Abstract

- **This presentation will briefly discuss the three methods of estimating; analytical, analogous and parametric before studying parametric cost and schedule estimating in more depth. It will consider the benefits of generating parametric estimates early in the project life cycle and other applications of parametric estimating when little information is available to the cost engineer.**
- **The presentation will review why parametrics is useful and how it can be adopted by an organization. The case study that will be presented will be based upon the creation of a simple parametric model, adapted from a recently completed study.**

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Parametric Cost Estimating

What is it and how is it useful to you?

ISPA / DACE 4th March 2010

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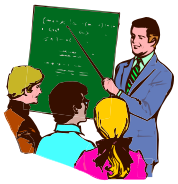
Outline



- **Methods of Cost Estimating**
  - Analytical Estimating
  - Analogous Estimating
  - Parametric Estimating
- **Appropriate methodology**
- **Applications of Parametrics**
- **Summary**

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Cost Estimating Methodologies

1. **Analytical (Bottom-up, Grass-roots, Detailed)**
2. **Analogy (near neighbour)**
3. **Parametric Cost Model**
   - Cost Estimating Relationship (CERs)

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Analytical

1. Analytical

- **Also known as**
  - Detailed Build-up
  - “Grass Roots”
  - “Bottom-up”
- **Most common technique in cost proposals**
- **Generally the most costly and time consuming**
- **Complete for each functional labor category**
  - Engineering
  - Manufacturing
  - Program Management
  - Quality
  - Tooling and Test

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Analytical (con’t)

- **Functional category hours are generally estimated by a Functional Specialist**
  - Requires a Statement Of Work and specification
  - Examples: number of people, standard hours, or historical hours for a specific task
- **Can be difficult to map functional hours to individual Work Breakdown Structure (WBS) elements**
- **Labor estimate is always completed at the lowest level and summed to a higher level**
- **Material costs may be estimated at the part or assembly level**
  - Bill of Materials must be known
- **Used when the product is well defined and each functional category of cost can be accurately estimated**
- **Commonly used to estimate hardware costs**

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Analytical (con't)

Advantages

- Very detailed
- Well-accepted methodology
- Promotes 'buy-in' to the resources

Disadvantages

- Resource intensive and time consuming
- Omissions and duplications are likely
- Often subjective; contains distortion, Can lack creditability
- Making changes is very difficult and normally cannot be accomplished in a timely manner
- Detailed specification and SOW must be available

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Analogy

2. Analogy

- **A comparison between two systems or efforts**
- **Based on a relative scaling of a data point**
- **Determination of how much more or less the new system will be relative to the historical data point**
- **Commonly used for ROMs and as cross-checks**
- **Subjective factors are used many times to adjust analogous system cost to new system**
- **Requires minimal time and cost**
- **Normally completed at the system or sub-system level**
  - Greater time and costs will be incurred when analogous estimate is completed at LRU level

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Analogy Example

	Performance	Cost
Old (Analogous System) :	Mach 1.5	$30M

New System: Speed is 2x old System

Cost of New System = 2 x $30M or $60M

Analogy normally assumes a Linear Relationship

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Analogy (con't)

Advantages

- Can be used early in program life cycle before performance or technical requirements are defined

Disadvantages

- Subjective
- Normally assumes cost and technology are Linear
- Difficult to obtain cost and technical data at LRU level

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Parametric Cost Model

3. Parametric

- **Parametric Cost Model**
  - Is a mathematical relationship
    - Cost to Cost
    - Performance to Cost
    - $ per pound
    - Factors
  - Statistical inferences
- **Cost Estimating Relationship (CER) is also considered a Parametric Cost Model**
- **Commercially available cost model**

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UK MOD need for a parametric model

- **UK MOD Requirements;**
  - Assurance and Approvals processes require evidence to support Business Cases
  - Requirement for Early cost estimates for new capabilities
  - Capability Gap in Forecasting team
  - Development of through life capability models
  - Models that were open and easily Validated and Verified
  - Better application of MOD specialist cost modeling skills
- **The objective to develop in house process for CER generation in order to:**
  - enable high level summary cost predictions at the concept phase,
  - utilizing platform specific performance parameters (Cost Drivers) relevant to the generic system types
  - Capture of rules of thumb in a single workbook

