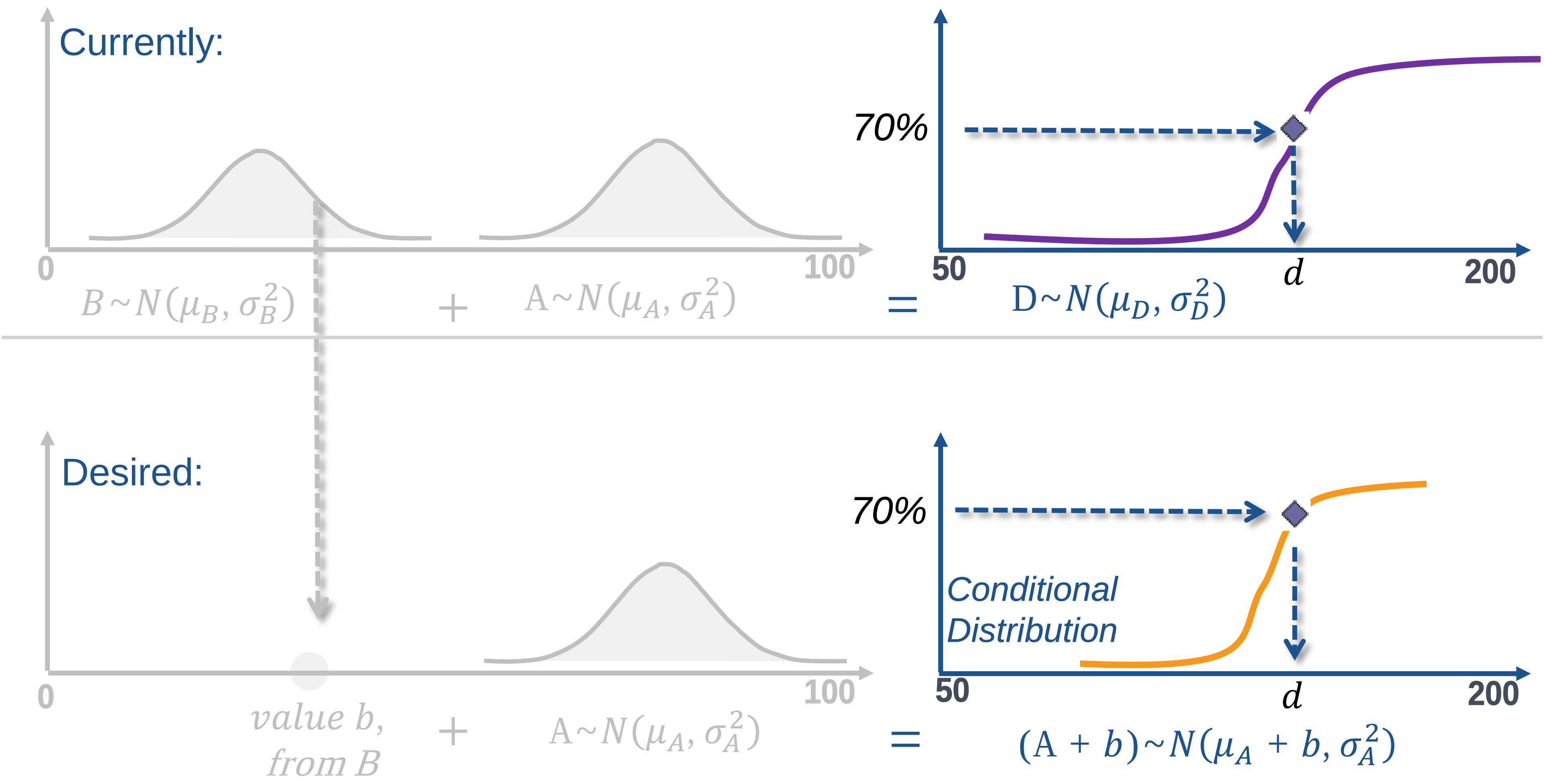


Interaction Between the Key Players



Goal is to find b such that the 70% value of distributions (A+b) and D are equal

Interaction Between the Key Players (another perspective)



Goal is to find b such that the 70% value of distributions (A+b) and D are equal

Resolution Between the Key Players

- Formulas exist to describe the conditional probability of **(A+b|b)**
  - Different combination of assumptions for the shapes of A, B and D give rise to different formula, but the concept remains the same
  - Efficiently straightforward formulation of the solution
- For example, assuming **A** and **B** are normal and correlated:

$$(A + b|B = b) \sim N\left(b + \mu_A + \rho\frac{\sigma_A}{\sigma_B}(b - \mu_B), \sigma_A^2(1 - \rho^2)\right)$$

$$d = N^{-1}\left(b + \mu_A + \rho\frac{\sigma_A}{\sigma_B}(b - \mu_B), \sigma_A^2(1 - \rho^2)\right)$$

$$\boxed{b = \frac{d - \mu_A + \rho\frac{\sigma_A}{\sigma_B}\mu_B - Z(c)\sigma_A\sqrt{1 - \rho^2}}{\left(1 + \rho\frac{\sigma_A}{\sigma_B}\right)}}$$

