Joint Confidence Level Analysis and the Dynamic Integrated Cost Estimator (DICE) Model

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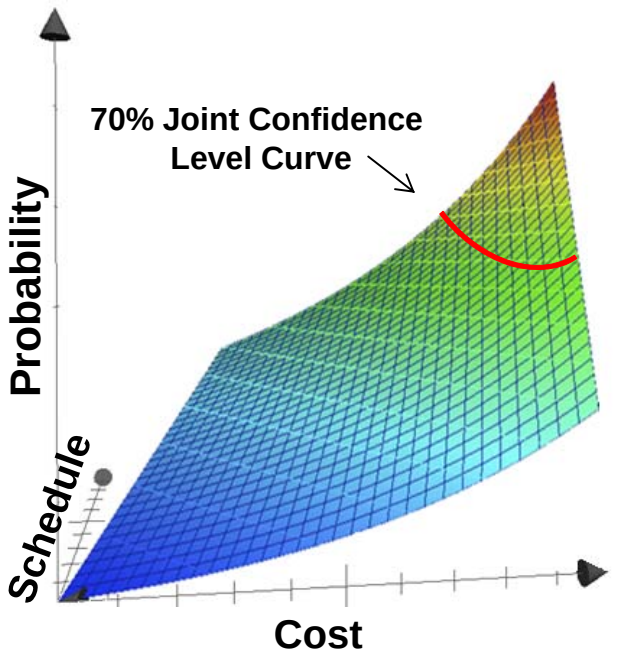
Presentation Outline

- Introduction
- Overview of Joint Confidence Level Analysis
- NASA's JCL Effort
- The Dynamic Integrated Cost Estimator (DICE) Model
- DICE Demo
- Conclusion

What is Joint Confidence Level Analysis?

- Historically, cost and schedule risk analyses are performed individually and yield disparate projected distributions for final cost and end date
  - The project calculates and reports separate confidence levels from these distributions
  - It is very difficult to link these analyses in order to provide a true understanding of their relationship
- A Joint Confidence Level (JCL) analysis is a combined cost and schedule risk analysis which creates a bivariate distribution of final projected cost and schedule pairs[1]
  - The resulting JCL curve on the bivariate distribution represents the probability of the program finishing ***both under cost and ahead of schedule***
- Basic ingredients for a JCL analysis are an Integrated Master Schedule, a Cost Estimate, and a Program Risk Register



[1] – for more information see "JCL in a Nutshell", Druker, SCEA 2010

Why the need for a Joint Confidence Level Analysis?

- Government agencies and commercial entities are all facing the same challenge: **Programs are increasingly experiencing growth above and beyond their initial cost and schedule estimates**
- Delays and budget overruns in one project are not isolated events and can cascade in a waterfall effect, causing other projects to become delayed or not receive enough funding
- As discussed, if a program performs a cost risk analysis and a schedule risk analysis, they are typically done independently and at the very least are reported as independent distributions
- A **Joint Confidence Level** analysis is crucial for:
  - Defending budgetary and scheduling decisions with evidence
  - Prioritizing risks and other threats based on their **overall impact** to the program and not simply their anticipated local impact
  - Developing more precise risk mitigation plans

Joint Confidence Level Analysis Process

- JCL analysis can be performed using existing resources; likely risk management, cost estimating, and scheduling personnel
  - Typically, one person is designated as the lead for the JCL Analysis, and this person is responsible for collecting all relevant artifacts, combining them into the IMS, and running the simulations

- The artifacts needed to perform a JCL analysis are:
  - The **integrated master schedule** with uncertainty bounds at the pre-determined summary level (typically subsystem or above)
  - A **quantified risk register** (probabilities, cost and schedule impacts) where each risk is mapped to a task in the IMS
  - A **cost estimate** with uncertainty bounds that maps to the IMS at a the pre-determined summary level
  - Costs are broken into **time-dependent** (which increase as schedule grows) and **time-independent** (which are unaffected by schedule growth) costs

