PRICE®

MAKING A DIFFERENCE FOR 40 YEARS

How Predictive Analytics is Improving Parametric Cost Estimation

Anthony A. DeMarco, President

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Predictive Cost Analytics

- What is it?
- Why now?
- What are the benefits?
- What's next?

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PRICE Systems, L.L.C.

- We improve our customers overall ***cost management*** to help them increase revenue and save money. By empowering our clients with ***proven cost models and predictive cost analytics***, they become better estimators - improving bid success ratios, and achieving tremendous savings in analyzing alternatives. They become confident in their costs, schedules, and risk estimates

- Headquarters: Mt. Laurel, NJ with additional offices in *DC, OH, VA, UK, France, Germany*
- Partner companies: China, S.Korea, Japan, Australia, Italy, Germany, and elsewhere
- Products: TruePlanning® software, PRICE Models, benchmark databases, integrated processes, and implementation services
- Education: PRICE University, instructor-led training on best estimating practices and product implementation
- 350+ customers & 12,000+ project professionals trained worldwide

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- ## Parametric Estimating
  - A cost estimating methodology using statistical relationships between historical costs and other program variables such as system physical or performance characteristics, contractor output measures, or manpower loading. The parametric cost estimation method is one of the four cost estimation methods recommended by the Office of Cost Assessment and Program Evaluation (CAPE).
- ## Predictive Analytics
  - The use of data, statistical algorithms and machine-learning techniques to identify the likelihood of future outcomes based on historical data. Predictive models use known results to develop (or train) a model that can be used to predict values for different or new data (SAS).

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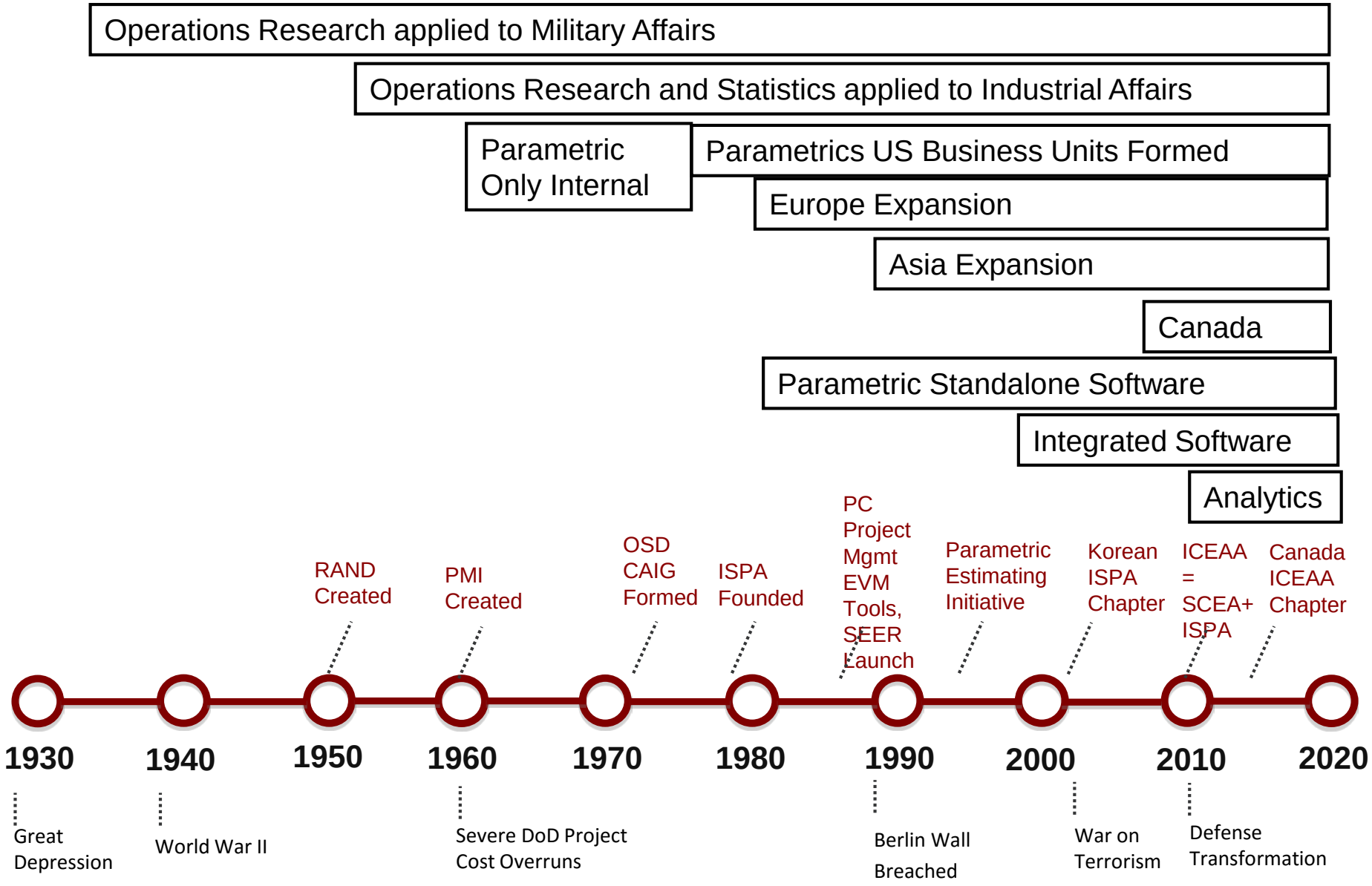
History of Parametric Estimating

2004 Anthony A DeMarco, International Society of Parametric Analysts



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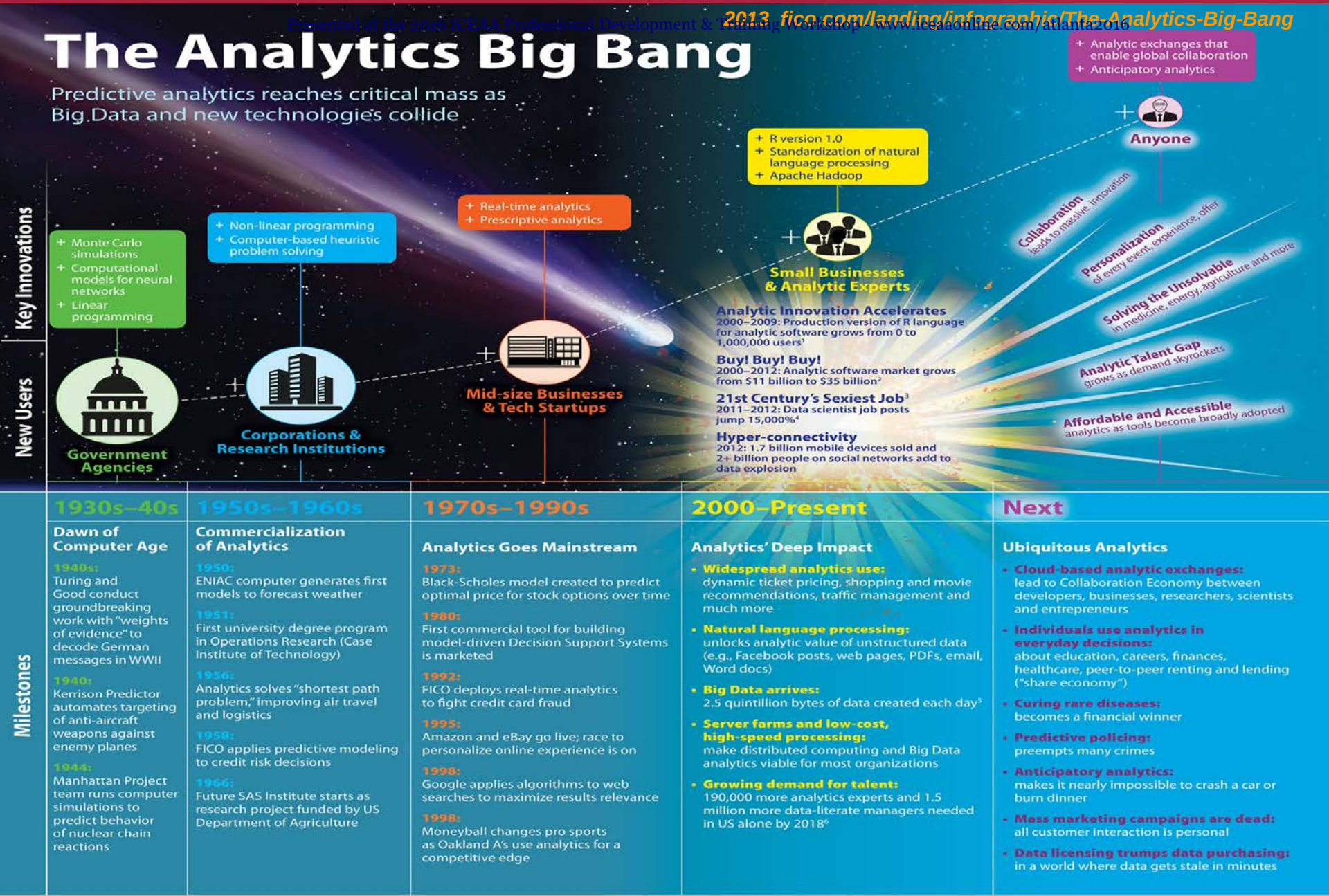
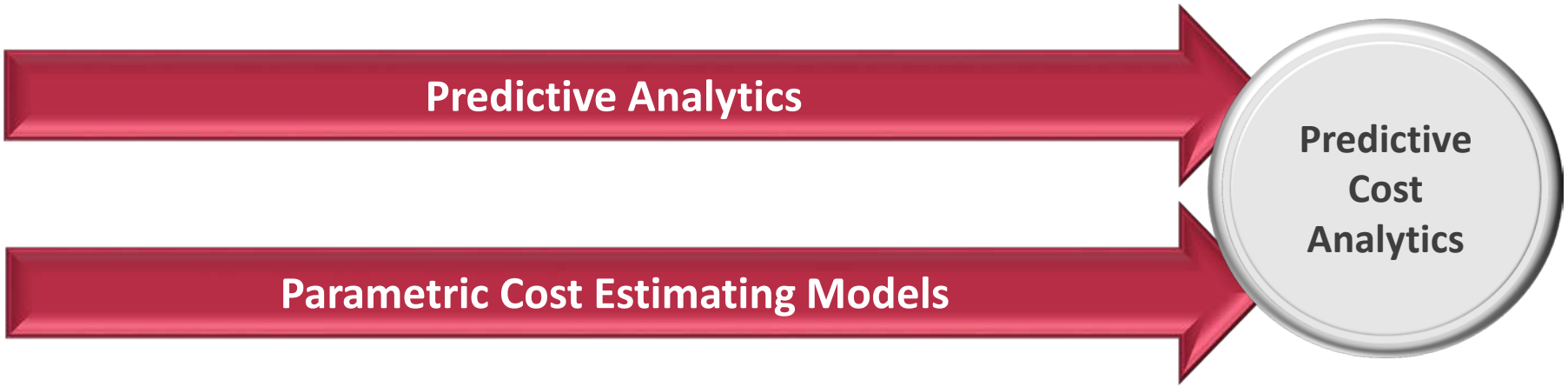
2013 fico.com/landing/infographic/The-Analytics-Big-Bang