Risk Informed Finish Threshold

μ_A : *mean of A*

μ_B : *mean of B*

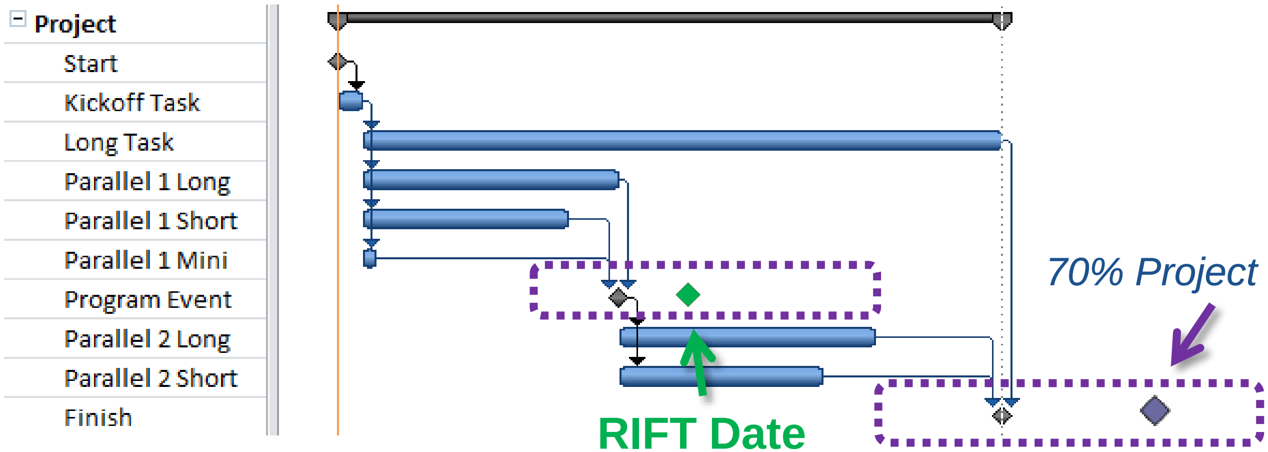
σ_A^2: *variance of A*

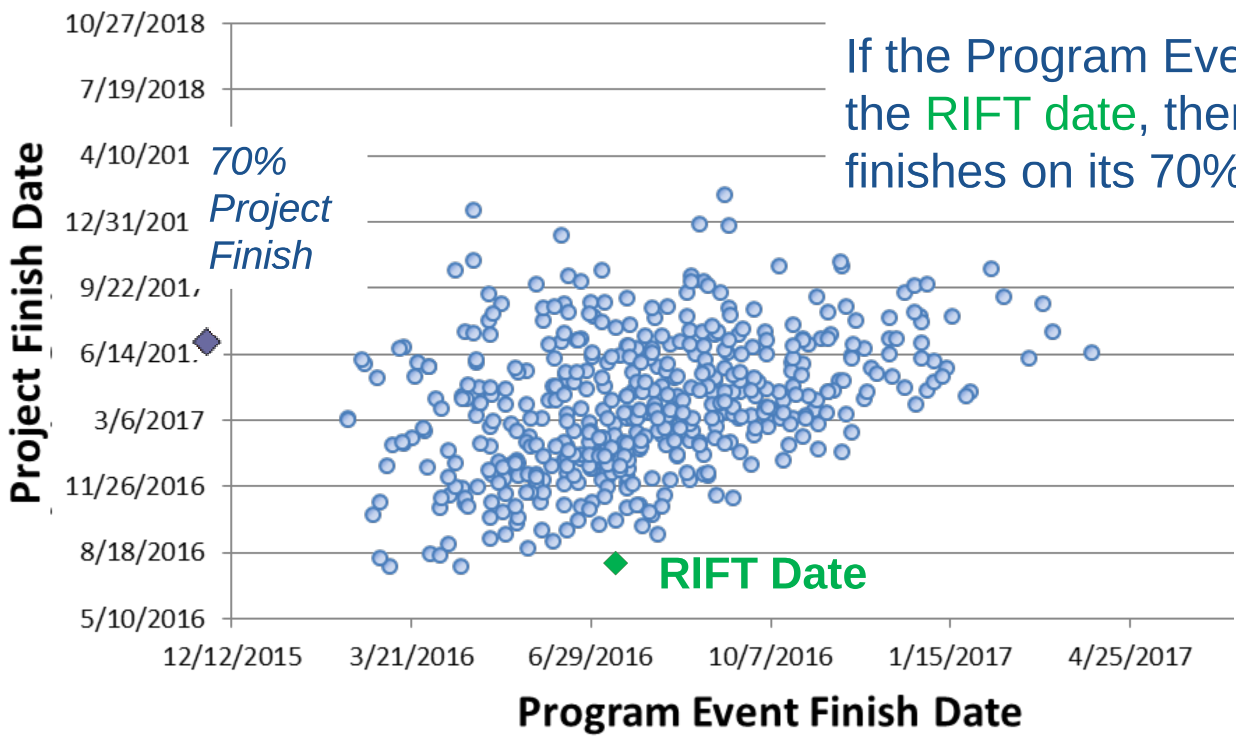
σ_B^2: *varianceof B*

ρ: *correlation between A and B*

$Z(c)$: *quantile of standard normal at c%*

Transition from Schedule to Scatter

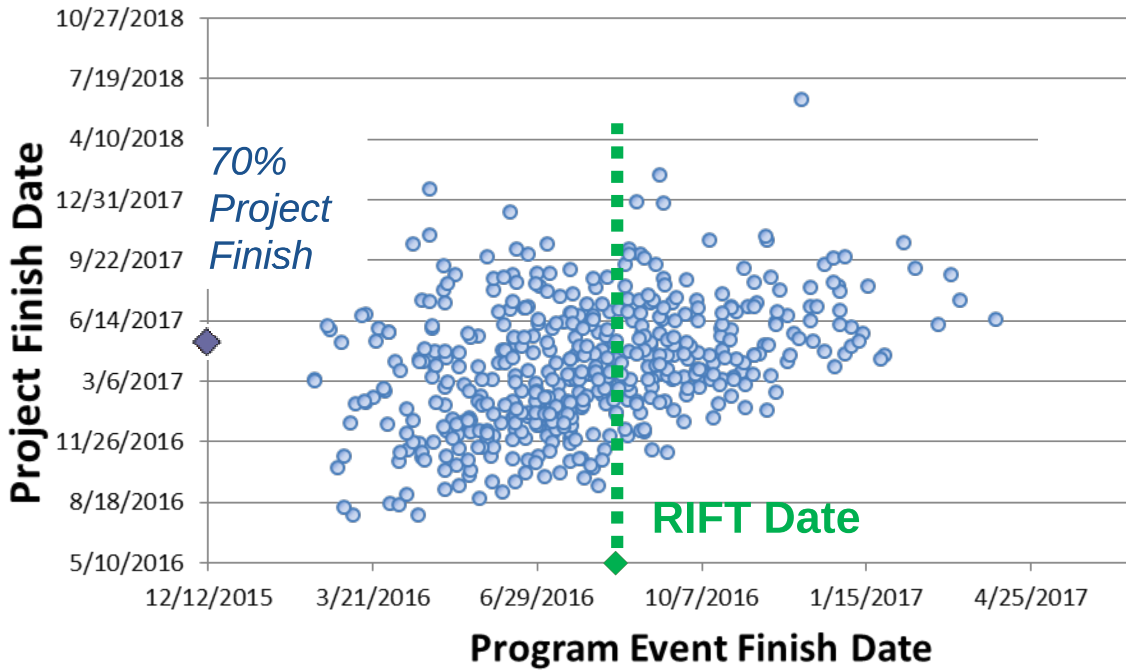




If the Program Event finishes on the RIFT date, then the project finishes on its 70% finish

