Analytical Program Management: Integrating Cost, Schedule, and Risk

REALTIME
ANALYTICS

POLARIS

Analytical Program Management (APM) Outline

▶ Integration of Cost, Schedule, and Risk Management Activities

▶ NASA's Approach to Analytical Program Management

▶ What goes into APM Analysis?

▶ Questions Addressed by APM

▶ Analytical Program Management Modeling

▶ Actionable Analysis and Insights Provided by APM Modeling
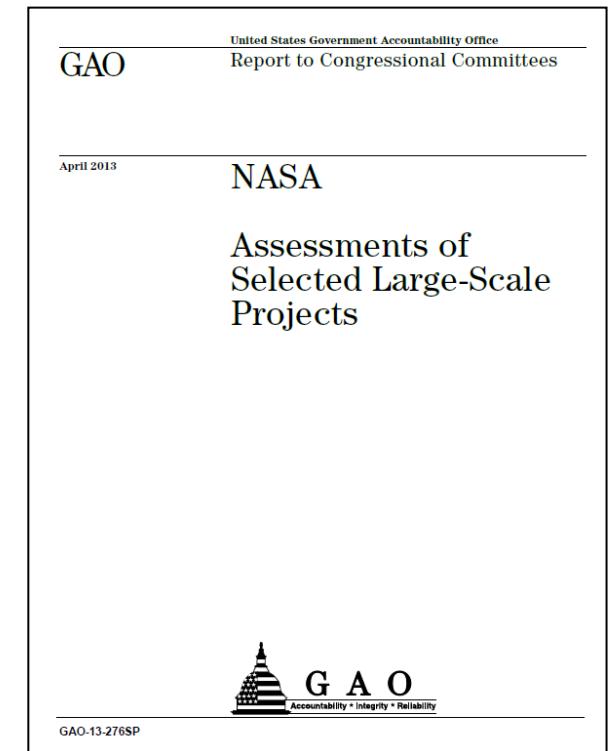
▶ Demonstration of APM Modeling

Cost, Schedule and Risk Activities Are Rarely Integrated on Programs

▸ Cost, schedule and risk management activities are typically not integrated on programs; oftentimes these teams have little interaction outside of program reviews

▸ This lack of integration has tangible consequences
  – When cost growth is identified, it almost always implies schedule growth
  – When the schedule growth is identified, it almost always implies cost growth
  – When risks are identified, they almost always imply both cost and schedule growth
  – *Program managers lose their opportunity to mitigate cost and schedule growth when these functions aren't integrated*

▸ The lack of tools for producing integrated artifacts has stood for years as a roadblock for integration

▸ Analytical Program Management (APM) provides a framework for integrating cost, schedule and risk using *existing artifacts* to produce a cohesive analysis

APM produces actionable analysis allowing PMs to proactively manage cost and schedule

NASA's Approach to Analytical Program Management

▸ Integrated cost/schedule estimation has gained significant momentum recently

- NASA is leading the way in the development of this methodology, which they have labeled Joint Confidence Level (JCL) Analysis

- NASA Policy Directive mandates that programs are baselined at the "70 percent confidence level" using a "joint cost and schedule probability distribution"[1]

- The goal was to provide stronger assurance that NASA can meet cost and schedule targets[2]

- A recent GAO report cites the <u>dramatic effects</u> of NASA's policy stating "Average development cost growth and schedule delay for the current portfolio have decreased to about a third of their 2009 level."[3]

▸ While the methodology has made substantial strides, the cost and schedule communities must overcome political and technical obstacles before full adoption

United States Government Accountability Office
GAO
Report to Congressional Committees

April 2013

NASA

Assessments of Selected Large-Scale Projects

GAO
Accountability ∗ Integrity ∗ Reliability

GAO-13-276SP

[1] – NPD 1000.5 - http://www.hq.nasa.gov/office/codeq/doctree/10005.htm - January 15, 2009
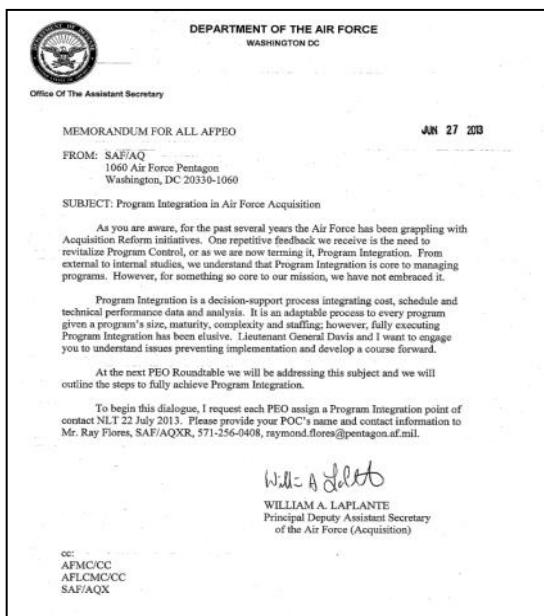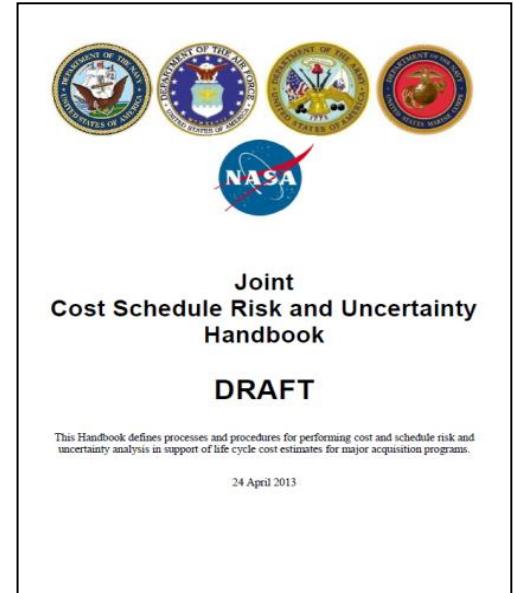[2] – JCL Status Report - http://www.nasa.gov/pdf/421542main_JCL%20Status%20Report-2010%20Feb.pdf – February 2010
[3] – GAO Report – "NASA – Assessments of Selected Large-Scale Projects" - http://www.gao.gov/products/GAO-13-276SP - April 2013

Movement by DoD to Integrate Cost, Schedule, and Risk

▸ Various programs from each Service have shown independent efforts to perform APM / JCL analysis, but so far no policy or guidelines have emerged to mandate the approach

▸ In 2013, the Naval Center for Cost Analysis (NCCA) led the publication of the Draft *Joint Cost Schedule Risk and Uncertainty Handbook*, which provides basic approaches and recommendations for APM / JCL


Joint
Cost Schedule Risk and Uncertainty Handbook

DRAFT

This Handbook defines processes and procedures for performing cost and schedule risk and uncertainty analysis in support of life cycle cost estimates for major acquisition programs.

24 April 2013

▸ Additionally, the Air Force has released a memo initiating a PEO roundtable for a decision-support process around "Program Integration" of cost, schedule, and technical performance

What Goes Into Analytical Program Management?

- Polaris analysis is performed by existing program staff using the following artifacts

- The ***program schedule*** (IMS or higher-level schedule) with uncertainty bounds on task durations
  - Program schedule is the backbone to which cost and uncertainty/risk are applied
  - Uncertainty bounds can be applied at the parent or child level and informed by EVM data

- The ***cost estimate*** with uncertainty bounds that map to the schedule at any level

- The ***quantified risk register*** (probabilities, cost and schedule impacts) where each risk is mapped to a task in the IMS

Polaris uses existing program artifacts or acts as a catalyst for their production