Parametric can now evolve to leverage the Predictive Analytics Big Bang to speed and lower the cost of Analytics



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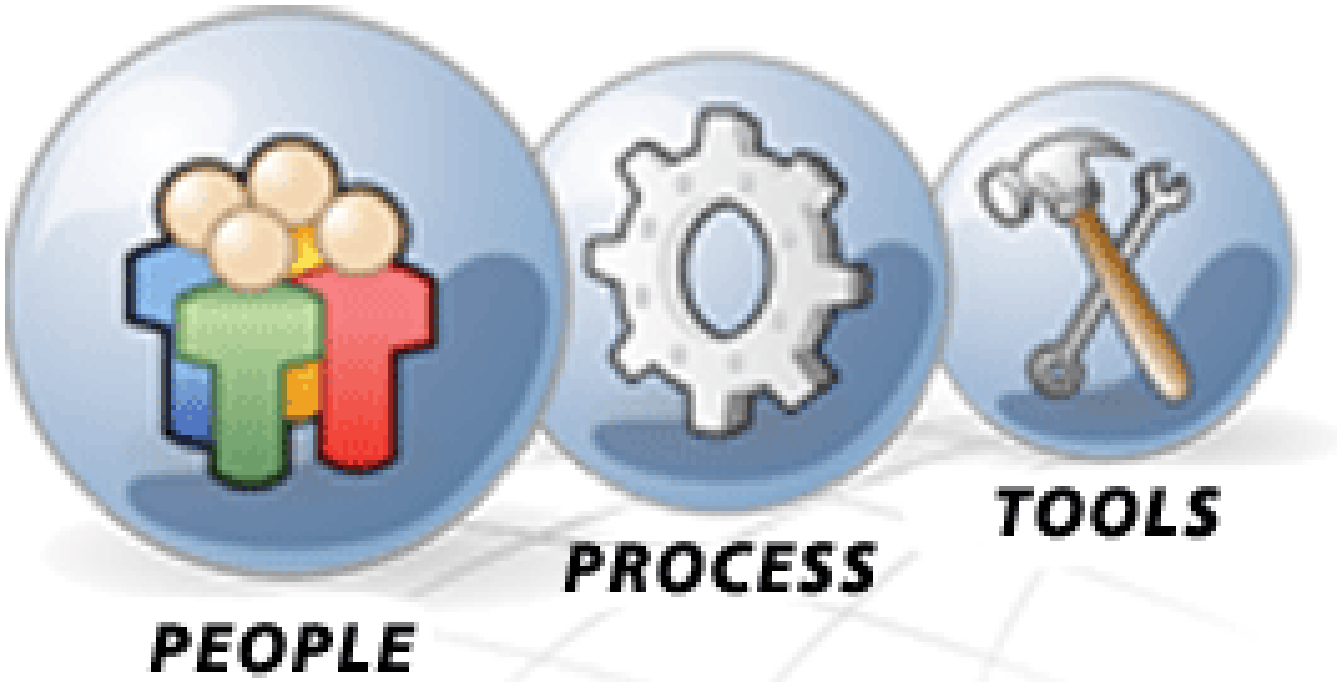
Analytics Big Bang causing change!



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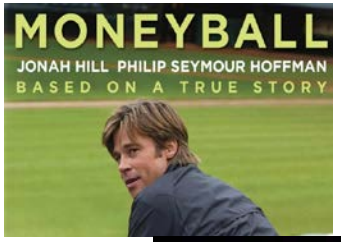
People Changes



Phillies hire ex-Google analyst to head baseball research & development

Matt Klentak, in his first winter at the head of a baseball operations department, wanted to learn how companies manage information. The 35-year-old Phillies general manager surveyed people in baseball, other sports, and some with zero connections to the game. How, he asked, do you implement analytics into decisions?

Those talks led him to Andy Galdi, a 30-year-old Google employee who was hired Thursday as the Phillies' first-ever director of baseball research and development.

PRICE Job Posting

Do you have a passion for excellence? Are you interested in a challenging career with a company that is the best in its field? Do you enjoy working in a collaborative environment with really smart people who are the best at what they do?

Then you should work for PRICE Systems.
PRICE Systems specializes in improving our customers' ability to improve their speed, accuracy and standardization of the foundation of their cost management culture. Our clients are some of the best known Aerospace and Defense organizations on the planet including many of the world's governments. PRICE Systems employs a small group of highly talented people who live and breathe to add value to our customers. We believe that work must have a high "purpose" factor, and we're looking for people who share in our passion to create exceptional value.
PRICE Systems wants to hire and develop distinguished scholars interested in a career in ***Business Intelligence, Predictive Analytics***, Cost Estimation and Analysis, Data Mining, Statistical Analysis and Model building. For these positions we are looking for applicants with outstanding academic credentials in Mathematics, ***Analytics***, Applied Mathematics, or Statistics, along with exceptional analytic skills, strong communication skills and the ability to work in a team environment.
Essential Duties and Responsibilities of the position include:

- Perform data collection, mining, categorization, mapping, analysis, normalization, calibration, and database implementation
- Develop, present and defend cost estimating relationships and mathematical cost models using applied mathematical approaches such as probability, statistics, regression analysis, linear algebra, learning curves and data collection
- Performing special cost analysis studies
- Write formal research papers

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Process Changes

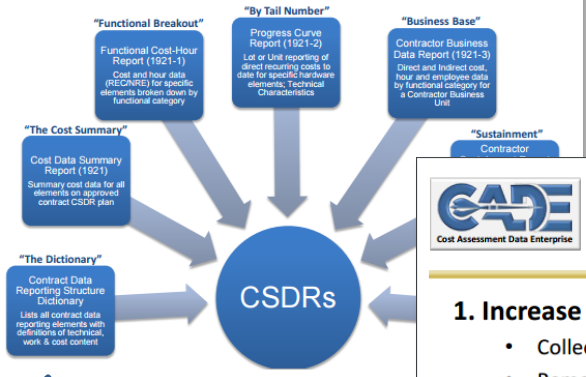
UNCLASSIFIED

CSDR Problem Statement

OSD CAPE

Current CCDR Shortcomings

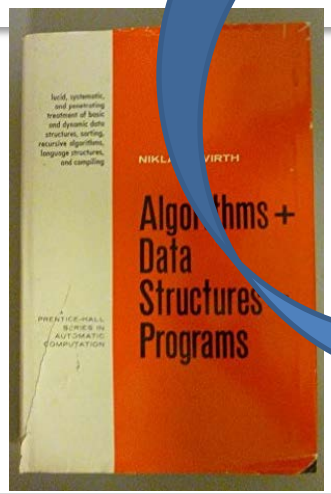
- Subjective Mapping
- Allocation
- Manual
- Inconsistent
- Time Consuming
- No details below the functional labor categories within a WBS element
- Data sampling over time typically limited to once a year



CSDR Data We Collect T

FlexFile Improvements

- Standard WBS
- Raw/Detailed Source Data
- Automated
- Consistent
- Traceable, Repeatable mappin



UNCLASSIFIED

FlexFiles: Objectives

A Win-Win Government and Industry Partnership

OSD CAPE

1. Increase Efficiency:

- Collect data according to the contractor's management structure
- Removal of legacy 1921 forms
- Reduce ad hoc/supplemental government data collection efforts
- Much easier and less time consuming for Industry – allows them to reduce back end support
- Automation: data flows directly from contractor systems into ours

2. Improving Data Quality:

- Eliminate Human Error/Subjectivity
- Collect raw data, and use technology to eliminate arbitrary allocations and errors
- Consistent application of Mil-STD-881C to both EV and CSDR data – data Alignment
- Review and mapping pre-contract award