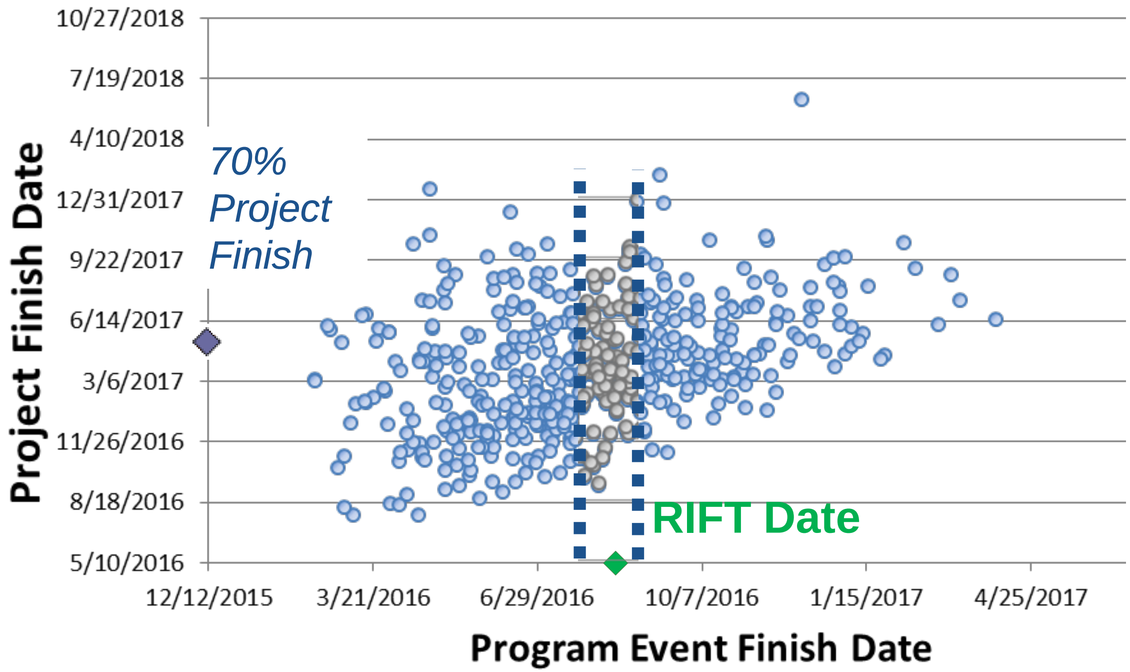
Validating the RIFT – An Issue

- Prove that if the Program Event finishes *on* the RIFT date then the project finishes at the chosen probabilistic date
- Singling out the Program Event's RIFT date to analyze corresponding project finish dates give few to no data points
  - The scatter plot may be misleading, there are not as many points exactly on the RIFT date as it may look