Cost/EVM
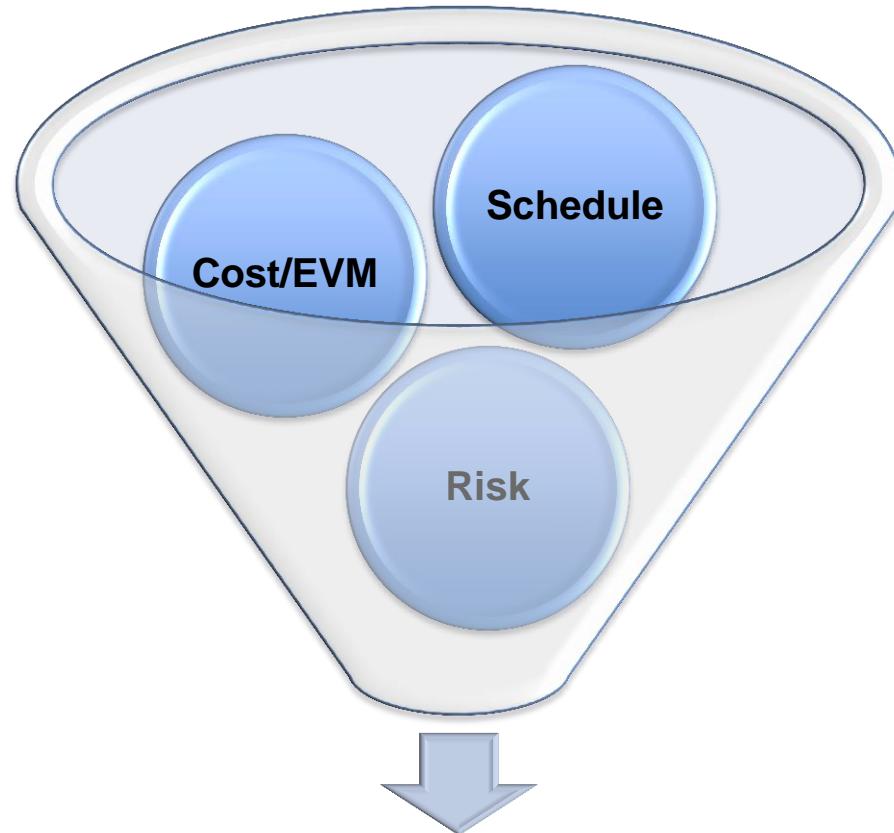
Schedule

Risk

Integrated Program Analysis

Questions Addressed by Analytical Program Management

▶ What risks have the greatest effect on my cost and schedule?
  – What are the primary, secondary, tertiary…impacts of these risks?
  – What is my optimal mitigation strategy and how much will it decrease my cost and schedule risk?

▶ How will schedule growth impact my costs? How will cost growth impact my schedule?
  – What are my potential critical paths?
  – How can I manage the cost impacts of change orders on contracts/subcontracts?

▶ How much management reserve do I need, where do I need it, and in what years?

▶ What action can I take to reduce cost and schedule risk?

▶ How can I best manage my portfolio of programs? Which combination has the best chance of providing maximum capability on time and on cost?

Analytical Program Management Modeling

▸ Booz Allen collaborated with NASA to build a standardized process and tool

– The result is an Adobe Flex-based decision tool called "Polaris", which integrates cost, schedule, and risk artifacts
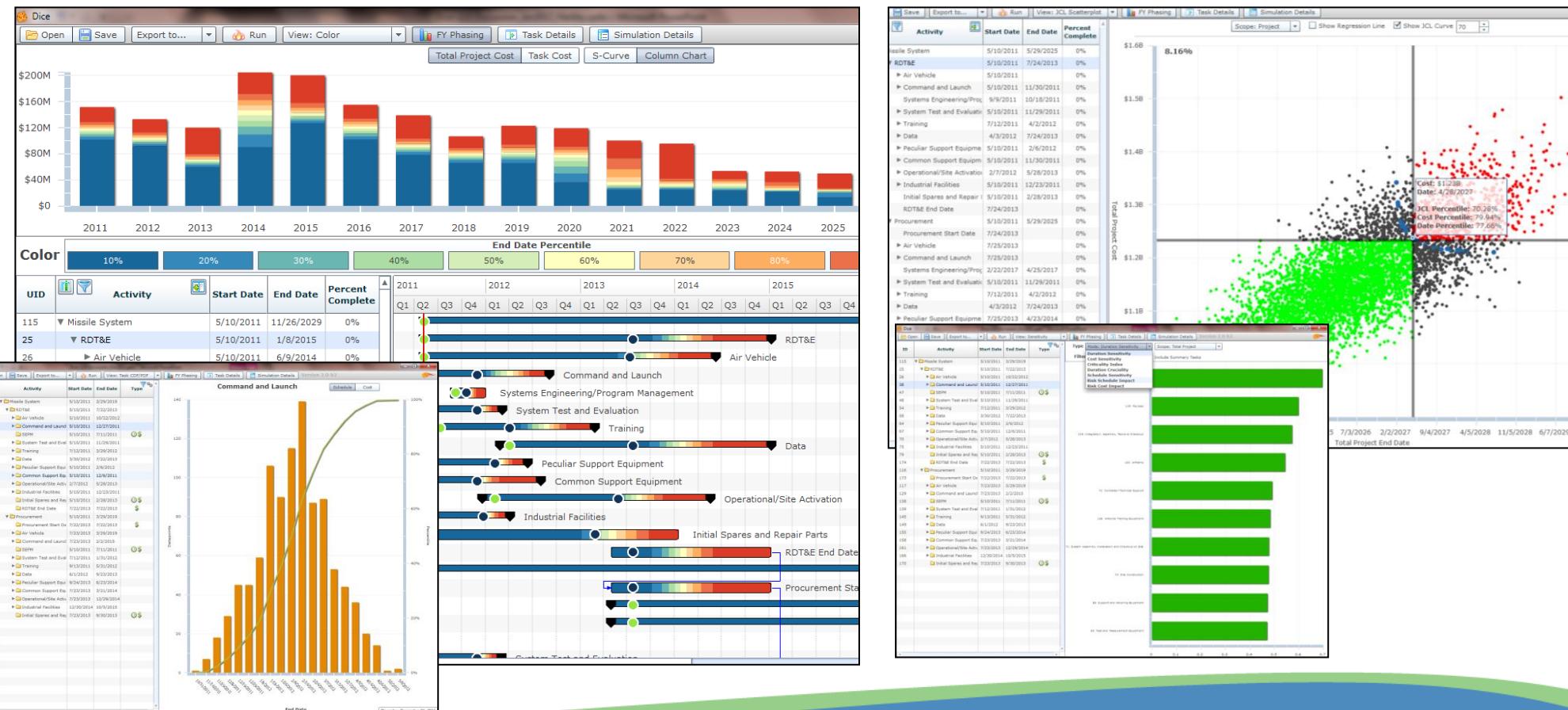
APM Provides Unparalleled Insight Into the Relationships Between Cost, Schedule and Risk

▶ Modeling provides a range of potential cost and schedule outcomes
  – Includes range of costs by year

▶ Allows PMs to set reserves based on *confidence levels* – required by DoD/IC/NASA

▶ Shows relationship between cost and schedule
  – Reveals the range of potential costs for any schedule outcome and vice versa

▶ All analysis is provided at every level of cost and schedule
  – Enables risk-based management of subcontracts; mitigates cost growth from change orders

▶ Standardized outputs allows combination of multiple programs into a portfolio-based analysis
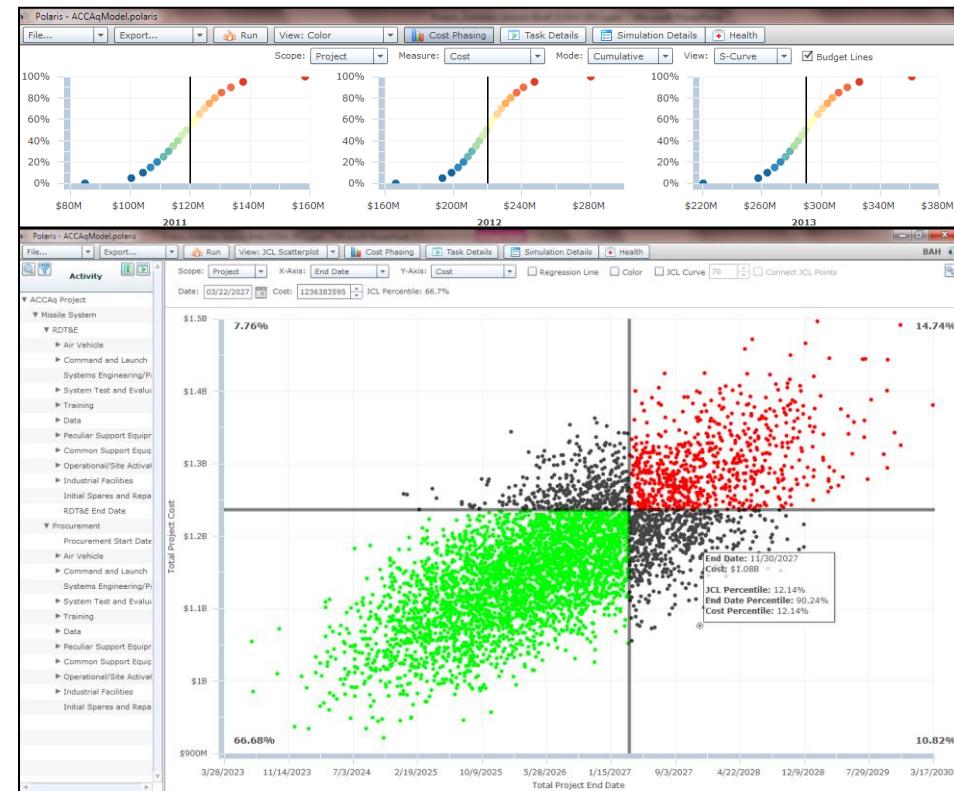
APM Provides Actionable Analysis Used to Prevent Cost and Schedule Growth