3. Ensure Completeness:

- Provides much more insight and analysis flexibility
- Higher frequency of submissions
- Receive data over time
- Include cost and supporting technical data

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Tool Changes

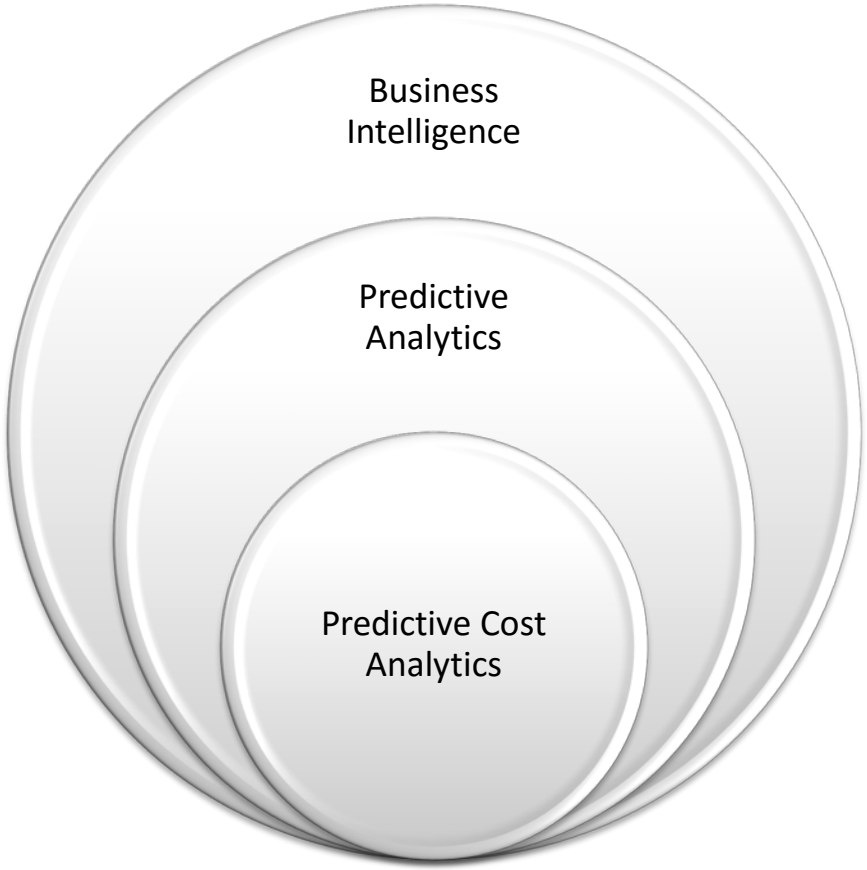
Magic Quadrant

Figure 1. Magic Quadrant for Business Intelligence and Analytics Platforms

"We are entering the Cognitive Era, which demands a powerful combination of tools to evolve your organization into one that thinks and learns from data."
- IBM

Predictive Cost Analytics

- **Business intelligence (BI)** is the set of techniques and tools for the transformation of raw data into meaningful and useful information for business analysis purposes (Wikipedia 2015)
- **Predictive analytics** encompasses a variety of statistical techniques from modeling, machine learning, and data mining that analyze current and historical facts to make predictions about future, or otherwise unknown, events (Wikipedia 2015)
- **Predictive Cost Analytics** a field of predictive analytics specifically targeting cost and schedule estimating for products, projects, on-going operations, other cost-incurring activities



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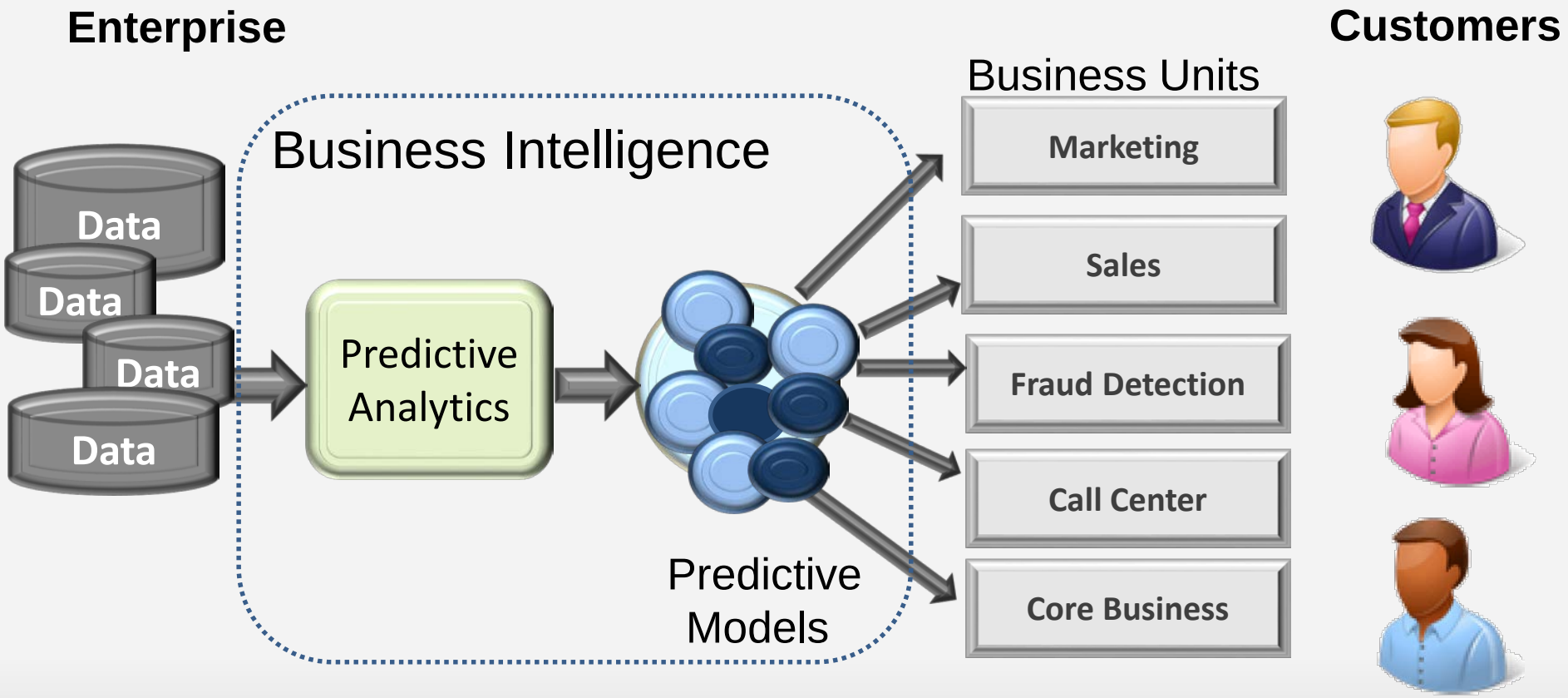
Predictive Analytics



Seven Reasons You need Predictive Analytics Today
Eric Siegel, PH.D., Prediction Impact, Inc.

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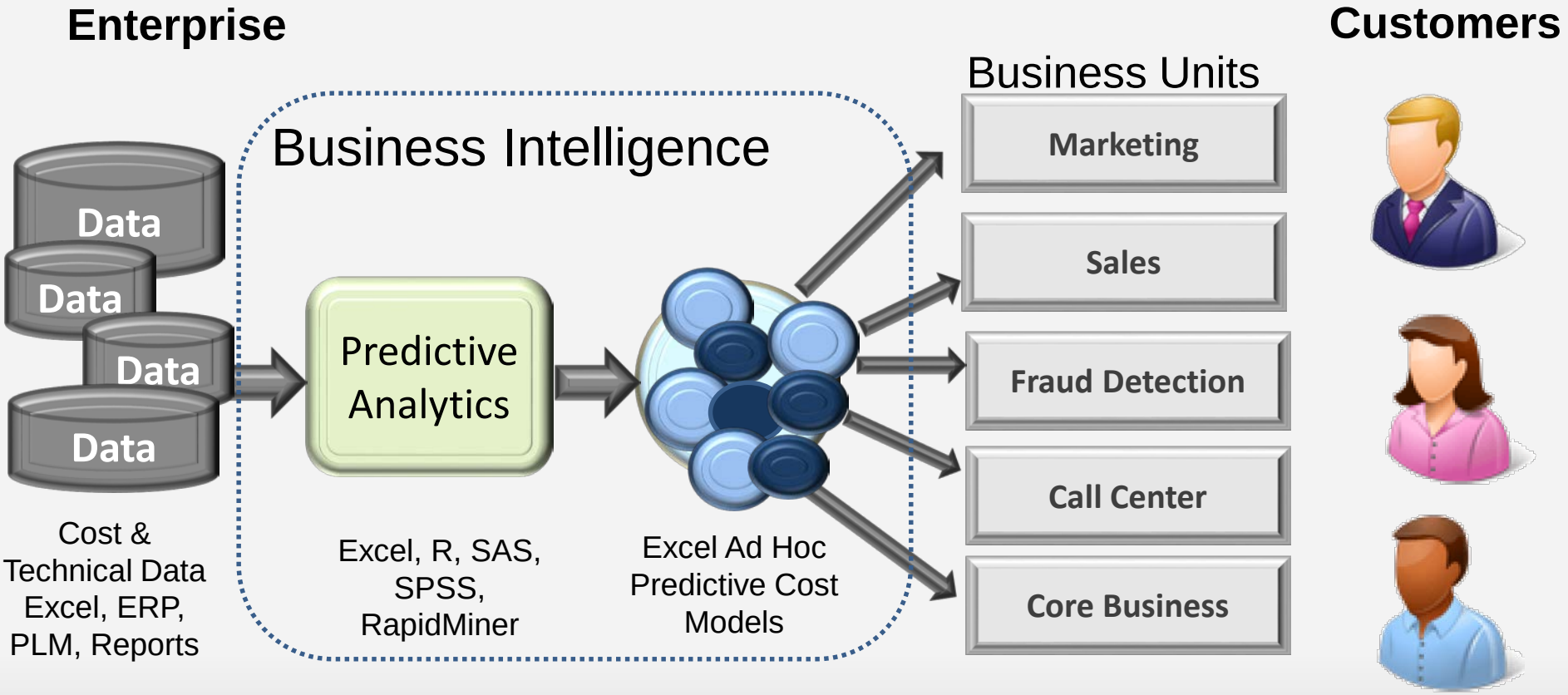
Predictive Cost Analytics without Parametrics