Joint Confidence Level Analysis Policy

- Joint Confidence Level Analysis has gained significant momentum recently
  - NASA is leading the way in the development of this methodology
  - NASA Policy Directive 1000.5 mandates that programs will be baselined at the "70 percent confidence level" using a "joint cost and schedule probability distribution"[2]
  - NPD 1000.5 also stipulates that projects are funded at no less than 50% of the JCL or as approved by the decision authority, maintaining JCLs through the program lifecycle
  - The goal is to provide stronger assurance that NASA can meet cost and schedule targets[3]
  - A recent GAO report cites NASA's JCL policy as an effort "to provide transparency on the effects of funding changes on the probability of meeting cost and schedule commitments" [4]
  - NASA Cost Analysis Division (CAD) has developed a handbook to provide more information and guidance on this topic
  - Programs conducting JCL Analysis include James Webb Space Telescope and SOFIA
- While the methodology has made substantial strides, the cost and schedule communities must overcome political and technical obstacles before full adoption

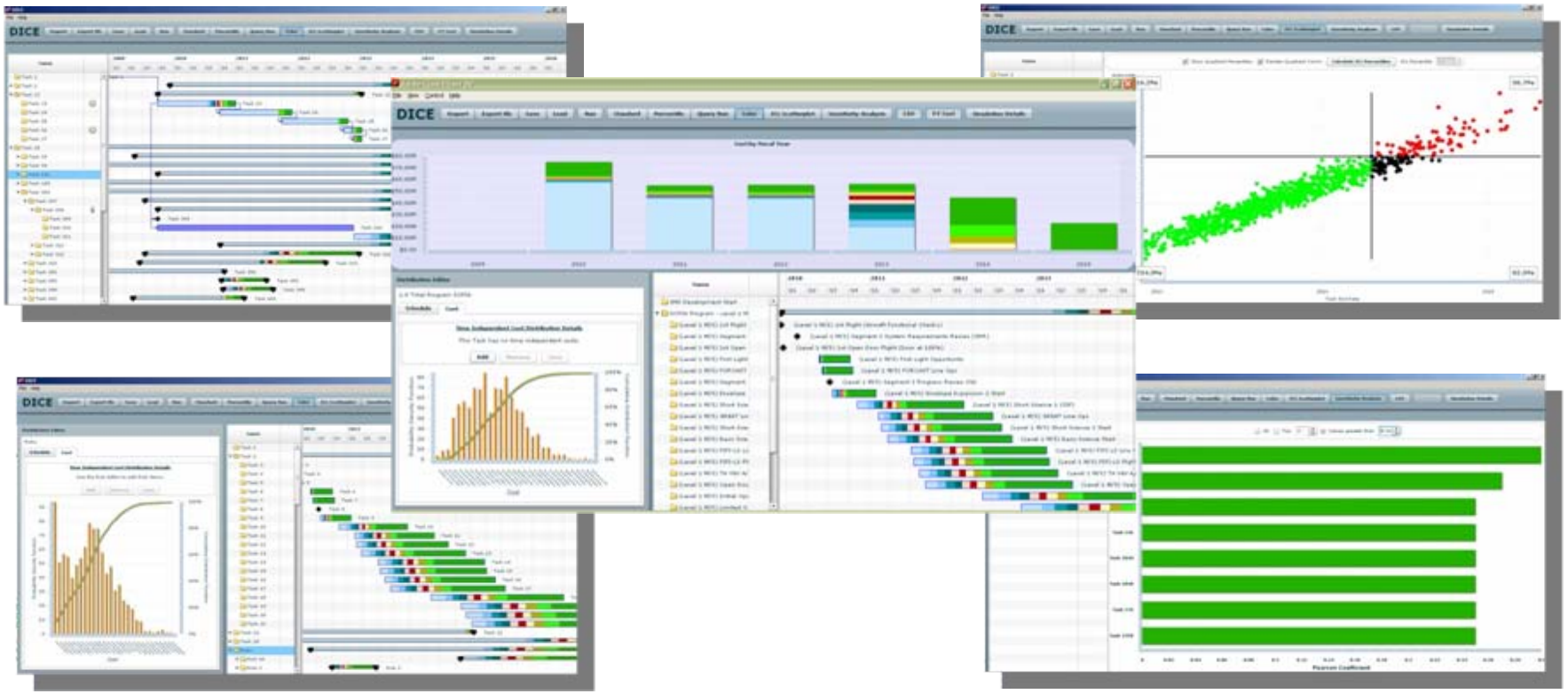
[2] – NPD 1000.5 - http://www.hq.nasa.gov/office/codeq/doctree/10005.htm - January 15, 2009
[3] – JCL Status Report - http://www.nasa.gov/pdf/421542main_JCL%20Status%20Report-2010%20Feb.pdf – February 2010
[4] – GAO Report – "NASA – Assessments of Selected Large-Scale Projects" - http://www.gao.gov/new.items/d11239sp.pdf - March 2011