▸ Most risk management methods use a simple likelihood x impact metric to rank risks
  – This ignores downstream risk effects

▸ APM reveals the impact of each task and risk on cost and schedule
  – …including secondary and tertiary risk impacts
  – E.g.: risks creating a new critical path or causing standing-army cost impacts elsewhere in the schedule

▸ Modeling also shows a probabilistic critical path
  – Shows the probability that each task ends up on the critical path
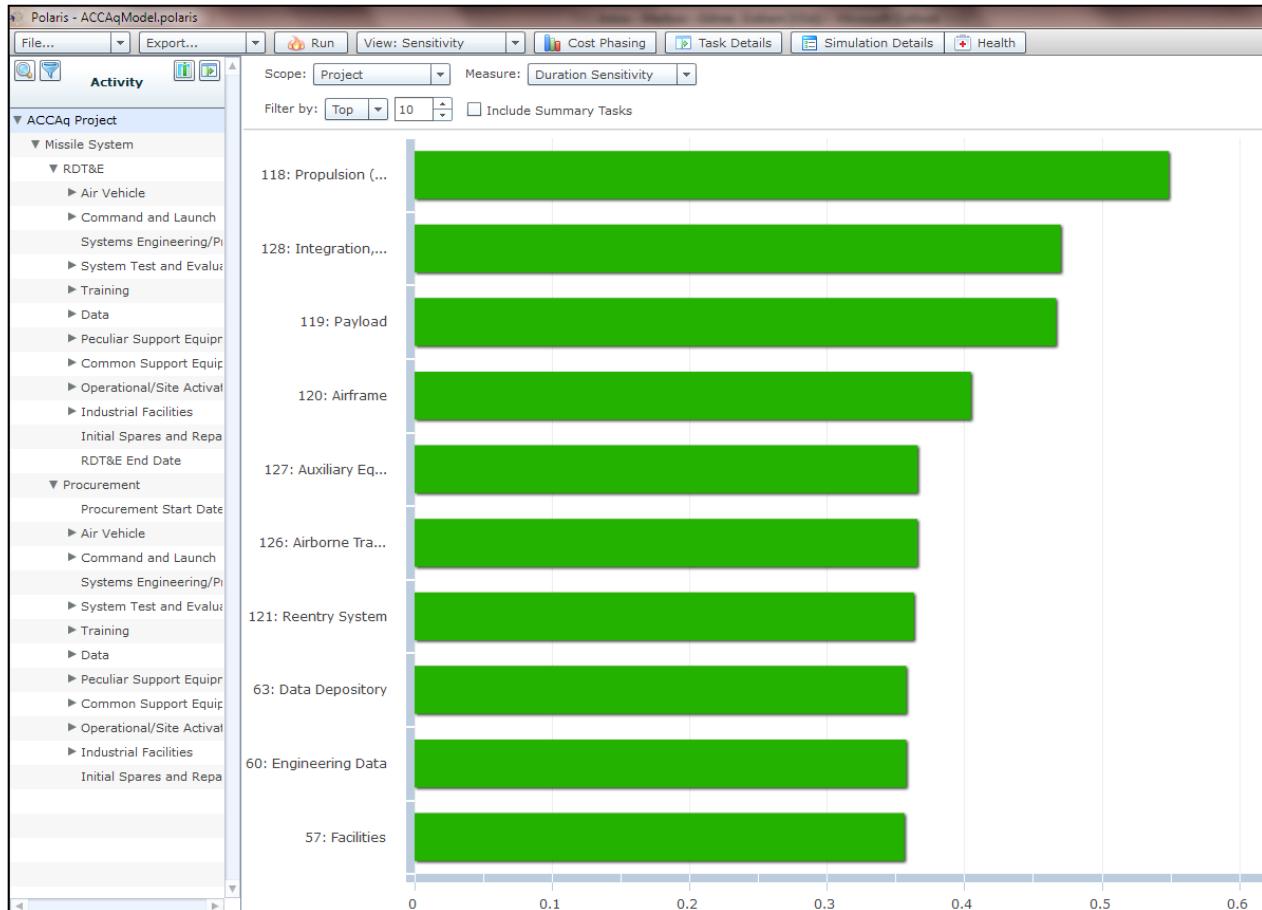
APM Provides Quality Insights and Analysis
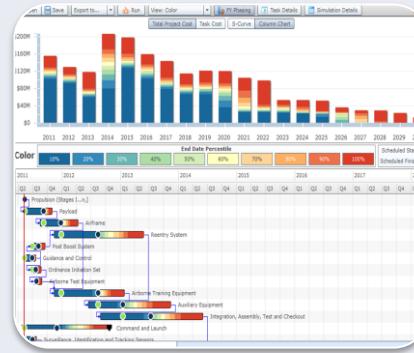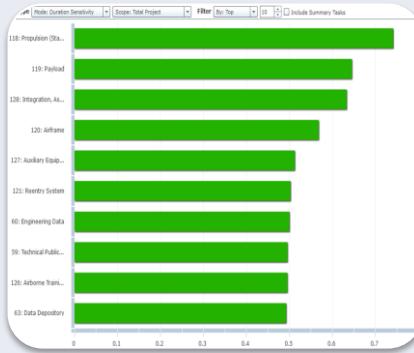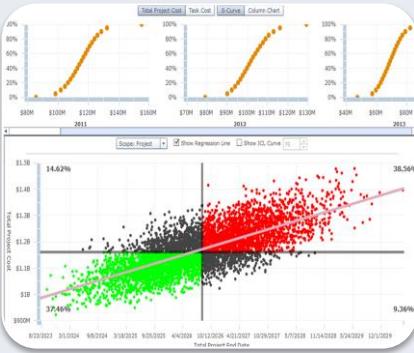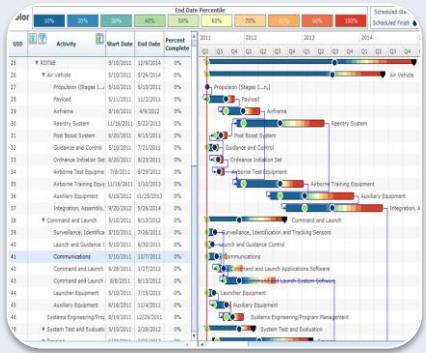
Schedule Risk Analysis

- APM modeling includes schedule health check and schedule risk analysis features with industry leading run-times
- APM calculates the probabilistic critical path, providing insight into potential program choke points

Integrated Cost & Schedule Risk Analysis

- APM integrates schedules, cost estimates and risk registers into a single analysis
- APM quantifies the relationship between cost and schedule revealing the cost impacts of schedule growth and vice versa

Analytical Program Management

- APM performs real-time scope and requirements trade-off analysis allowing managers to design an architecture that fits into a constrained budget
- APM identifies lead sources of cost and schedule risk

Portfolio Optimization

- APM looks across a portfolio of programs and allows real-time capability/program trade-off analysis enabling decision makers to quickly optimize their portfolio to provide maximum capability within a constrained budget