Predictive Cost Analytics, if it exists at all, is typically a labor-intensive, Ad Hoc, un-standardized, unrepeatable process using various tools. Predictive cost models are re-created every time. Little information sharing among projects. Only analytical experts can perform the process

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Parametric Estimating without Analytics

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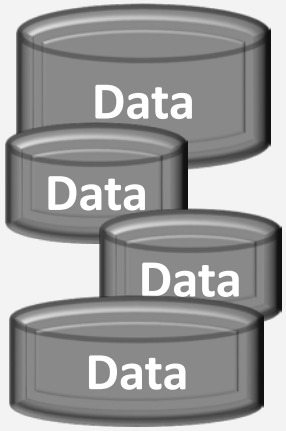
Enterprise



Cost & Technical Data
Excel, ERP, PLM, Reports

Math

SEER Suite
SLIM
ACE-IT
TruePlanning &
the PRICE Models

Business Units

- Business Development (Price-to-Win)
- Budgeting
- Design Affordability Tradeoffs
- Strategic Sourcing
- Bid & Proposal

Customers

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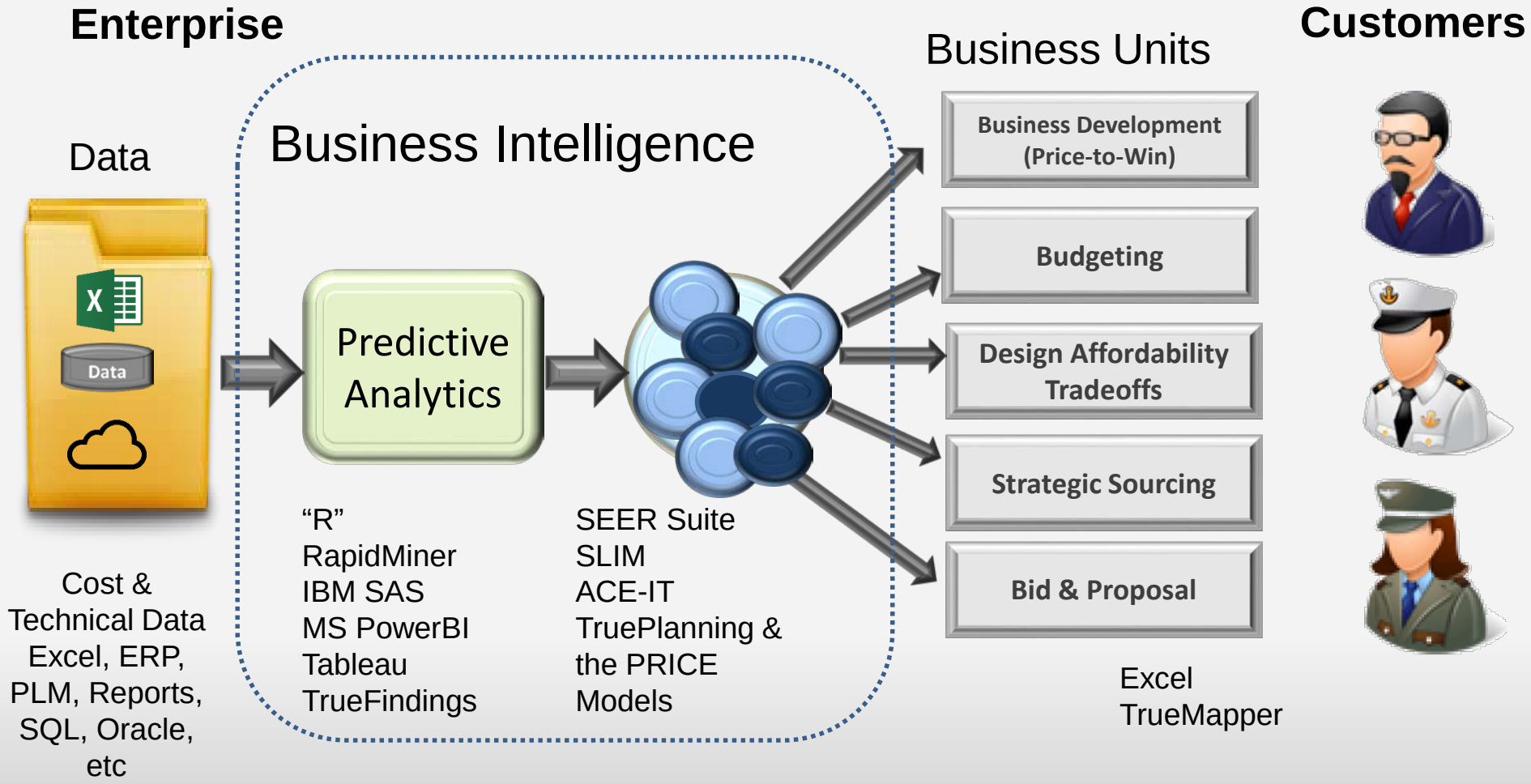
Parametrics with Predictive Cost Analytics



Supervised Data-Mining Speeds the Process

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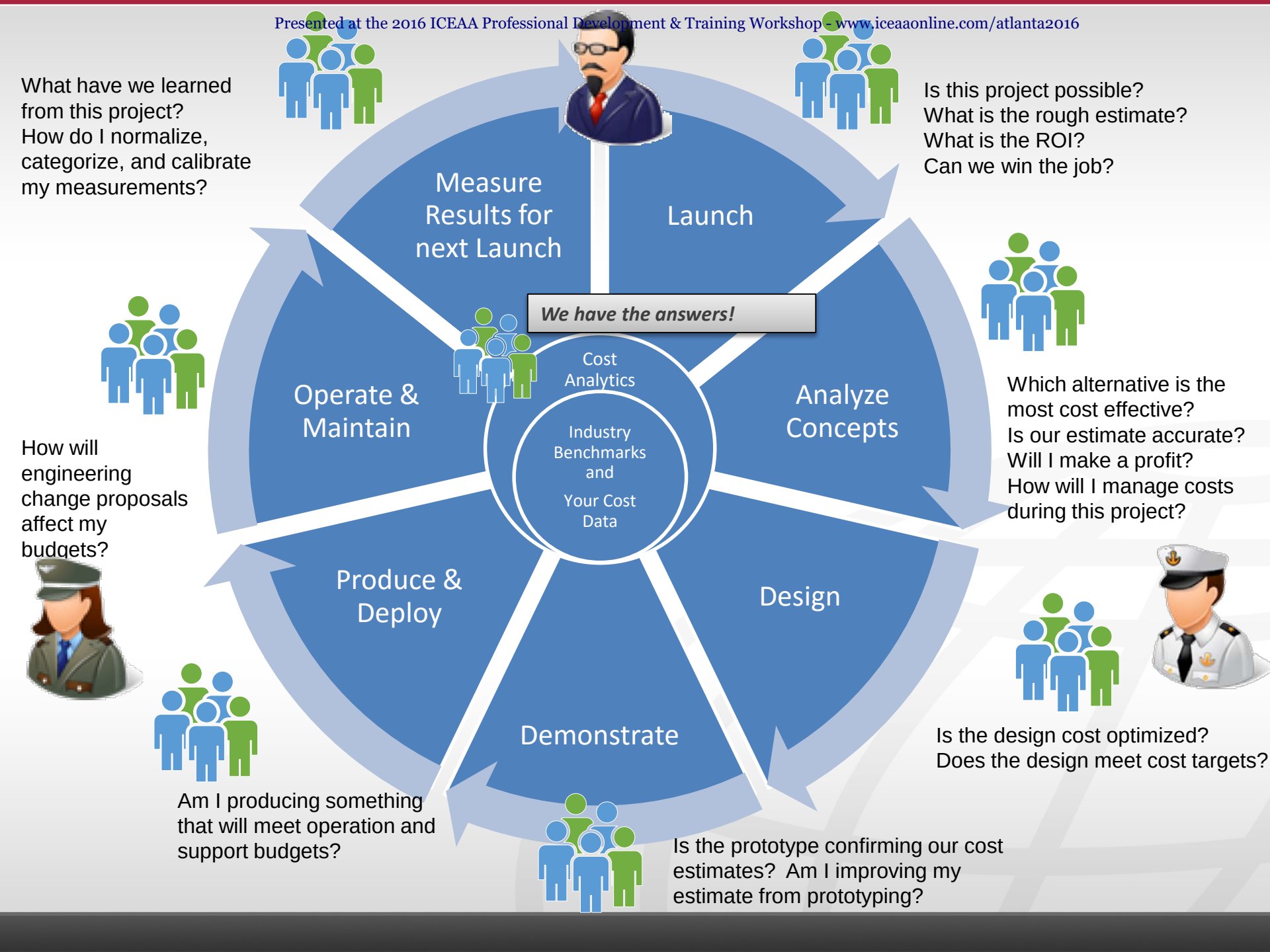
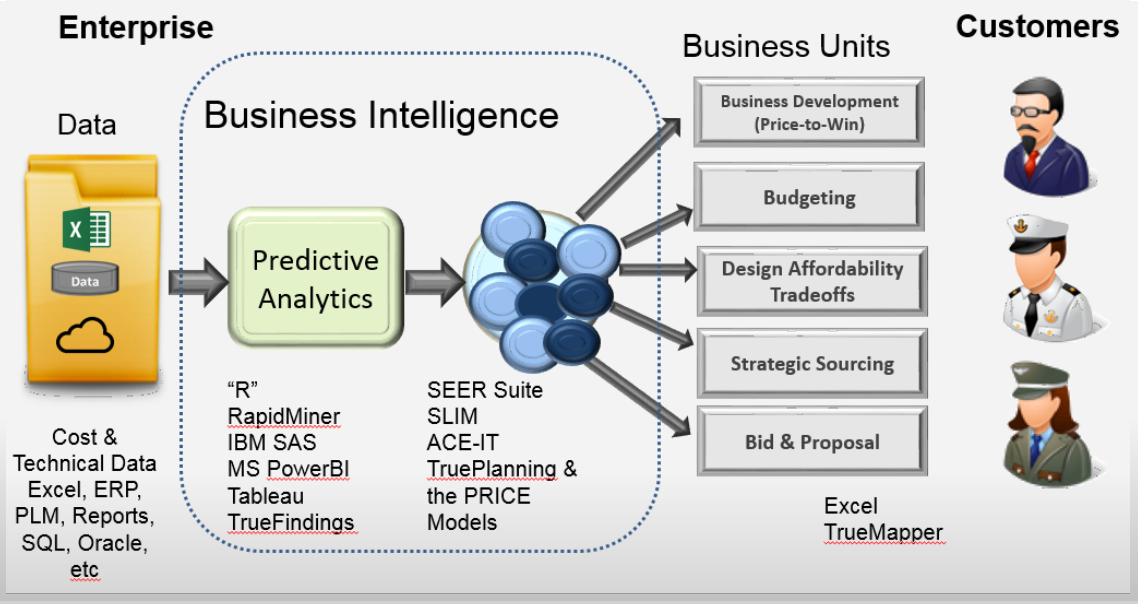