NASA JCL Model Prototype

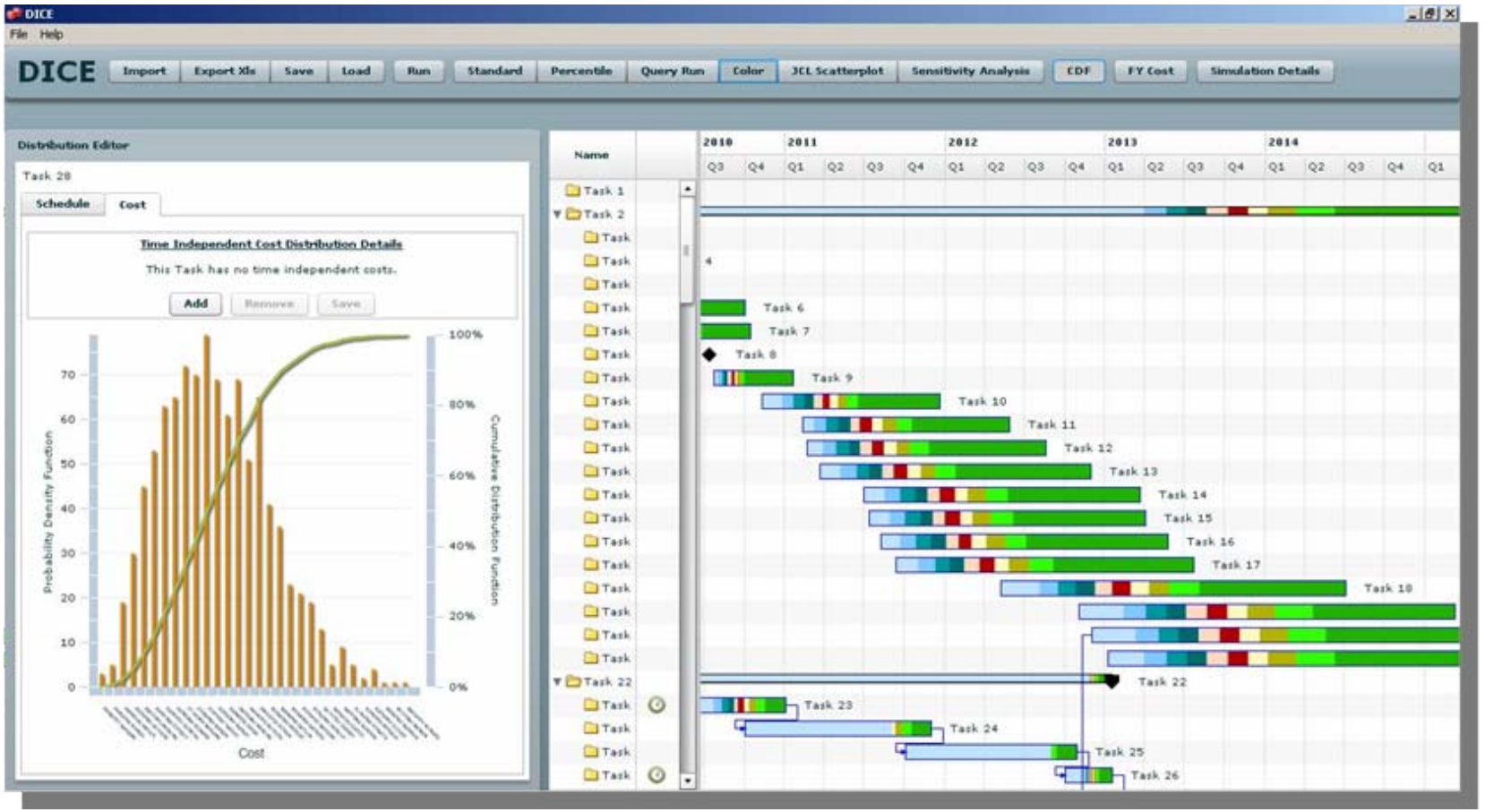
- In Fall 2010, NASA CAD commissioned the development of a JCL model prototype
- The intention of this effort was to explore the value of producing a standard toolset for NASA programs conducting JCL analysis
- Booz Allen created the Dynamic Integrated Cost Estimator (DICE) with a focus on **streamlining the JCL process** and **decreasing simulation runtimes**
- Other key features of the DICE prototype development included:
  - Rapid schedule import from MS Project
  - Cost-Loading
  - Discrete Risk Analysis
  - JCL Scatter Plots and Iso-Curves
  - Benchmarking effort with other JCL tools
- It is important to note that there are many tools that projects can use to develop JCLs, but DICE is optimized for this analysis