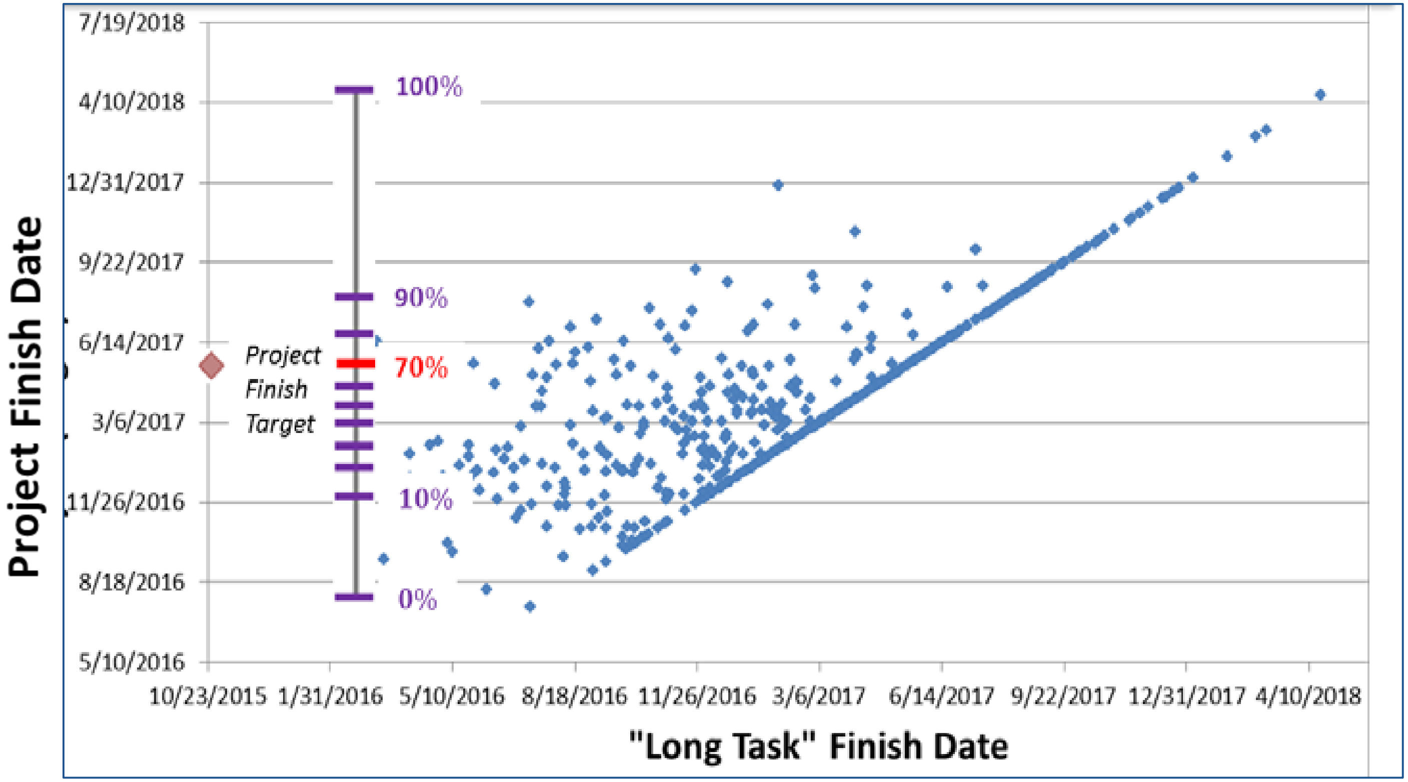
Validating the RIFT – A solution

- Using the results that fall within a small range around the RIFT date, the probability of the chosen project finish date can be calculated
  - If it is 70% (the original example value), then the RIFT date is accurate
  - As with most data binning, objectivity is desired but subjectivity is hard to completely remove from the determination of the width



The Conditional Probability

- If the probabilistic finish date lands at the 70% probability level out of all the iterations…

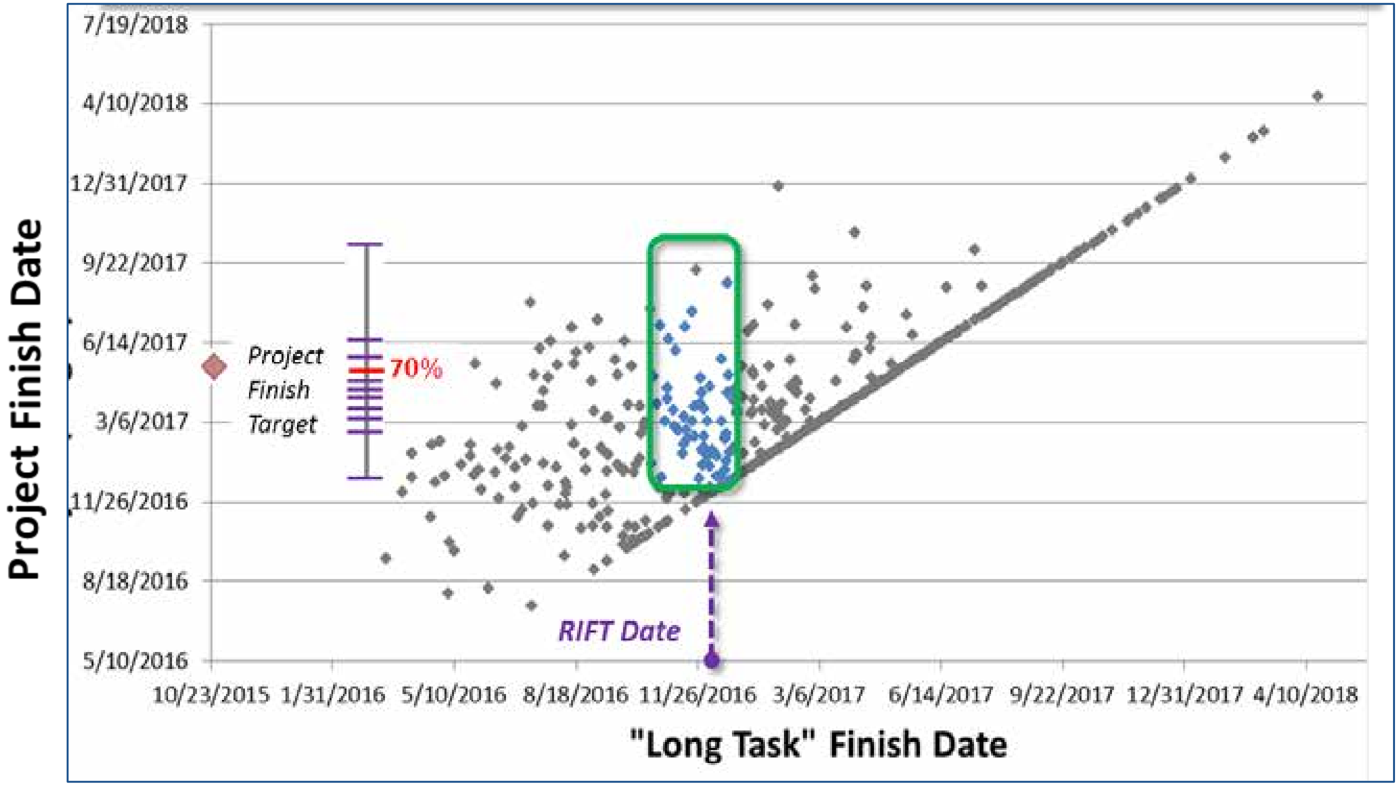


The s-curve of the entire results was used to ensure the purple probability labels were drawn to scale