What have we learned from this project? How do I normalize, categorize, and calibrate my measurements?
Is this project possible? What is the rough estimate? What is the ROI? Can we win the job?
Measure Results for next Launch
Launch
We have the answers!
Cost Analytics
Industry Benchmarks and Your Cost Data
Operate & Maintain
Analyze Concepts
Which alternative is the most cost effective? Is our estimate accurate? Will I make a profit? How will I manage costs during this project?
How will engineering change proposals affect my budgets?
Produce & Deploy
Design
Is the design cost optimized? Does the design meet cost targets?
Demonstrate
Am I producing something that will meet operation and support budgets?
Is the prototype confirming our cost estimates? Am I improving my estimate from prototyping?

Predictive Cost Analytics Process



1. *Gather* historic cost data in Excel, rows=items / columns=costs, measures
2. *Categorize & normalize* the data with "supervised" data-mining tools
3. *Analyze* data with statistics to create item and cost driver "findings" to support future estimates
4. *Estimate* costs and schedules with your findings as a frame-of-reference for each item and each cost driver
5. *Map* your estimate to the "customer-language", alternate WBS's. Use mappings to prevalent standards
6. *Inform* your customer so that they can decide with data-driven confidence
7. *Capture* performance on ongoing and completed projects and add to historic data
8. *Repeat*

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Refreshingly Different

Typically, predictive analytics requires painstaking processes for normalizing data and creating "one-off", multivariate models to predict outcomes. Tailoring generic predictive analytics tools to estimate costs and schedules is complicated and time consuming

It is faster and easier to perform "supervised" data-mining and "calibrate" existing, proven models that are tested and supported by experts…

Predictive Cost Analytics

- Specifically designed to predict costs and schedules
- Integrated tools combine to speed the process and lower the cost to predict costs and schedules
- Proven, reusable cost models that capture the common cost drivers of like-items to be estimated
- Subject matter experts know the process, and are available to help you along the way

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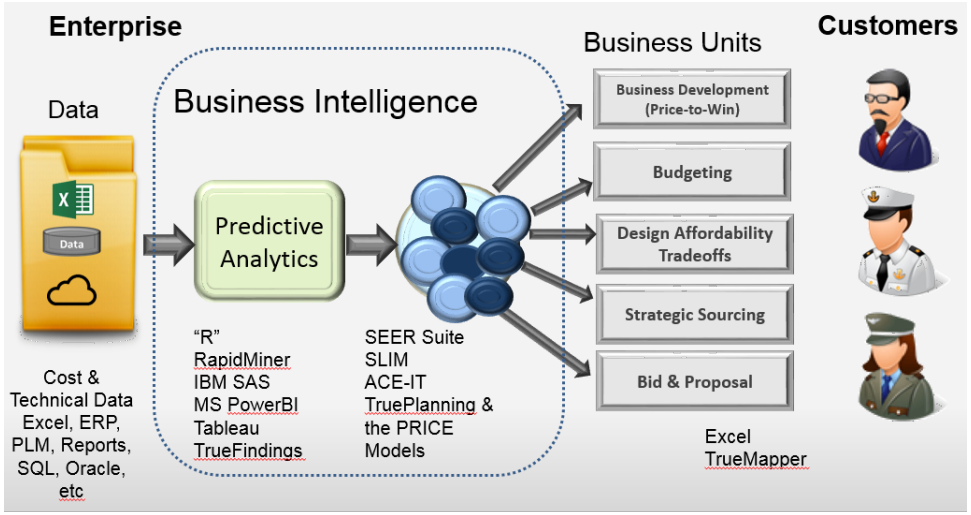
Parametric Models Ease Data Normalization!

Leveraging Supervised Data-Mining

- How big *was* it?
- How much of the engineering and manufacturing *was* new work?
- What *was* the complexity item and the job?
- How familiar *were* the people doing the work?
- *Was* the technology mature?
- When *did* it take place?



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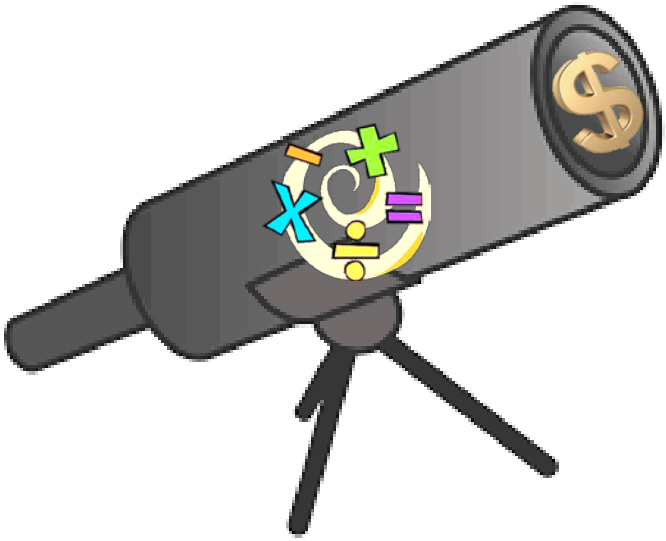
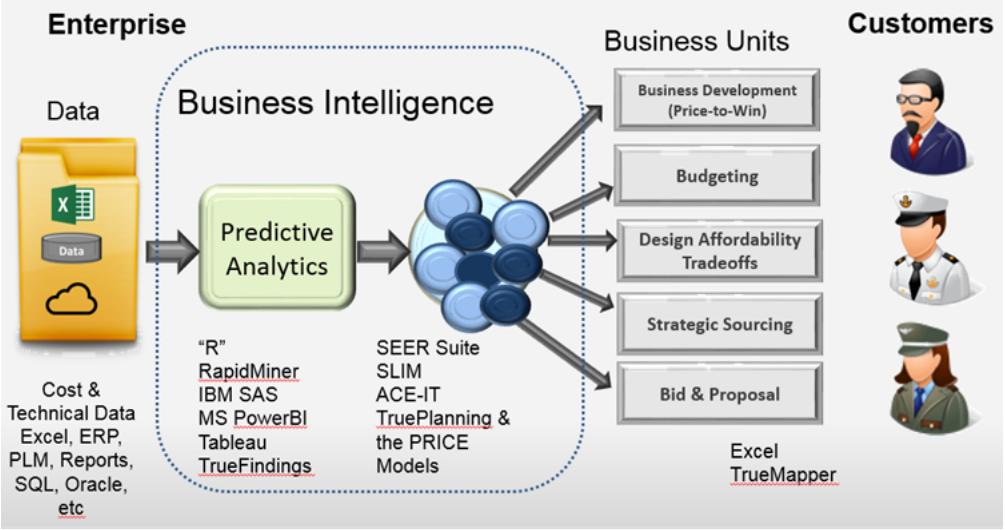
Parametric Models Produce Data-driven Estimates!