DICE facilitates Joint Confidence Level Analysis

- DICE is an Adobe Flex-based tool for cutting-edge cost and schedule risk analysis
  - Includes modeling capability for producing build-up Joint Confidence Levels (JCLs)
  - Achieves industry-leading runtimes using Booz Allen's RealTime Analytics

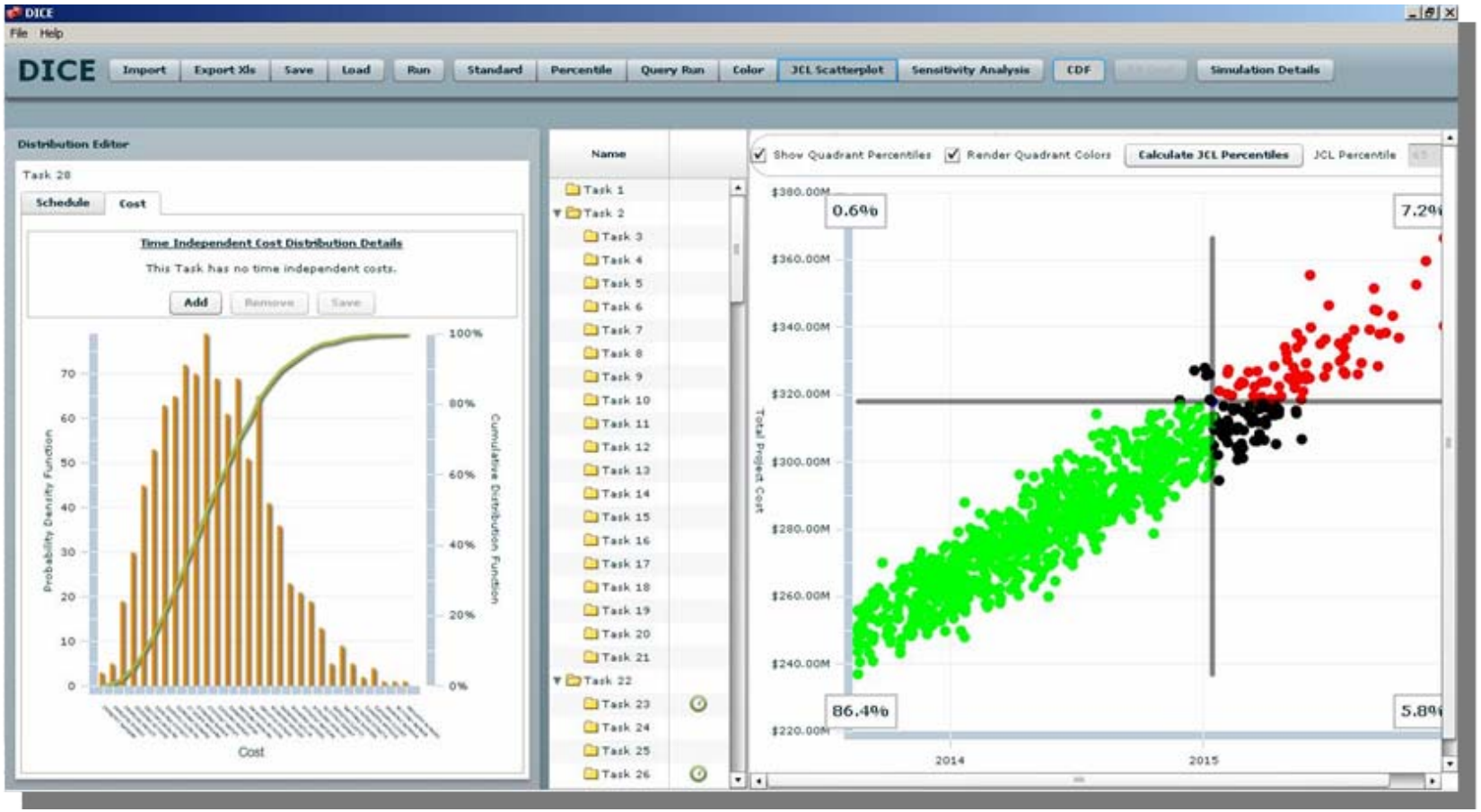


DICE Functionality – Gantt Chart and Cost/Schedule Uncertainty



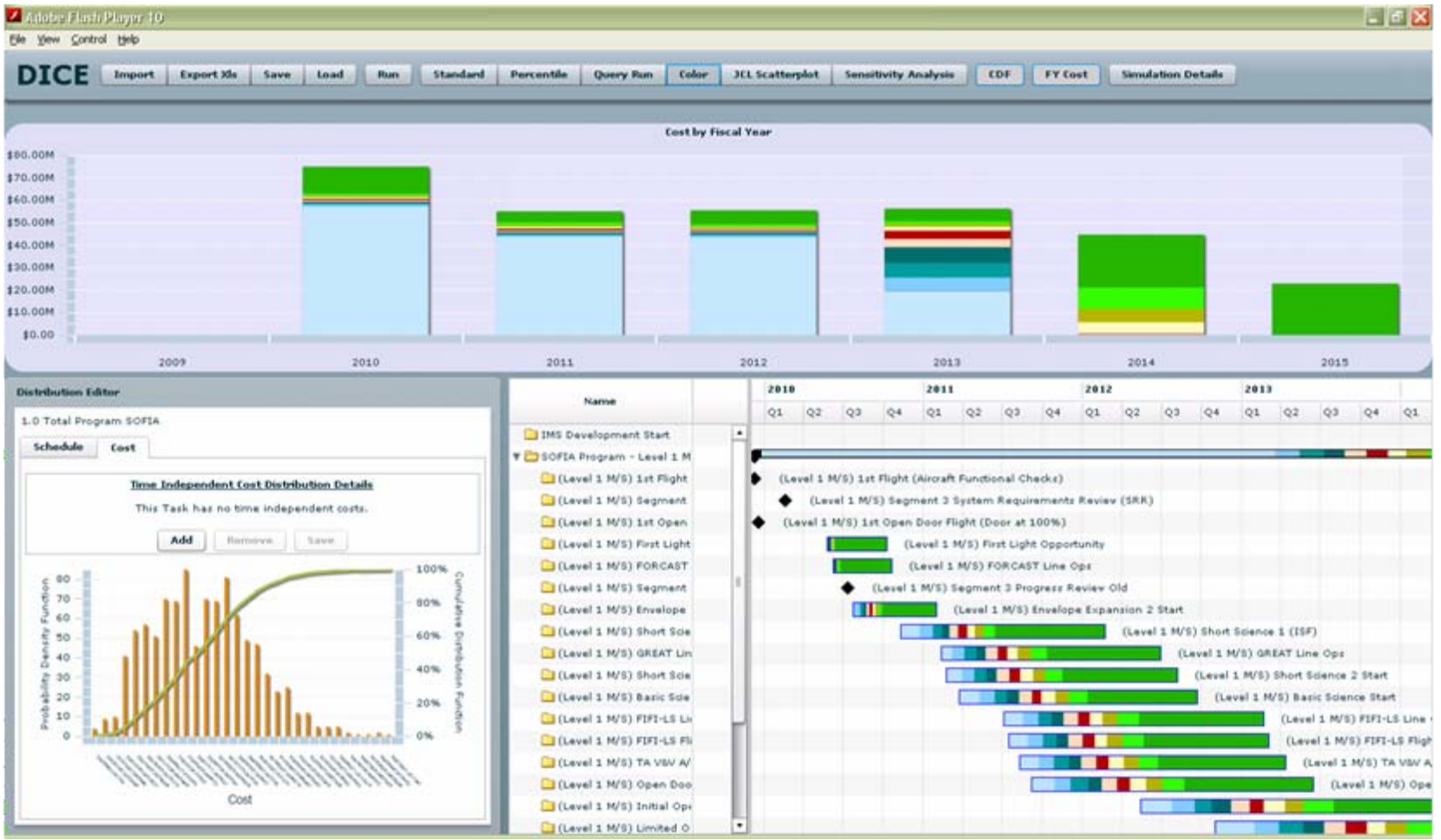
- Organizes project tasks, costs, constraints, schedule interrelationships, and adds uncertainty to individual cost and schedule items