Demonstration of APM Modeling

Initial View

▸ Analysis is schedule-based, begins with a Gantt chart environment
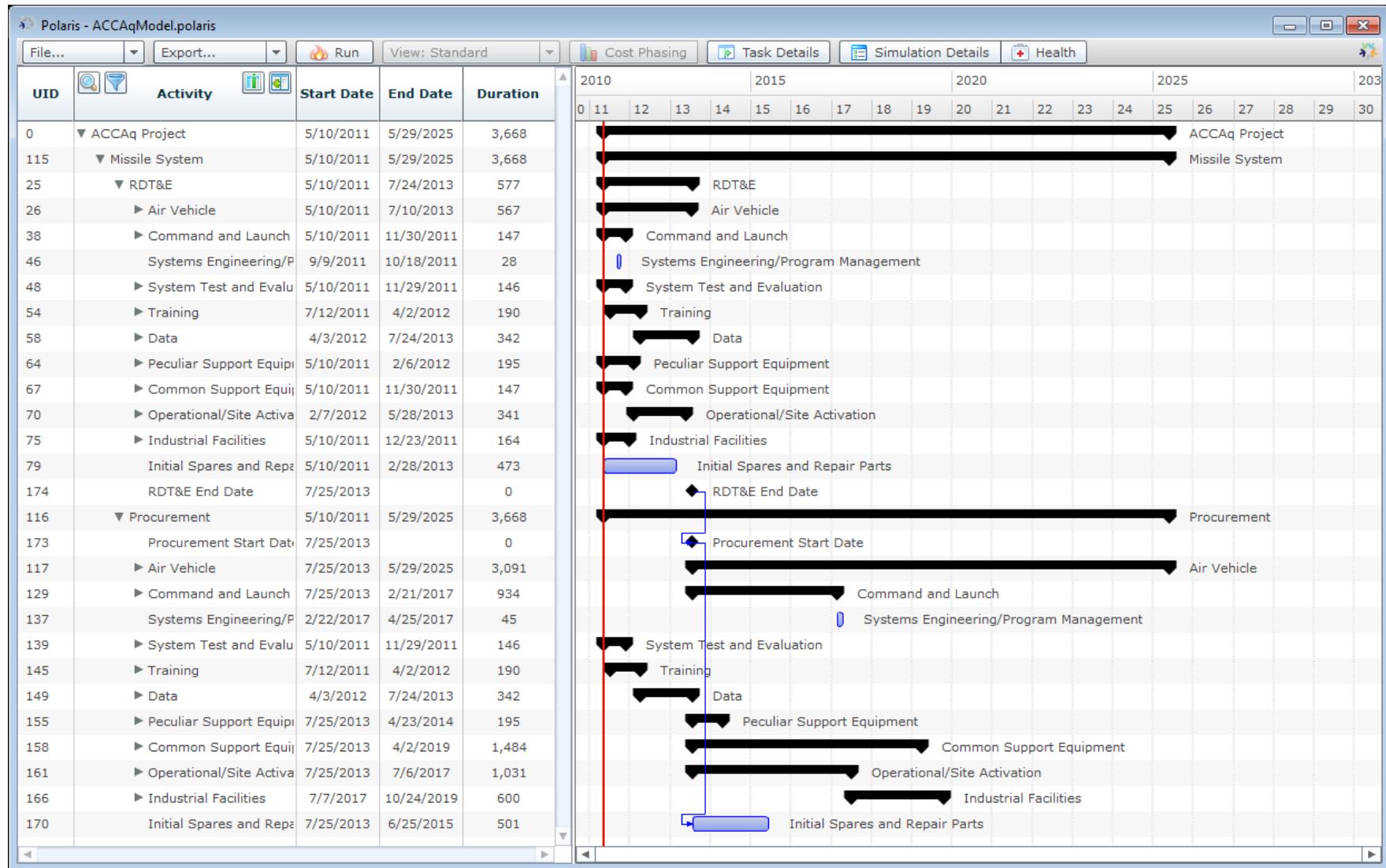
Data Import

▶ Quick import of schedule, cost, and risk data from Microsoft Project and Excel
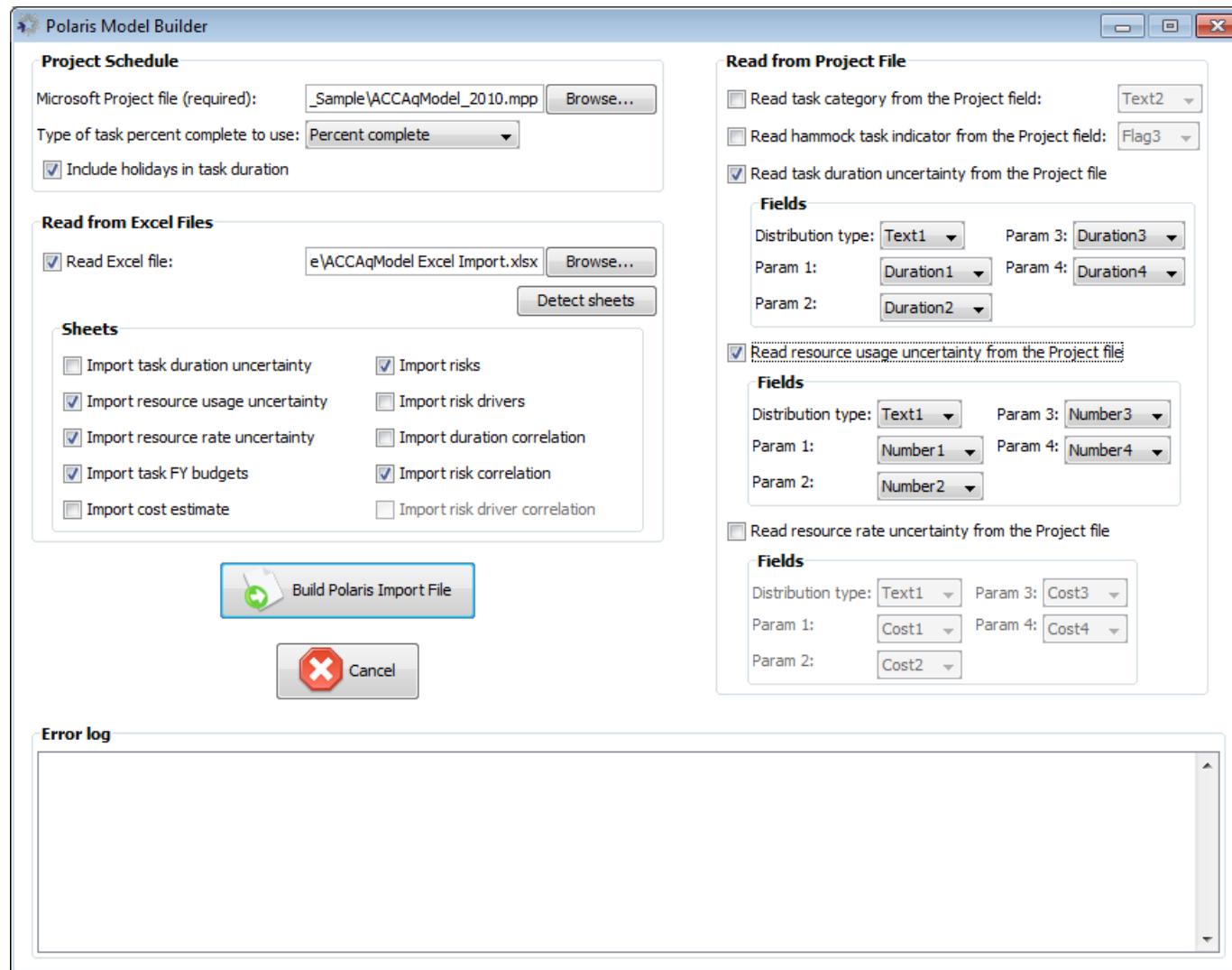
Entering Uncertainty

▸ Schedule and cost uncertainty can be entered in Project, Excel, or the model

Risk Register

▸ Import a complete risk register from Excel or add and edit risks within the tool

Correlation

▸ Add correlation to the uncertainty model either by entering in a blanket correlation or specifying correlation between different tasks or categories of tasks