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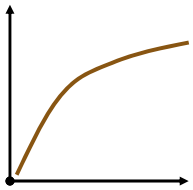
Summary of approach

Cost Estimating Relationship (CER)

Cost Drivers
- Design
- Performance



Output
- Cost
- Schedule
- Performance

Normalised

Historical Project Data

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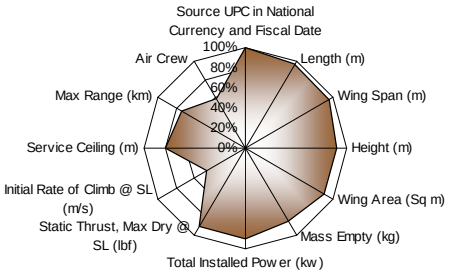
Database coverage

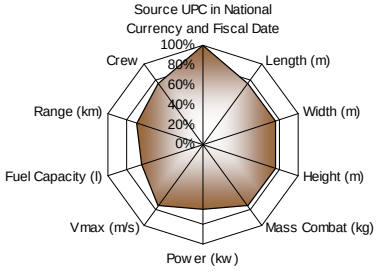
Air Systems

260 Systems



Land Systems

30 Systems



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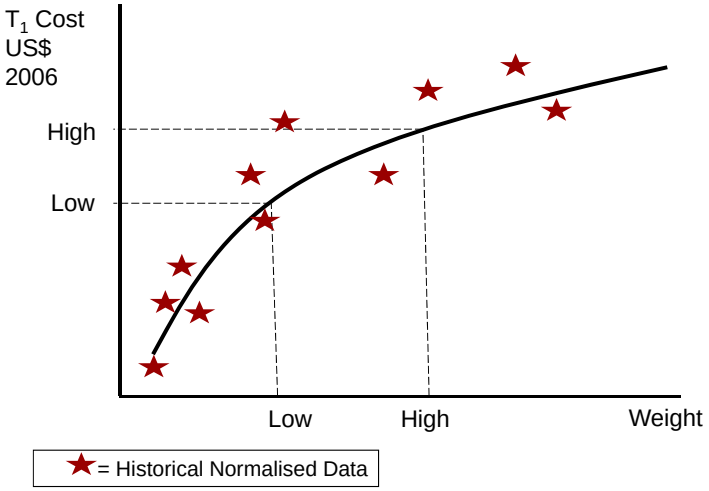
First Hypothesis - Weight Cost Driver



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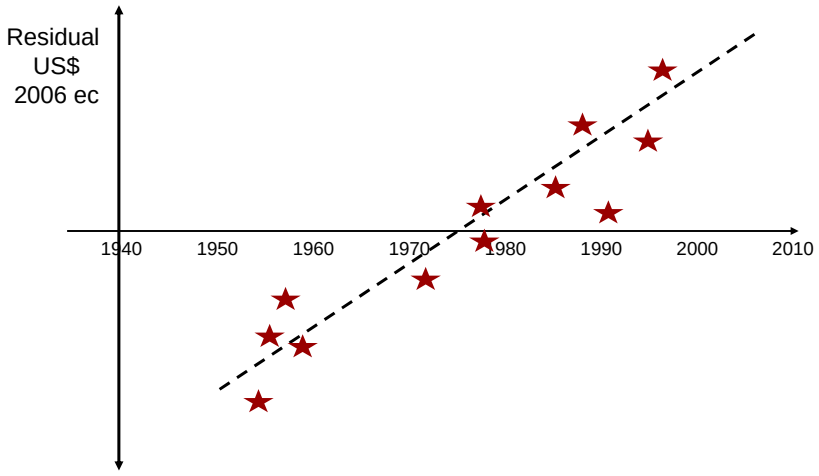
Second Hypothesis - Technology Cost Driver