The way the scatter tightens into a straight line as "Long Task" pushes out further implies it lands on the critical path every iteration

The Conditional Probability

- … then the project finish date should land at the 70% probability level out of the iterations around the RIFT date

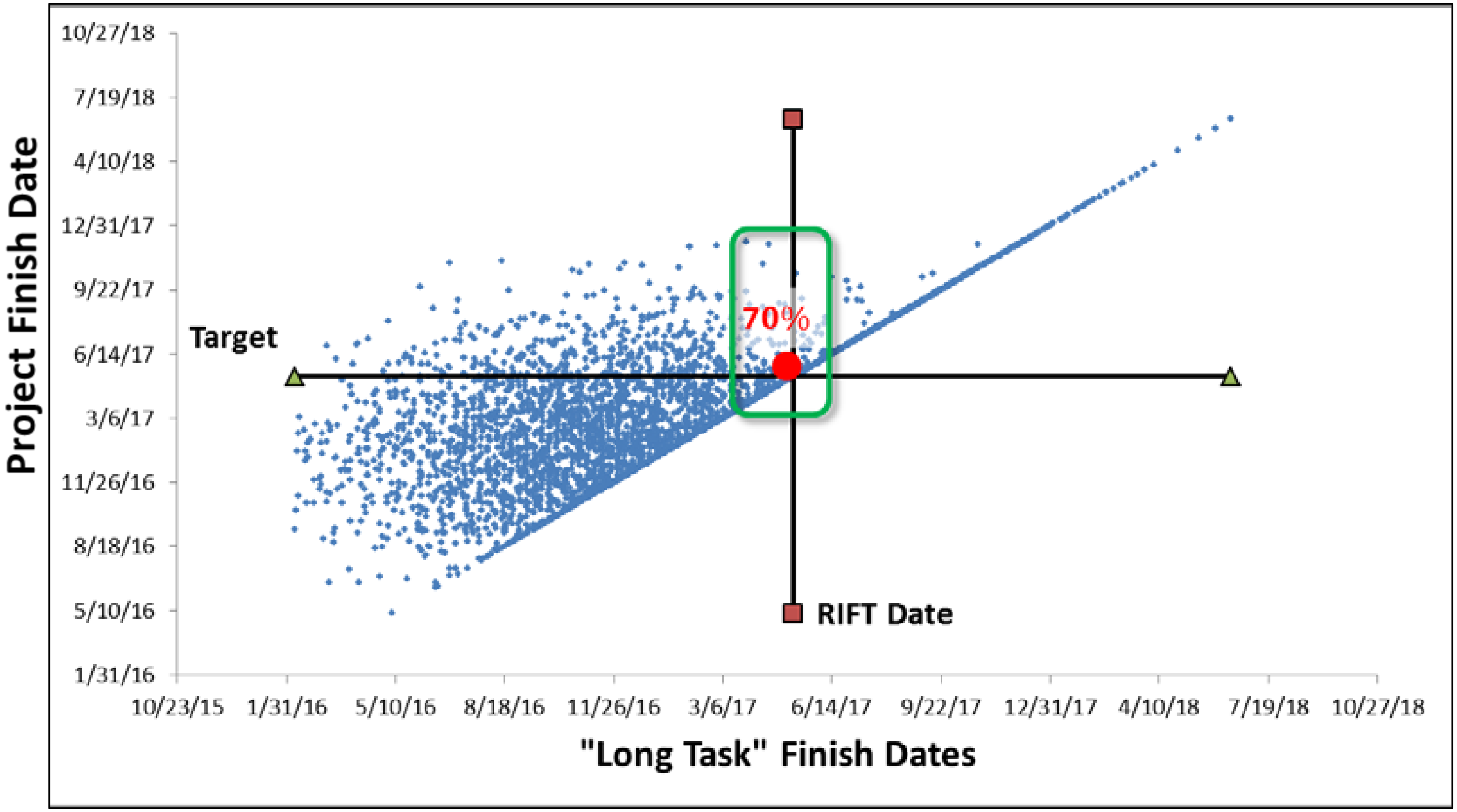


The s-curve of the highlighted results was used to ensure the purple probability labels were drawn to scale

The way the scatter tightens into a straight line as “Long Task” pushes out further implies it lands on the critical path every iteration