- How big *is* it?
- How much of the engineering and manufacturing *is* new work?
- What *is* the complexity item and the job?
- How familiar *are* the people doing the work?
- *Is* the technology mature?
- When *will* it take place?





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1 DATA CAPTURE | 2 DATA MINING & ANALYSIS | 3 KNOWLEDGE MANAGEMENT | 4 PARAMETRIC MODELS | 5 ESTIMATION FRAMEWORK | 6 ESTIMATE MAPPING

Case Study

Defense Contractor

United States

Bid & Proposal *A more efficient DCAA-Compliant estimating system*

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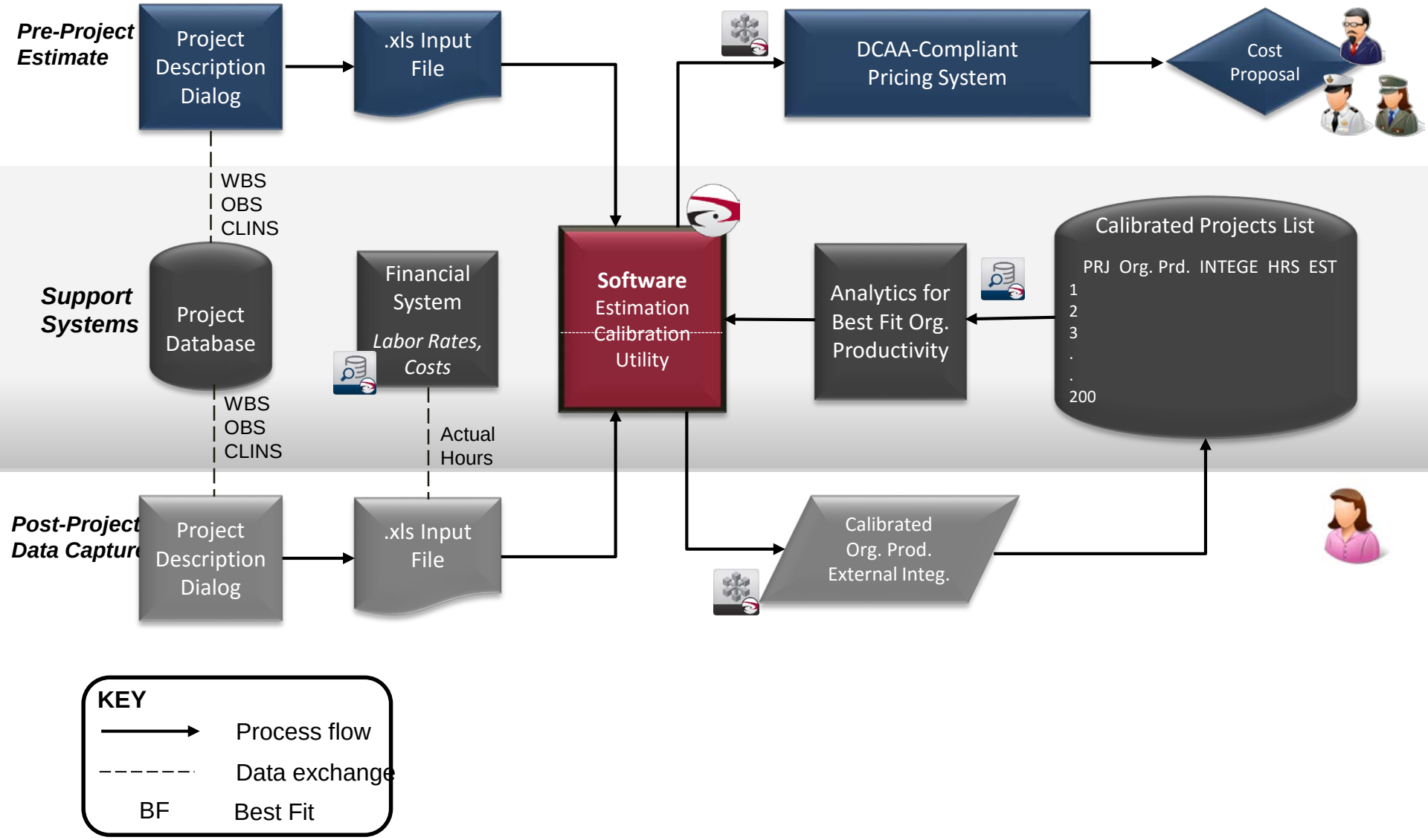
Predictive Cost Analytics in a DCAA-Compliant Estimating System



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Benefits

Revenue Growth – *higher bid volume and win rates based on management and customer acceptance of estimates*

- **Quality –** standardized methodology across domains
- **Efficiency –** faster cycle time to gather data and estimate costs
- **Credibility –** defendable estimates based on historical data
- **Accuracy –** improved accuracy of cost estimates
- **Compliance –** passed DCAA estimating system audits

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1 DATA CAPTURE | 2 DATA MINING & ANALYSIS | 3 KNOWLEDGE MANAGEMENT | 4 PARAMETRIC MODELS | 5 ESTIMATION FRAMEWORK | 6 ESTIMATE MAPPING

Case Study

Major Automobile Manufacturer

Design Tradeoffs *and* ***Strategic Sourcing***

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Predictive Cost Analytics on Parts & Assemblies

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Feature

Attribute

Feature	609
Attribute	16
Platform	5
Brand	3
Model Line	10
COC	5
CSS	32
CPSCII	340
Part	

Platform

BRAND

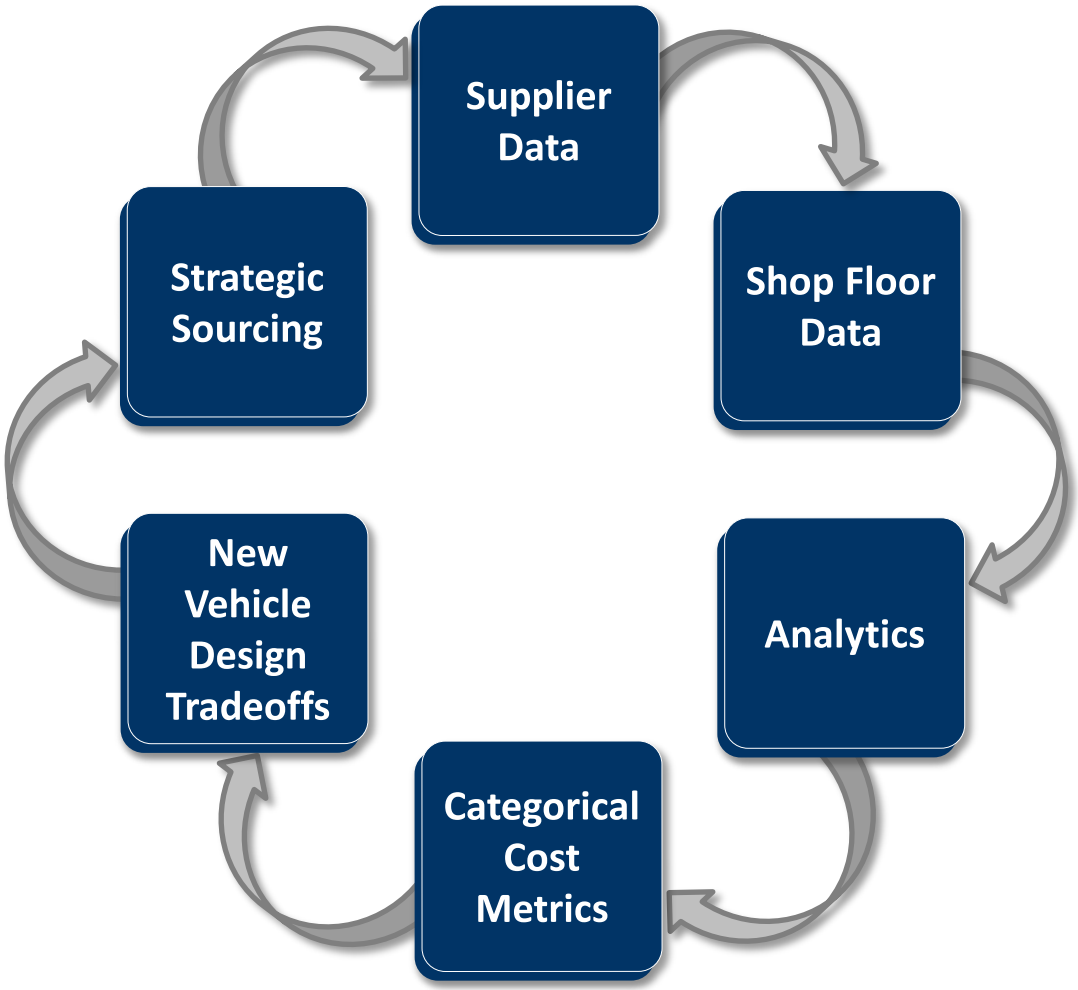
Model Line

COC

CSS

CPSCII

Part



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Benefits

Faster Design Times – Speedier design tradeoffs to meet forecasted market demands

- **Quality –** standardized methodology across domains
- **Efficiency –** faster cycle time to gather data and estimate costs and determine options to be designed
- **Credibility –** defendable estimates based on historical data

Lower Costs – better negotiating position with suppliers by analytically extrapolating from historical data

- **Efficiency –** faster cycle time to gather data and estimate costs
- **Credibility –** defendable "should-costs" based on historical data