Simulation Run

▶ Unmatched simulation runtimes. 1000 trials in two-tenths of a second!
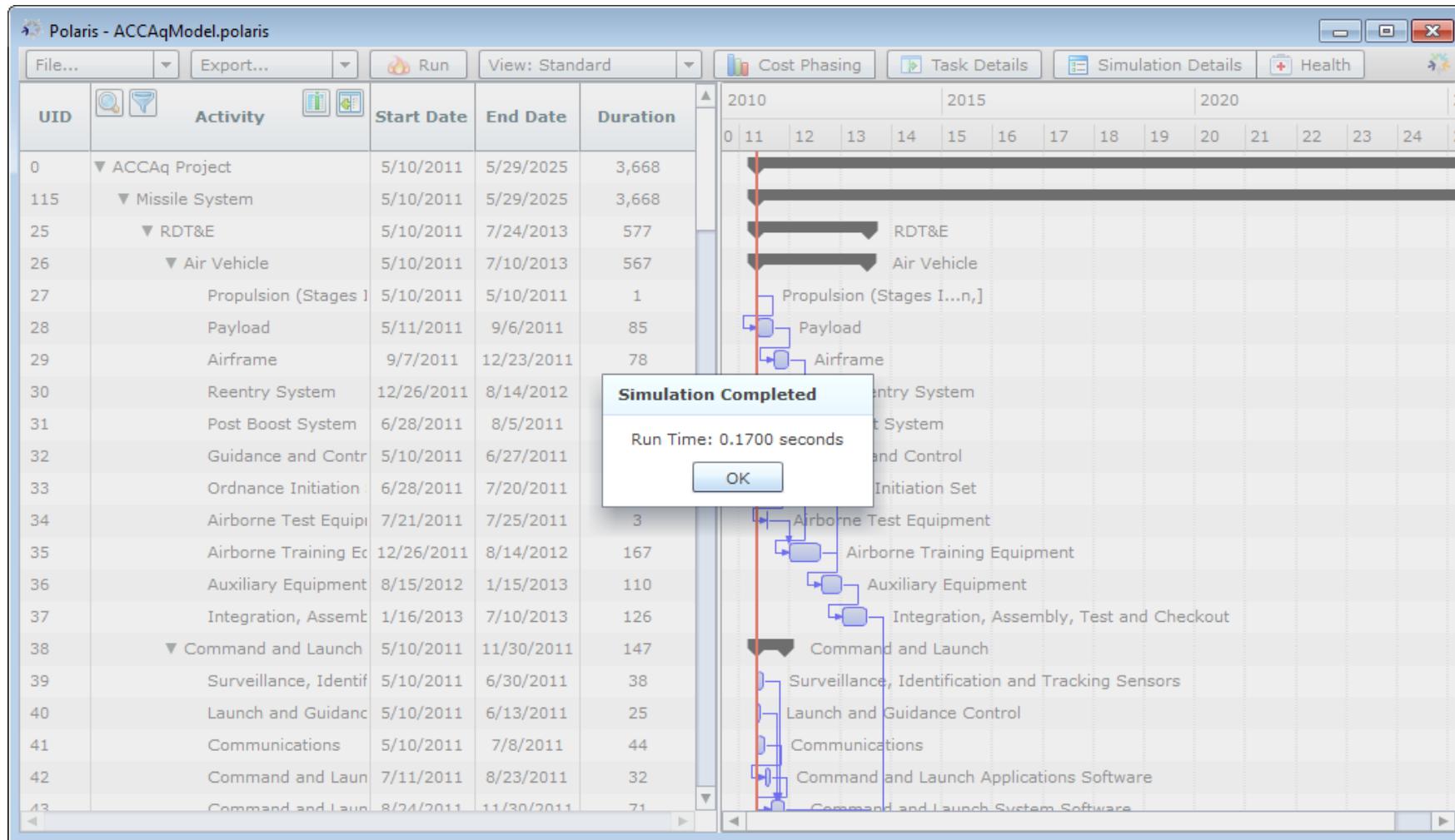
Cumulative Distribution/Probability Density Function

▸ Generate S-curves and histograms of schedule and cost measures as well as quickly query specific percentiles and values
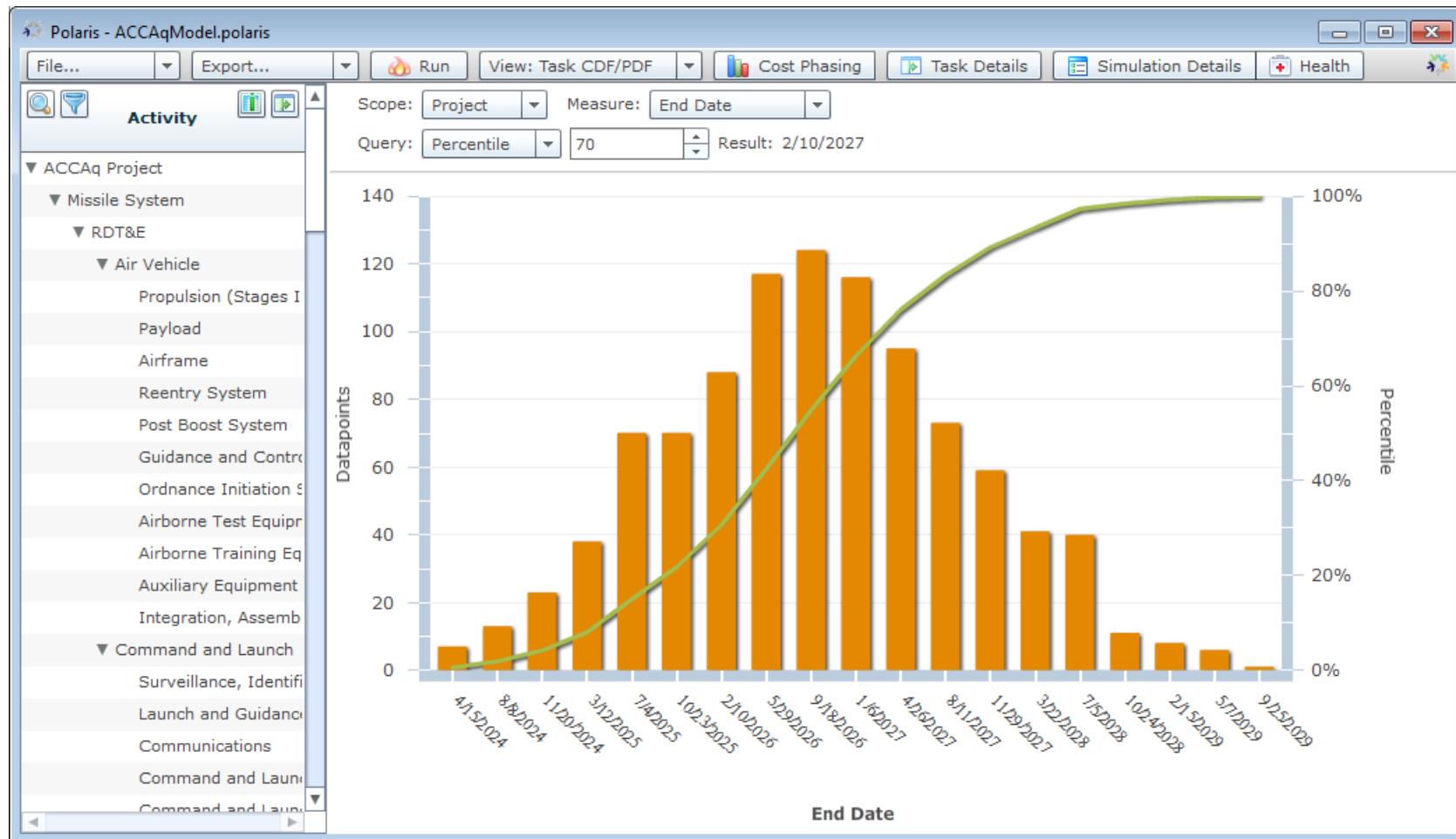
Percentile View