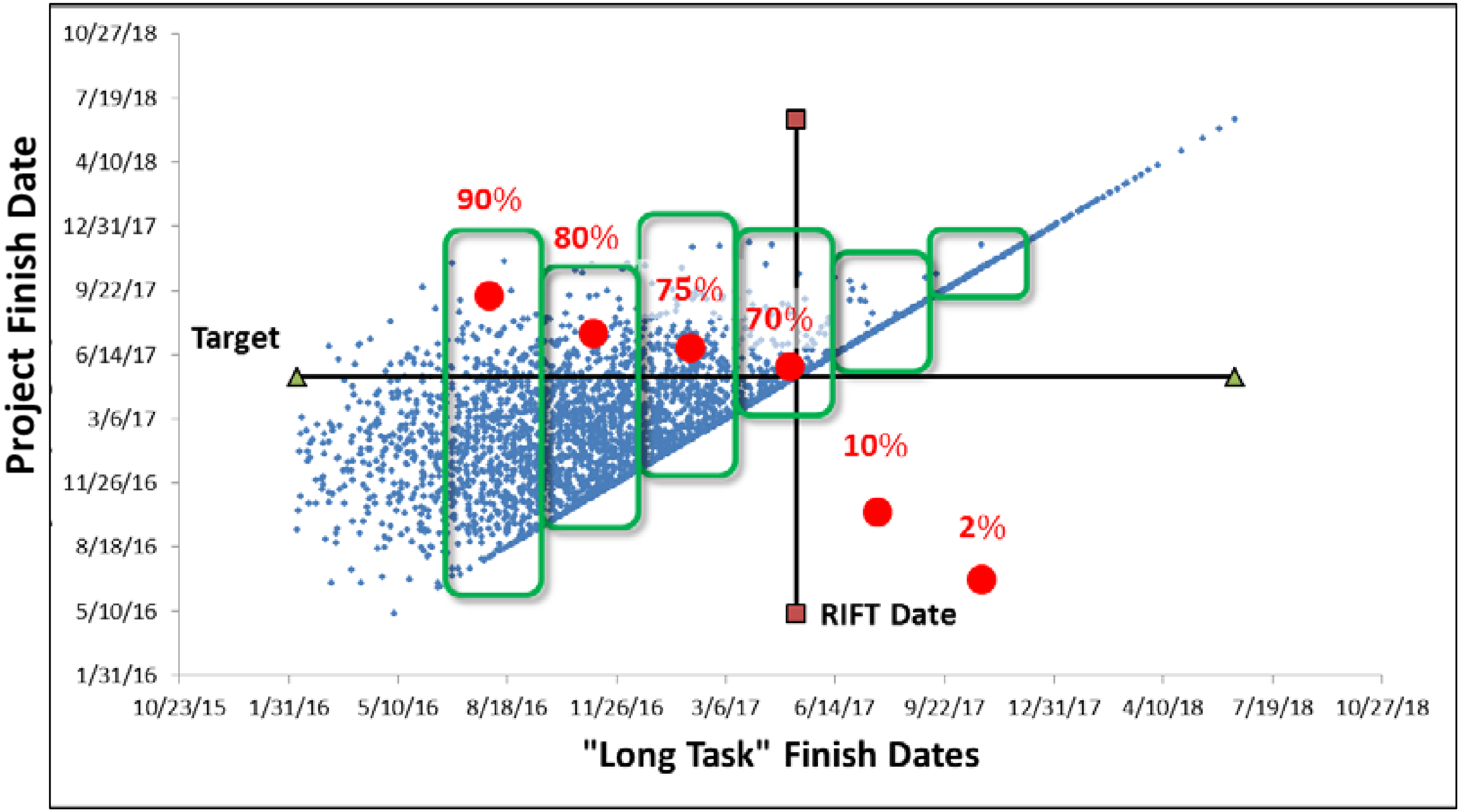
The Conditional Probability - Plotted

- Once calculated, the conditional probability of the selected project finish can be plotted on the scatter as a labeled red dot
  - Project Finish date of the red dot is the date corresponding to the labeled probability
  - The closer the red dot is to the crosshairs the more accurate the RIFT