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1 DATA CAPTURE | 2 DATA MINING & ANALYSIS | 3 KNOWLEDGE MANAGEMENT | 4 PARAMETRIC MODELS | 5 ESTIMATION FRAMEWORK | 6 ESTIMATE MAPPING

Case Study

U.S. Army AMRDEC ADD
United States
Affordability *- Rotorcraft Tradeoffs*

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Predictive Cost Analytics for Rotorcraft Systems and Subsystems

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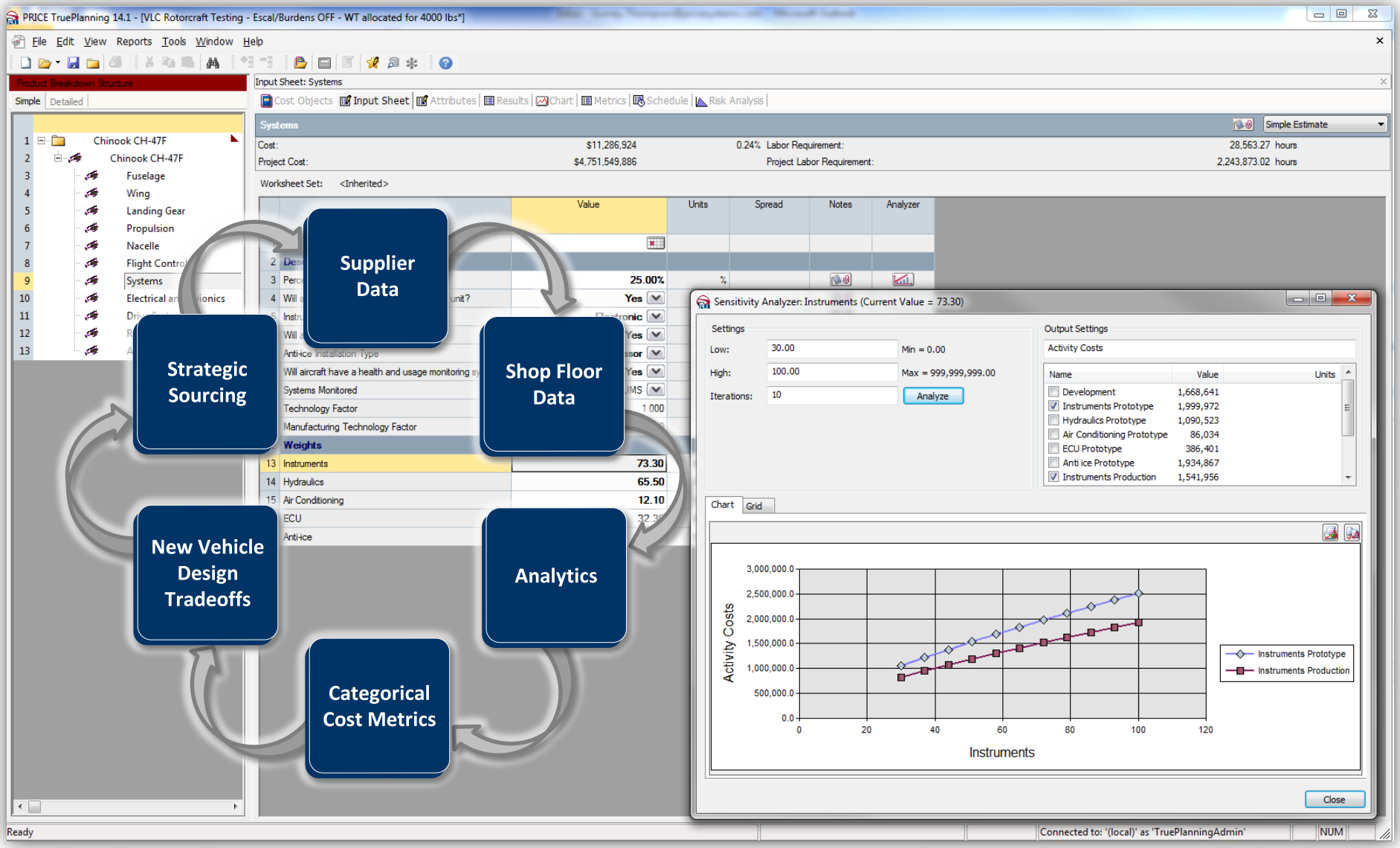

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Benefits

Faster Design Times – Speedier design tradeoffs to meet threat analyses and budget constraints

- **Quality –** standardized, thoroughly tested methodology
- **Efficiency –** familiar, comprehensive framework and user interface. Interoperability links with other systems.
- **Credibility –** defendable estimates based on historical data from OEMs

Credible Budget Requests – realistic budgets from the start, little need for exorbitant budget reserve

- **Credibility –** defendable budget estimates based on historical data from OEMs

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1 DATA CAPTURE
2 DATA MINING & ANALYSIS
3 KNOWLEDGE MANAGEMENT
4 PARAMETRIC MODELS
5 ESTIMATION FRAMEWORK
6 ESTIMATE MAPPING

Case Study

U.S. Army PEO STRI
United States
Budgeting *for Simulation and Training Systems*

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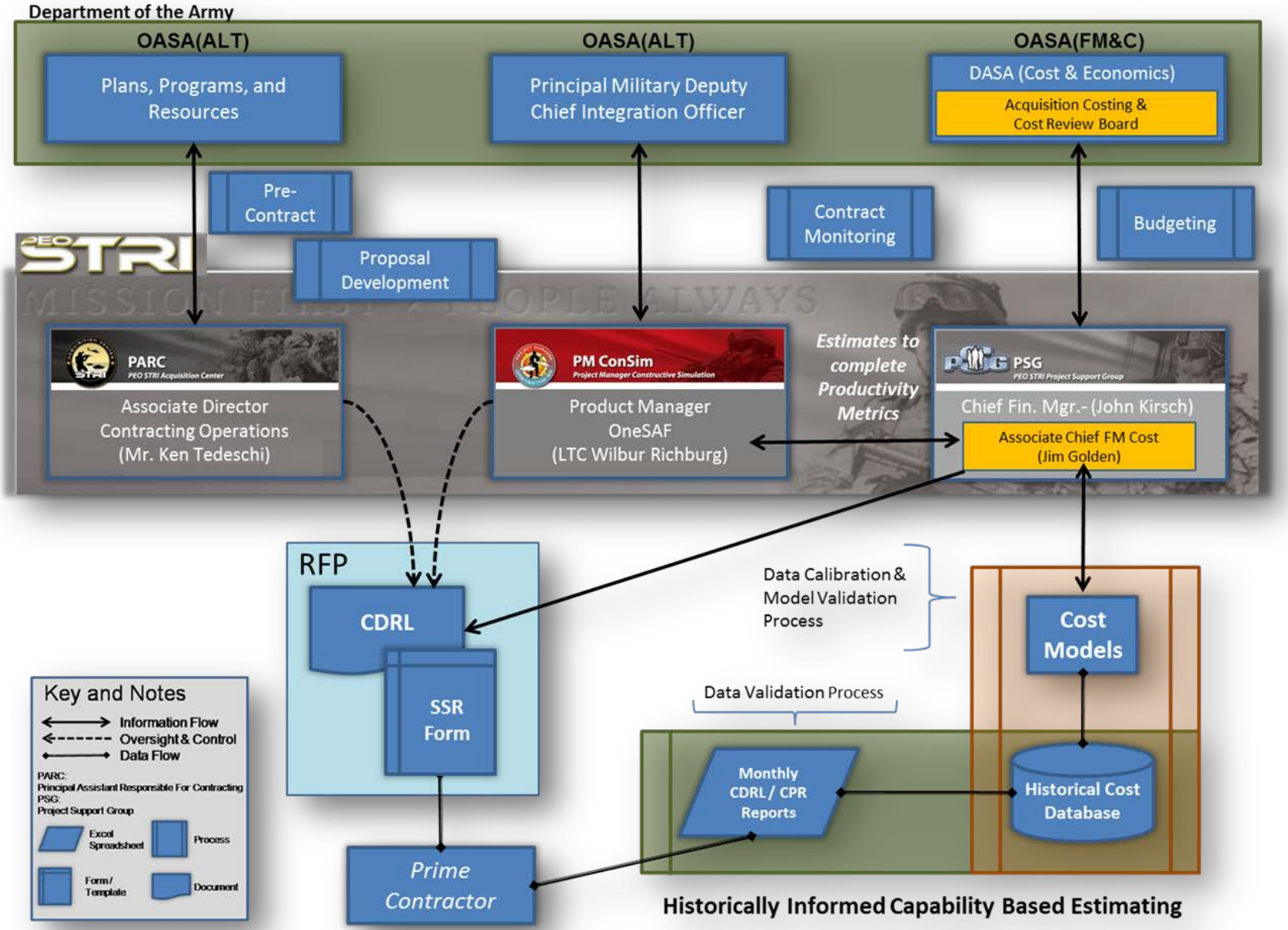
Predictive Cost Analytics for Agile Software Development



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Benefits

Cost Savings

- Program cost savings of over $90M indicated by pilot
  - *Across six years – life cycle usually full operational capability +20*
  - *Using only a 15% reduction in growth factor – actual reduction higher*
  - *Pilot looked at only eight software-intensive programs*
- Cost savings on program life cycle costs significantly reduced
- Cost savings can be reinvested in new technology and to reduce funding requests
- Revenue generation increases as PEO STRI lowers cost to take on more work
- Effective measurement of the productivity of contractors' software development efforts for future pricing/cost estimates.