▸ Specify a schedule confidence level and view the schedule at the chosen level relative to baseline
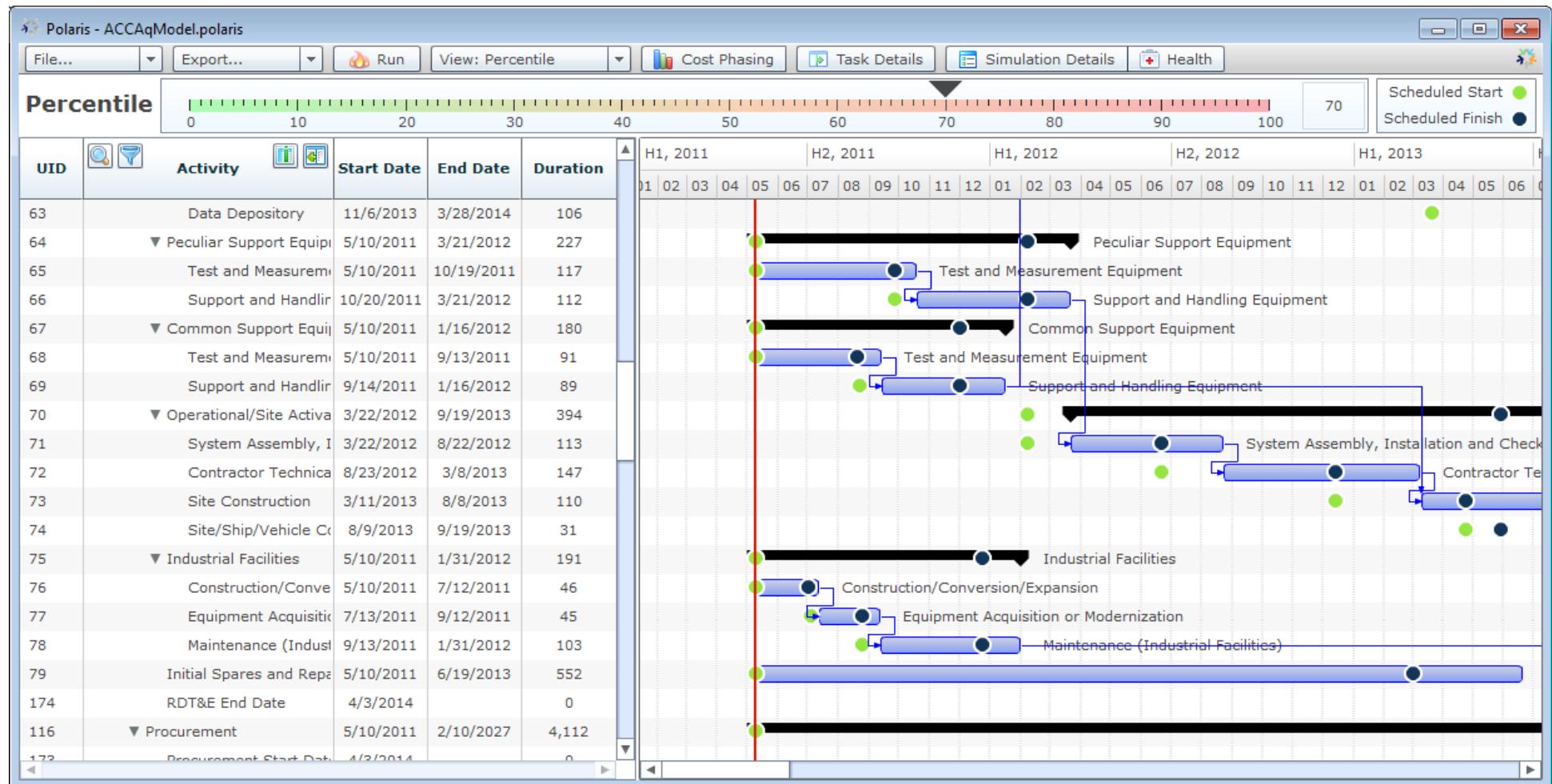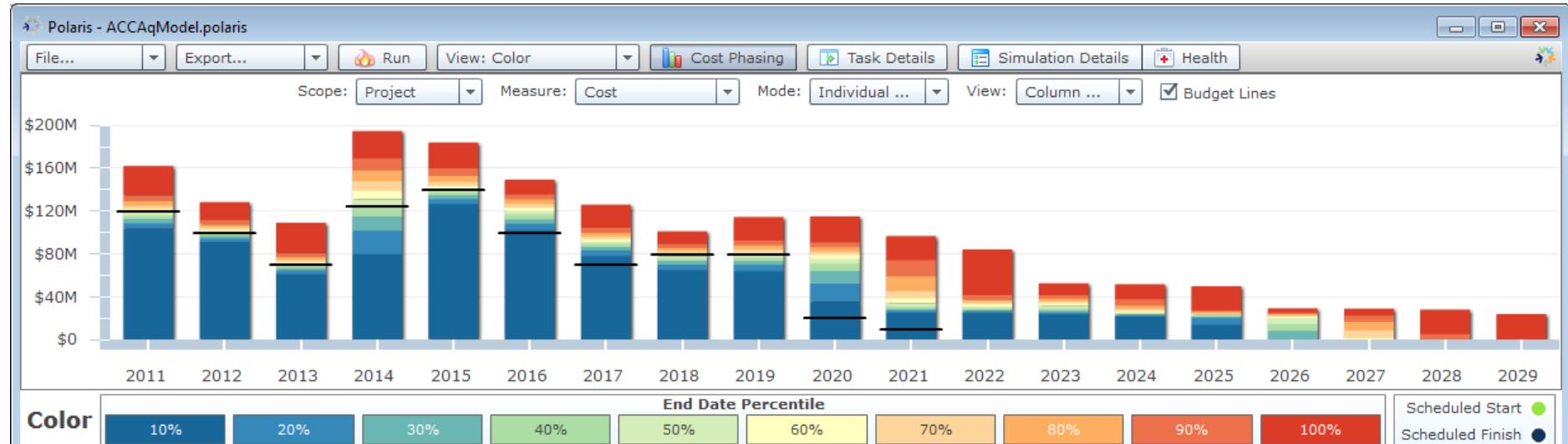
Color View

▸ Display all percentile values in one view revealing the range and likelihood of all possible outcomes
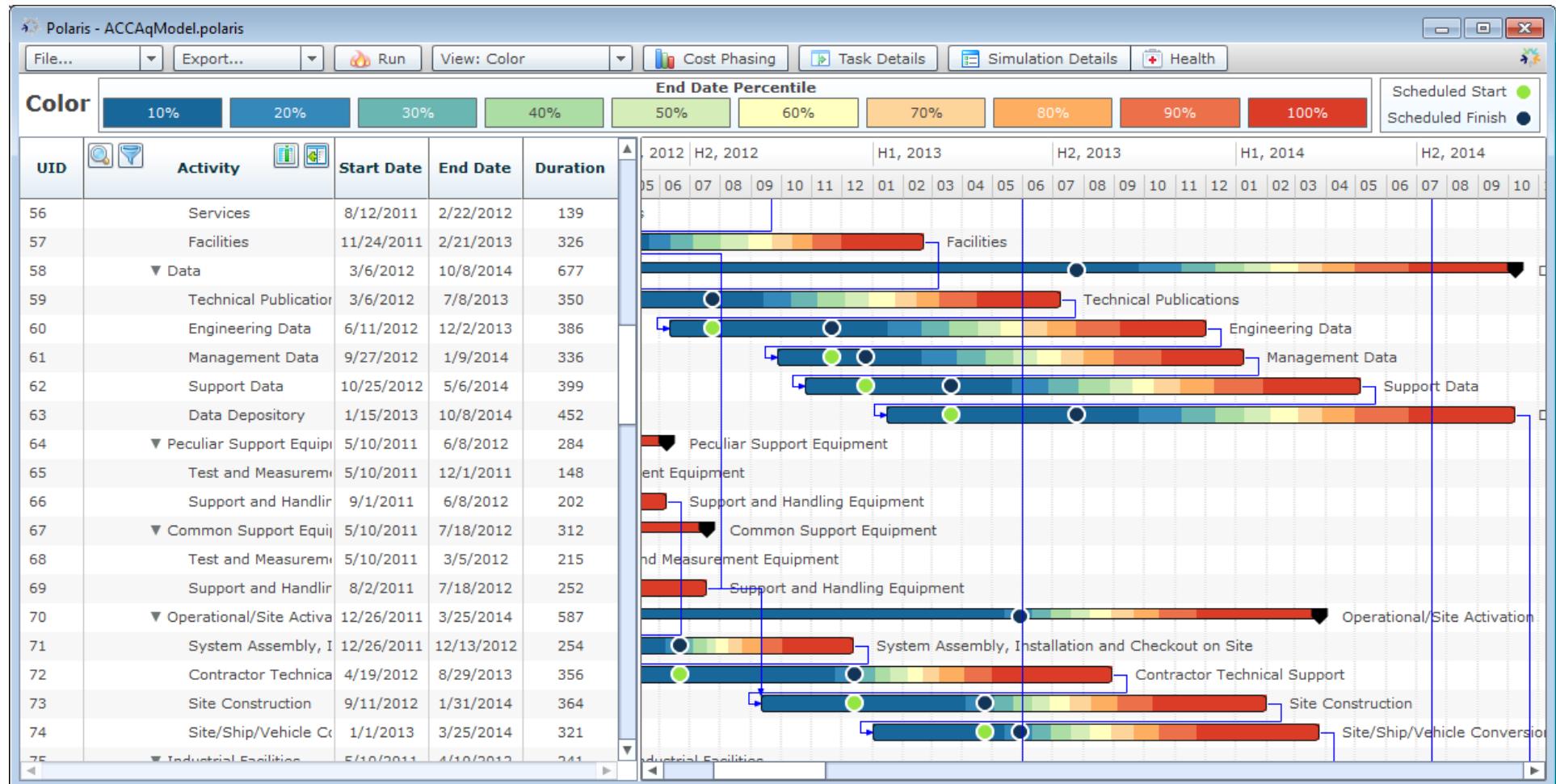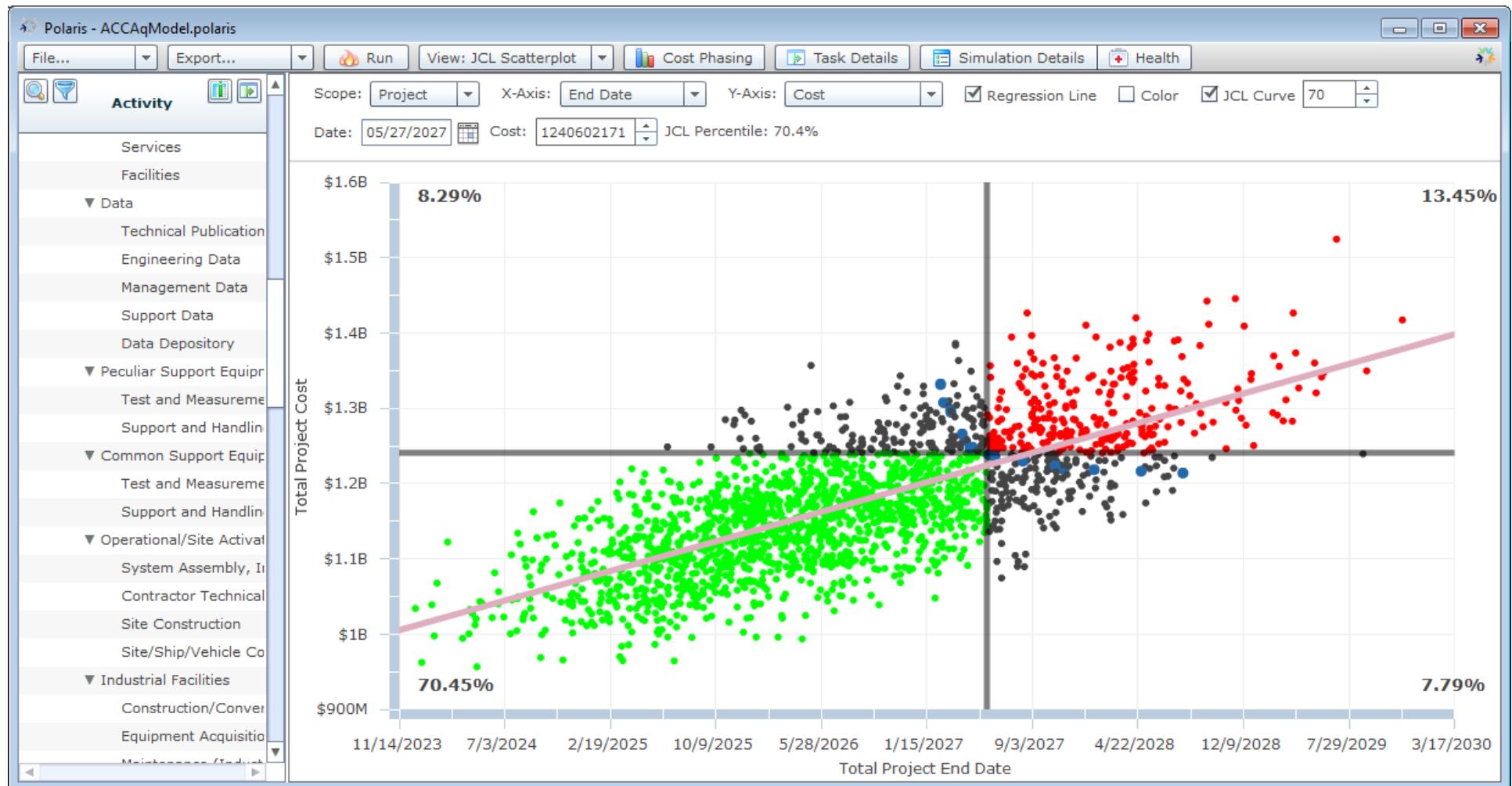
Cost Phasing