DICE Functionality – Cost-Loading



- DICE can load schedules with time-dependent and time-independent costs, generating standard outputs such as JCL scatter plots and iso-curves

DICE Functionality – Fiscal Year Segmenting



- DICE accounts for costs (and uncertainty) by fiscal year – aids budget planning

DICE Functionality – Run-time Features

- DICE incorporates blanket correlation across the model, or specifies individual correlation between schedule tasks, time-independent costs, or risks
- The model is optimized for Joint Confidence Level Analysis
  - Greatly increases understanding of how schedule growth impacts cost
  - Contains robust schedule logic functionality and discrete risk integration
- DICE includes RealTime Analytics to enable industry-leading simulation runtimes
  - Reduces the time required to evaluate decisions and provides decision makers with on-the-spot analysis
  - Booz Allen's RTA allows for quick initial runtimes and near-immediate re-runs
- Interactive features provide intuitive user experience and rapid evaluation of alternatives
  - Enables comparison of multiple different scenarios or confidence levels of the same project
  - Builds off of existing tools (like MS Project, Excel) for seamless data integration, cost visualization, and navigation of risk analysis

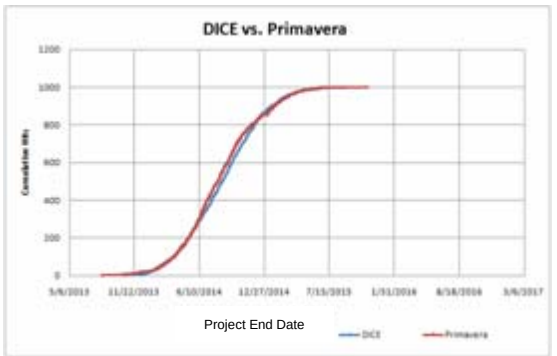
DICE DEMO

DICE – Benchmarking against Primavera Risk Analysis

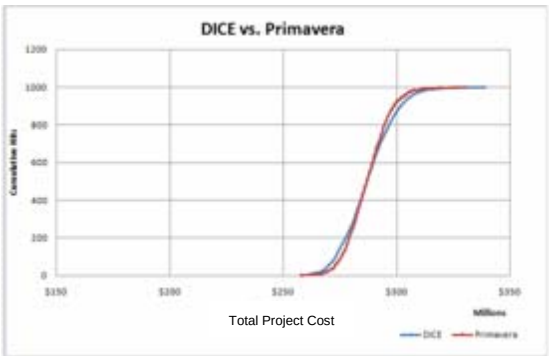
Runtimes (3200-line schedule)

Task	Run Time	
	DICE	Primavera
Opening Tool	0:02	0:05
Import Schedule	0:03	2:05:27
Load Risk File	0:03	0:01
Initialize Correlation	0:02	0:05
Run Simulation	0:09	2:27
Export Data	0:08	0:00

S-Curves (at 0.4 correlation)



Schedule

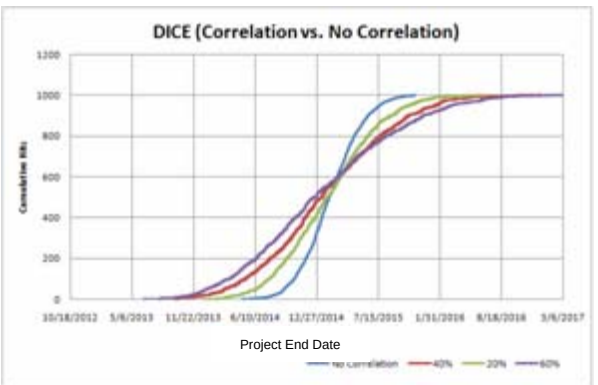


Cost

Key Points

- Identical input parameters to ensure consistency in benchmarking
- Importing risks from 3rd party template
- Outputs <1% variation from Primavera

Correlation



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