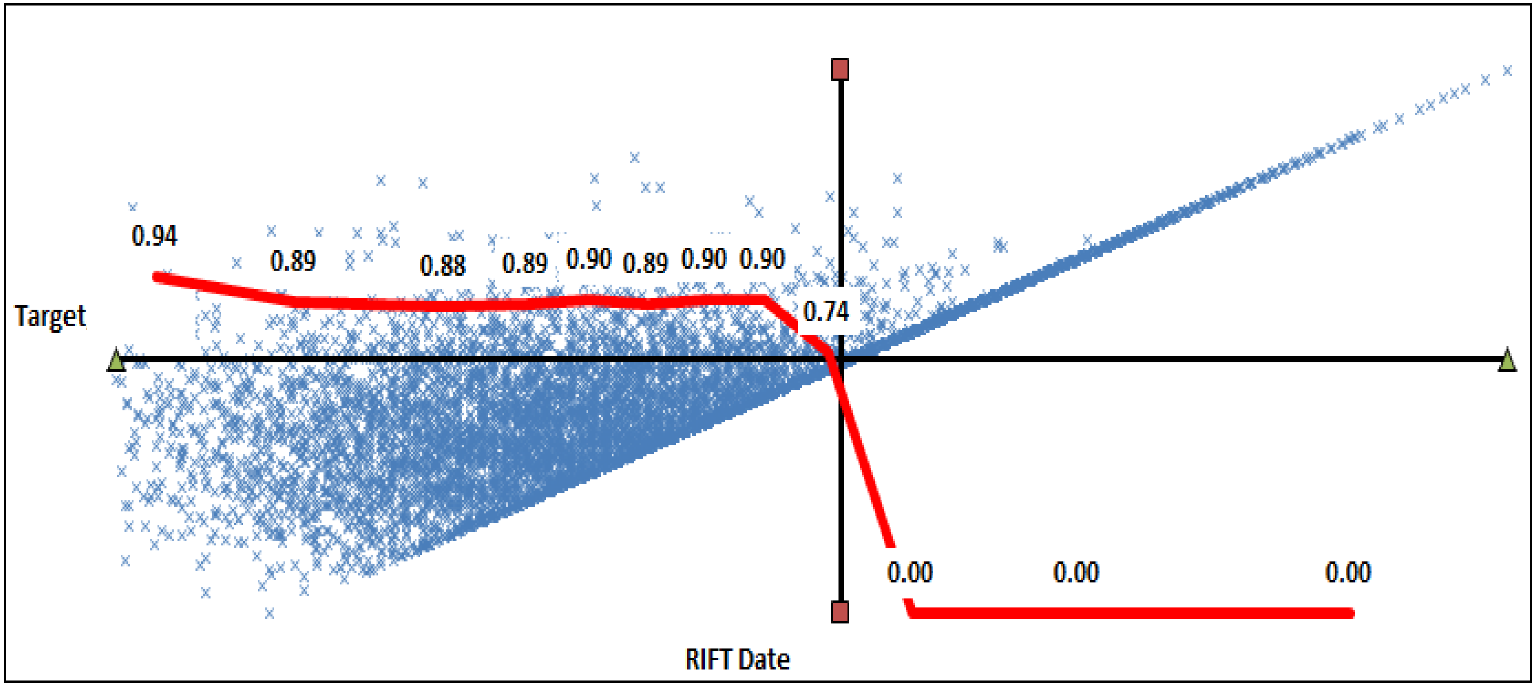
The Conditional Trend

- Not limited to calculating the conditional probability of the selected project finish around *just* the RIFT date
  - The trend of the red dots tells the story of how the probability of achieving the selected project finish date changes over time



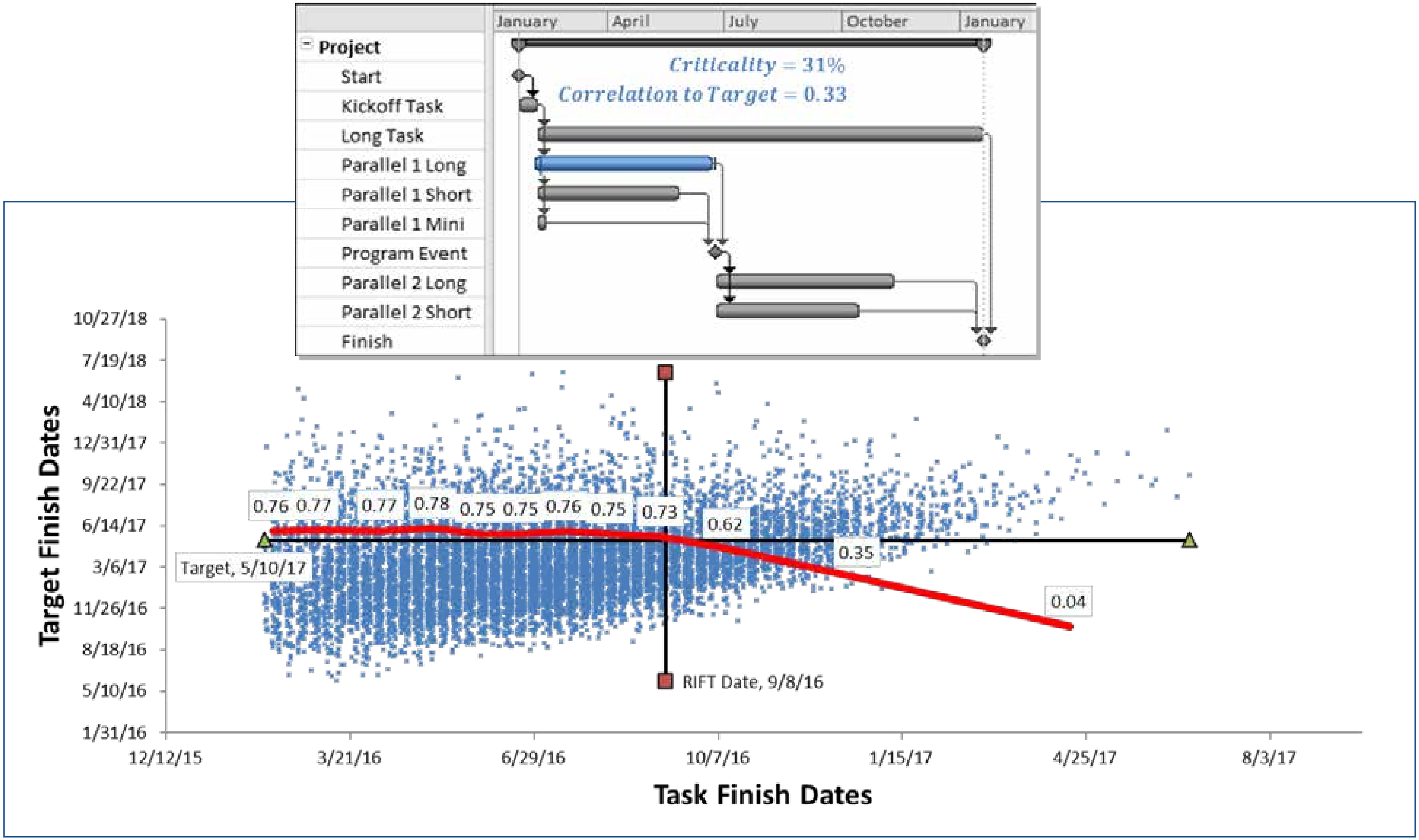
An Actual RIFT Chart

- Since the conditional probability is a *trend* defined by binning the iteration results, a line is more appropriate
  - This image comes directly from the RIFT report