▶ Display cost by fiscal year, quarter, or month across the program lifecycle
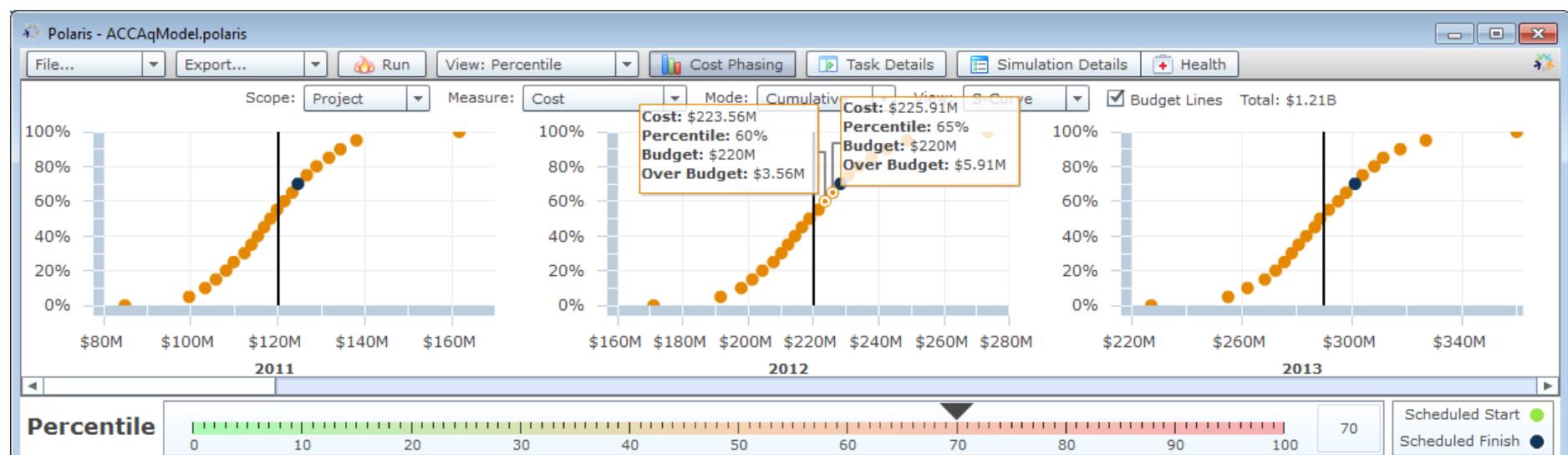
Cost and Schedule Scatterplot

▸ Plot all simulation cost and schedule outcomes, calculate the regression line, and show joint cost-schedule percentiles
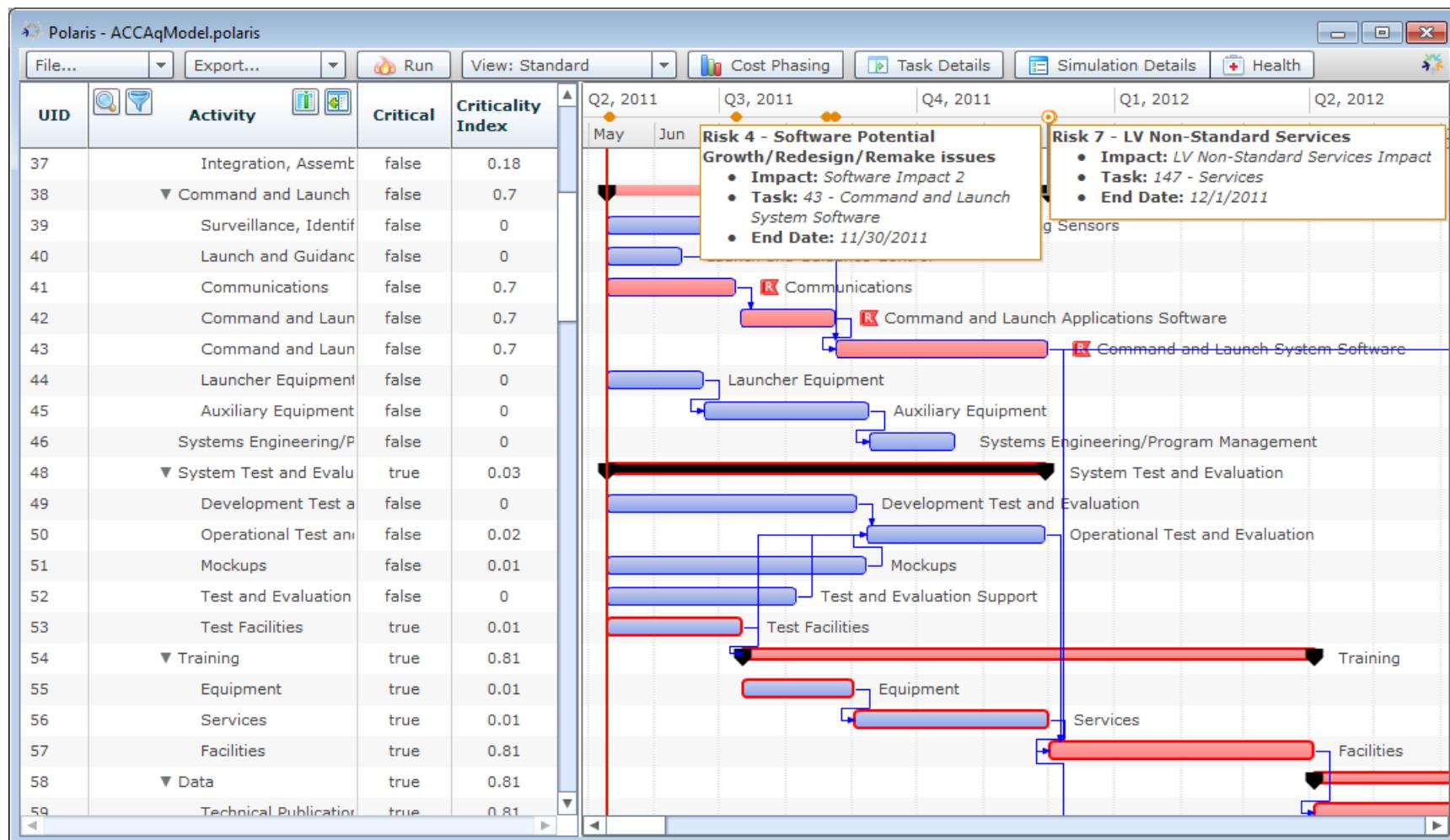
Sensitivity Analysis