Qualitative Benefits

- **Compliance –** valid software cost estimate IAW policy
- **Quality –** standardized methodology across domains
- **Efficiency –** faster cycle time to gather data and estimate
- **Credibility –** defendable estimates based on historical data
- **Accuracy –** improved accuracy and funding requests
- **Improved** contractor software data collection process

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6 ESTIMATE MAPPING

Case Study

Thales Group
International – HQ France
Bid & Proposal
Data-driven Bid Validation

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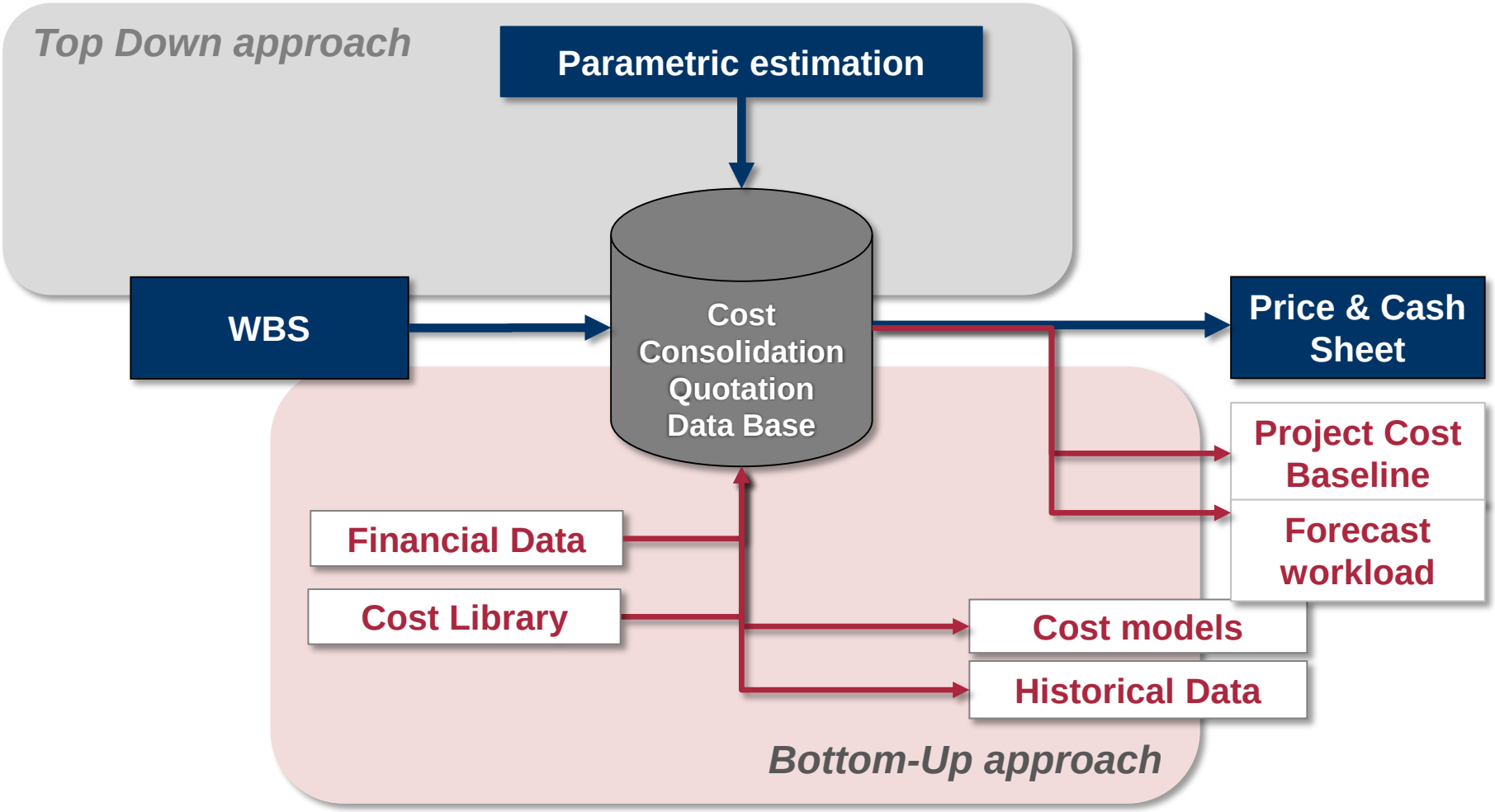
Predictive Cost Analytics for Bid Validation



Reliable Forecast for Efficient & Accurate Decisions

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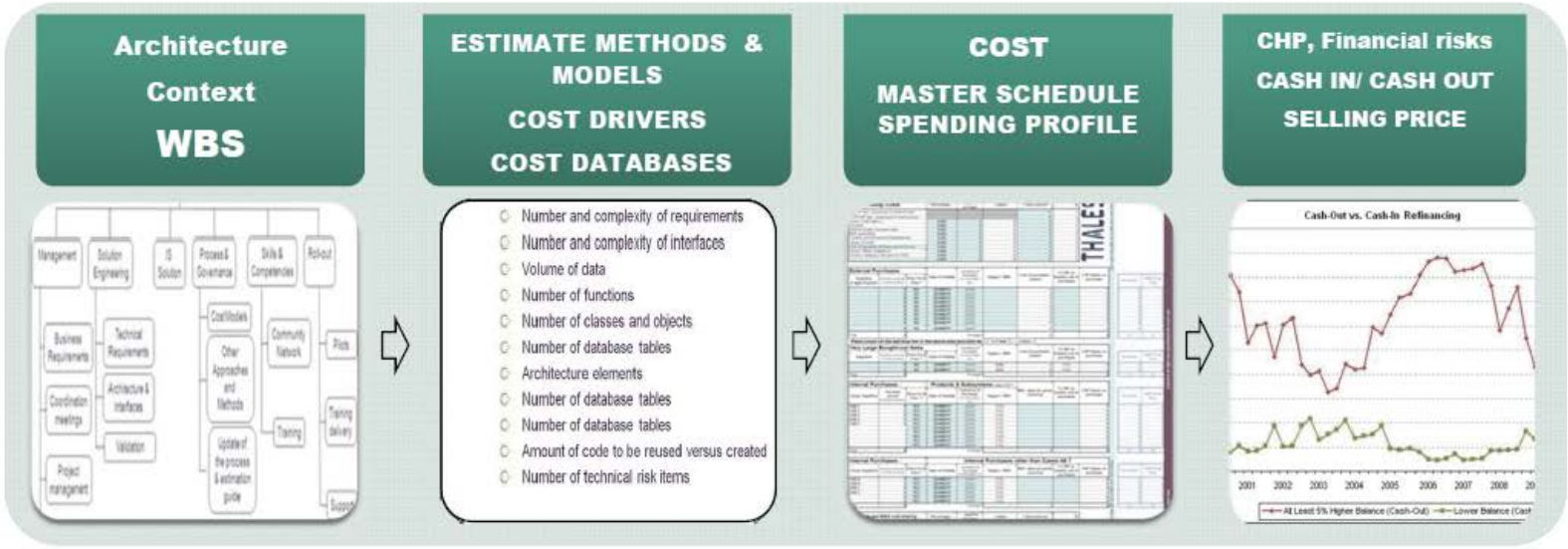
Cost Estimate Toolset

ORIENTATION ORGANISATION → ESTIMATING → COSTING → FINANCIAL ENGINEERING



Cost Estimate solutions

Top/Down Parametric Approach

TruePlanning® by PRICE® Systems

Mapping **Cost Consolidation**

Bottom-up Estimates

OPEN

qdv quickdevis advanced estimating tools

THALES

Main Use Cases

	Top Down Approach	Bottom-Up Approach
Target Cost definition, ROM, quick estimates	✓	
Firm Fixed Price		✓
Cost Challenging & Optimization	✓ Together	✓
External Benchmark	✓	
Complex solution or organization, low maturity	✓	
Business as usual / Product lines		✓
Easy comparison of various scenarios	✓	
Detailed risk analysis		✓
Commitments		✓

Complementary Approaches
to Improve Estimates Challenging and Confidence

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Benefits

- **Improved Win Rate -** Consistent use of Bid Verification/Validation methodologies avoids over optimism
  - Unbiased metrics from measured benchmarks
  - Provides consistent and credible link to Price-to-Win
- **Accuracy -** Persistent link between "as built" Product Breakdown Structure (PBS) and "reporting" Work Breakdown Structure (WBS)
  - Reveals missing or inconsistent estimates
  - Reconciles Data-Driven estimates with grassroots estimates
  - Mitigates Risk
- **Team Unity -** Unifies "Top Down" Parametric Estimating with "Bottom Up" Grassroots estimating
  - Creates "buy-in" across the organization
  - Minimizes errors and omissions

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Predictive Cost Analytics

- What is it?
  - Leveraging over 40 years of parametric estimating experience with the predictive analytics big bang
- Why now?
  - To speed and lower the cost of predictive cost analytics to expand its reach
- What are the benefits?
  - Better budgeting, revenue growth, win rates, efficiencies. Cost savings. Data-driven Credibility.
- What's next?

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What's next?

Predictive Cost Analytics for Everyone

- More and improved Models
  - Model improvements
  - New models
  - Analytical findings
- More automation of tasks
  - Automatic analytics
  - Seamless tool integration
  - Seamless data integration
- More widespread use
  - Modeling simplification and automation with Business Process Management (BPM)

Provider objectives are to speed and lower the cost of predictive cost analytics for everyone!

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Questions?

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