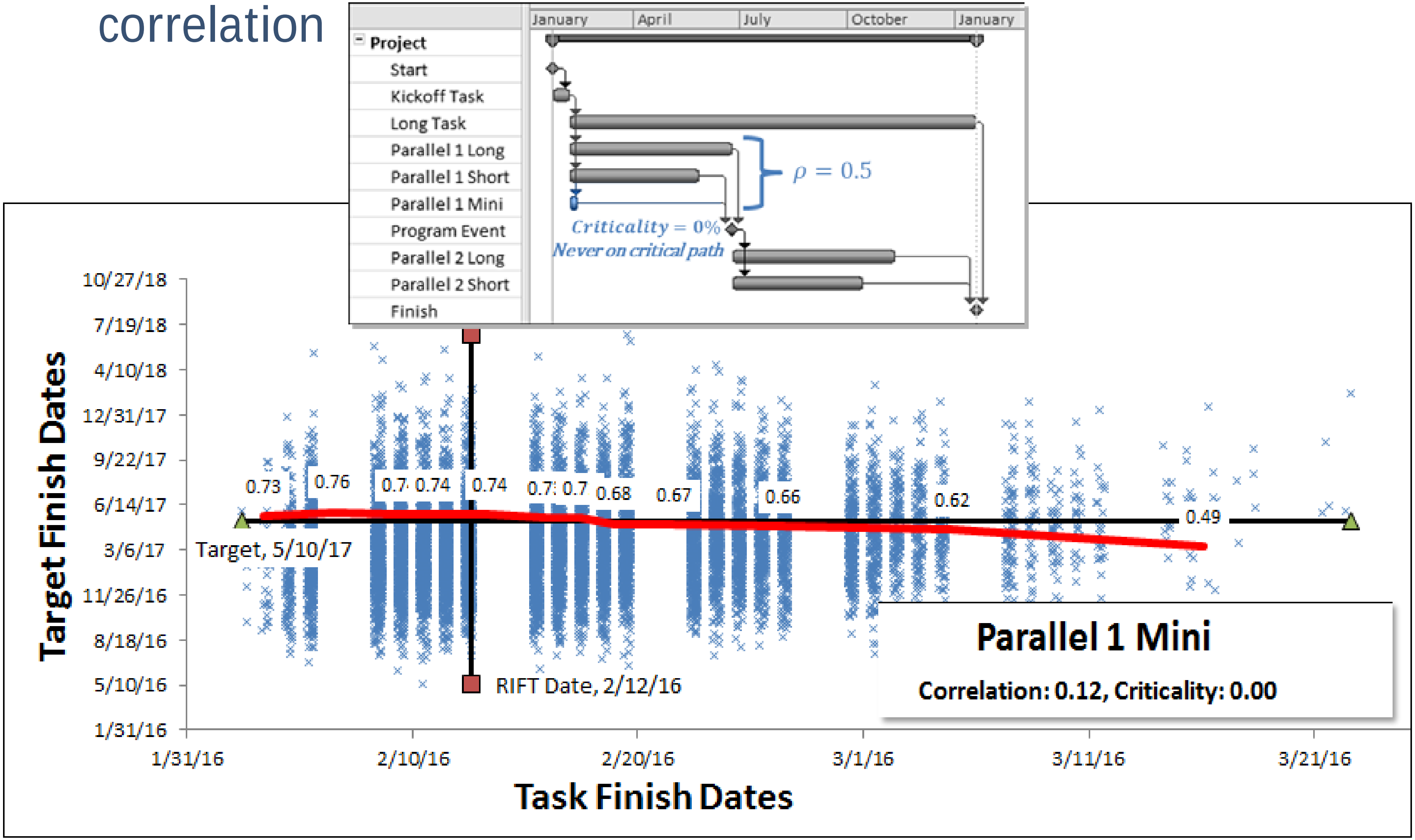
Example of the Story the RIFT Chart Tells

- The “ideal” RIFT candidate: some correlation, some criticality



Example of the Story the RIFT Chart Tells

- The "less-than-ideal" RIFT candidate: never critical, very weak correlation



RIFT In Context

- Like most metrics, RIFT must be taken in context
  - Very low influence on project duration *and* very low criticality ===> RIFT date is trivial
  - Perfect influence on project duration or 100% criticality ===> RIFT date is redundant
  - **Ideal candidate is a task or milestone with *some* correlation and *some criticality***
    - Current research suggests at least 10% critical *and* .10 correlation

How to use RIFT

- Two methods based on the perspective of the analyst
  1. **Technical**: focused on finding high risk tasks
  2. **Management**: focused on keeping specific milestones on track
- Technical analysis:
  - Rank all tasks based on delta (buffer) from planned finish to RIFT to find which tasks are positioned to push out the project sooner than others
  - Sort based on the probability of achieving the RIFT date
    - Calculated by looking at where the RIFT date lies relative to the entire set of finish date results from which it was derived from
    - Low probability of achieving RIFT date indicates high risk of project slippage
  - Keep the RIFT date, the buffer, and the probability in context with the correlation and criticality of the task/milestone to ensure valid results
- Management analysis:
  - Run RIFT on the important milestones to learn how much it can slip
  - Scrutinize the trend of the conditional probability (red line) on the RIFT chart to understand how dramatically the project slips if RIFT date is surpassed
  - Rerun RIFT analysis whenever schedule is updated to keep track of when the schedule begins to slip

Conclusion

- RIFT analysis solves a long standing problem in managing with schedules with uncertainty
- The RIFT date is a singular metric, but the analysis used to derive and verify is so much more
- Conditional metrics can be an entirely new dimension of analysis
- The simplicity and consistency in which this approach can be implemented begs further research
- *The theory is sound and the equations have already been derived for a Cost RIFT analysis…*
- *…this is just the beginning of the RIFT story*

The End

Please contact Nick DeTore
with any questions or comments
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