▸ Display the full spectrum of standard schedule and cost sensitivity metrics as well as filter for specific portions of the schedule or time periods
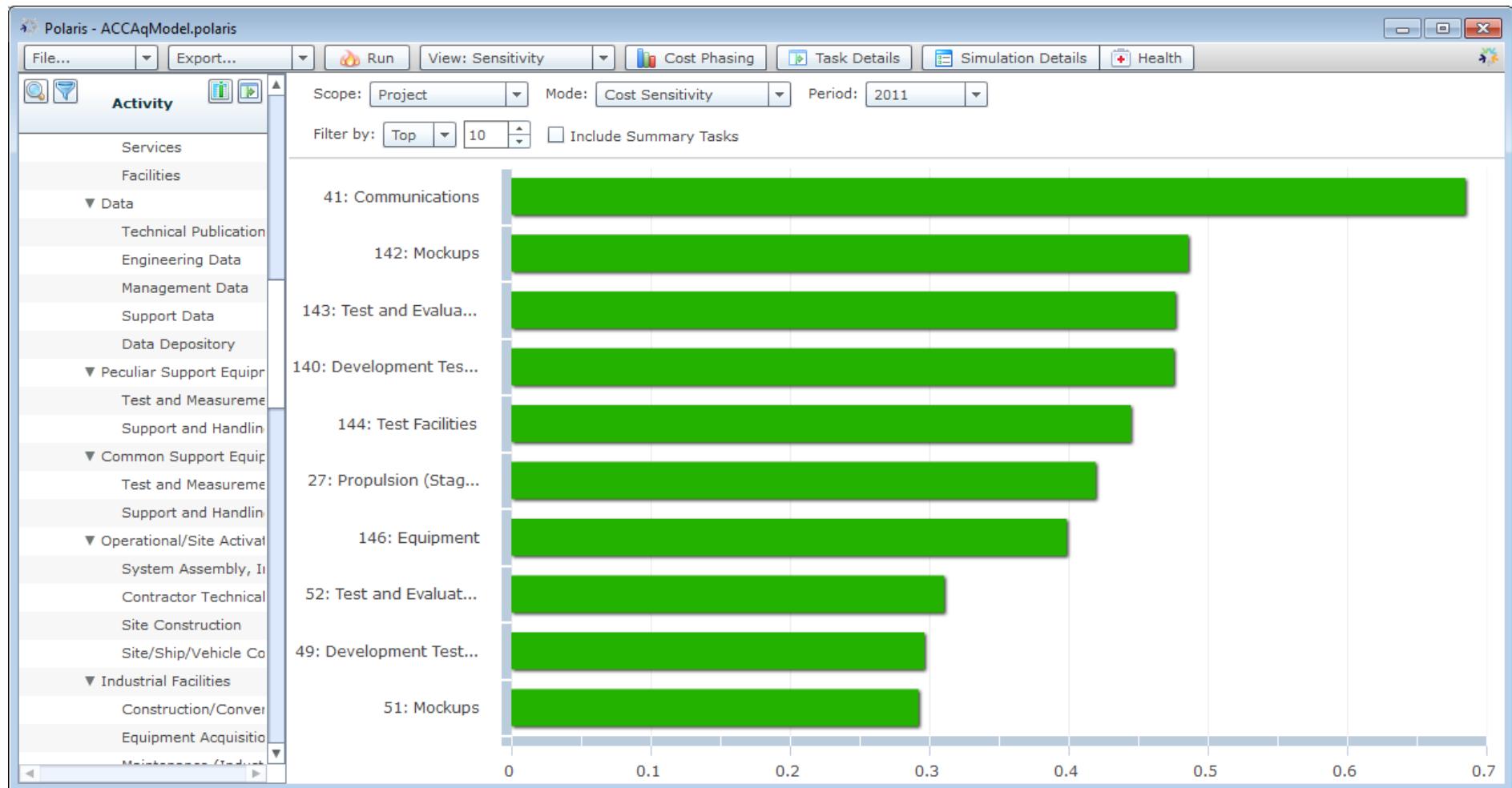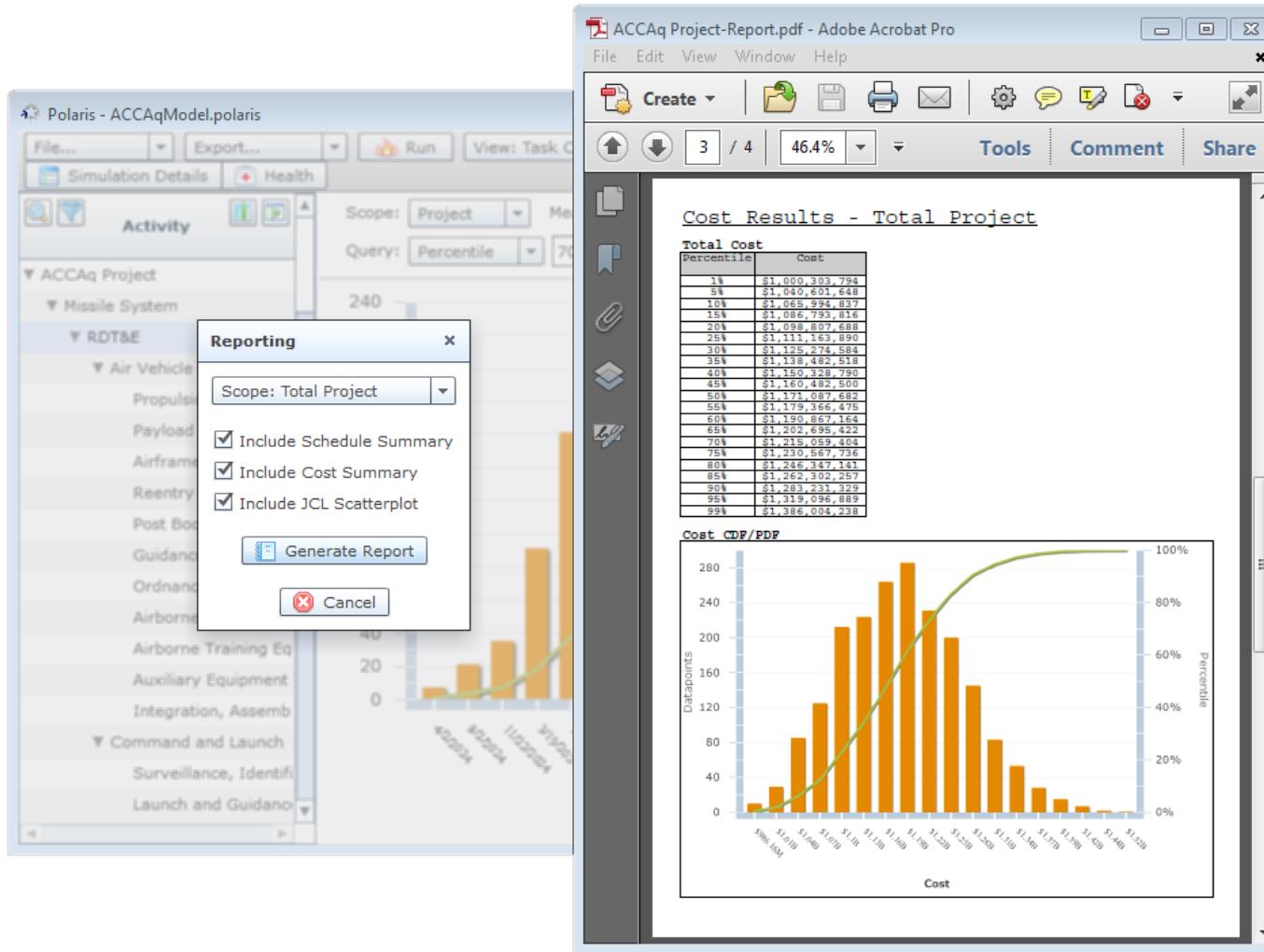
Gantt Based Criticality and Risk Tracking

▸ Show the probabilistic critical path in the Gantt view relative to baseline as well as indicate the occurrence of risks in the timeline

Export Data

▸ Export all charts as images which can be used in PowerPoint or Word, save all generated data to Excel, or create PDF reports

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