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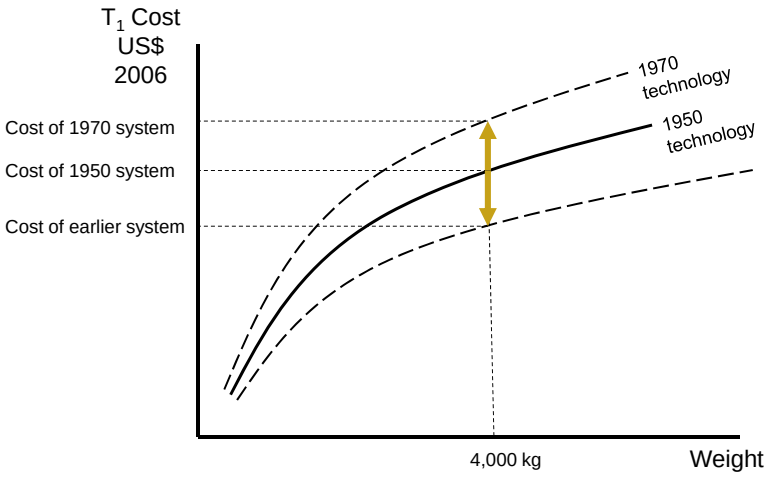
Combined weight and technology drivers



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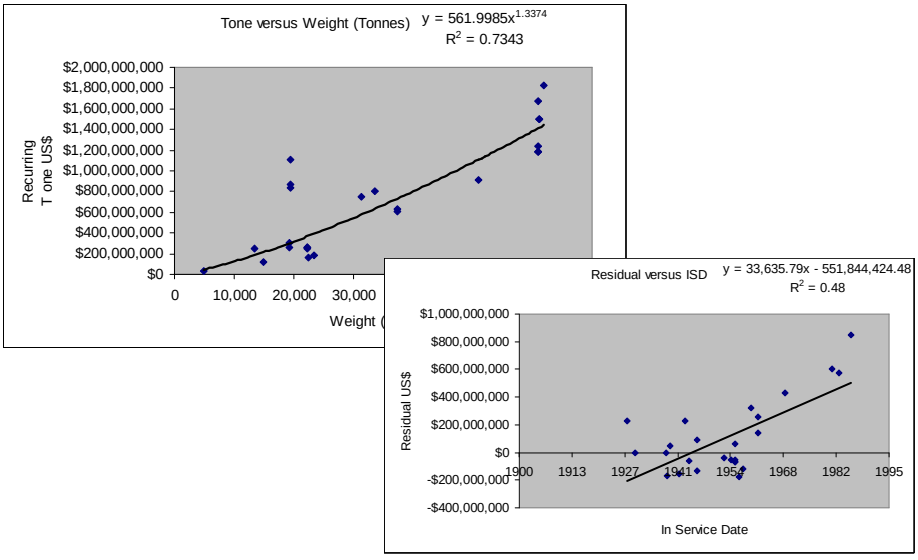
Aircraft Carriers Cost Object



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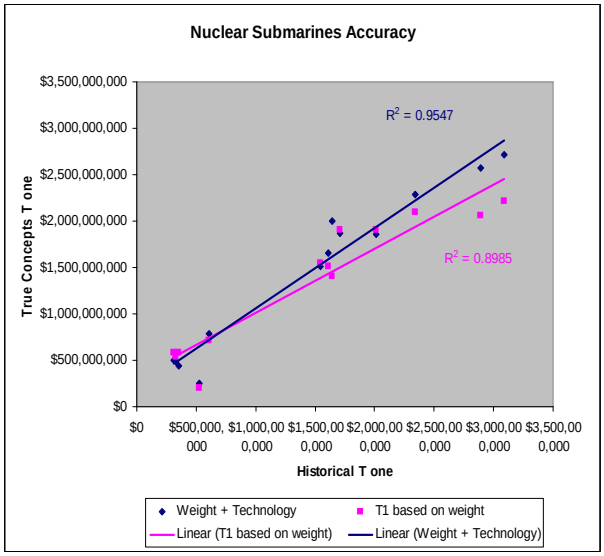
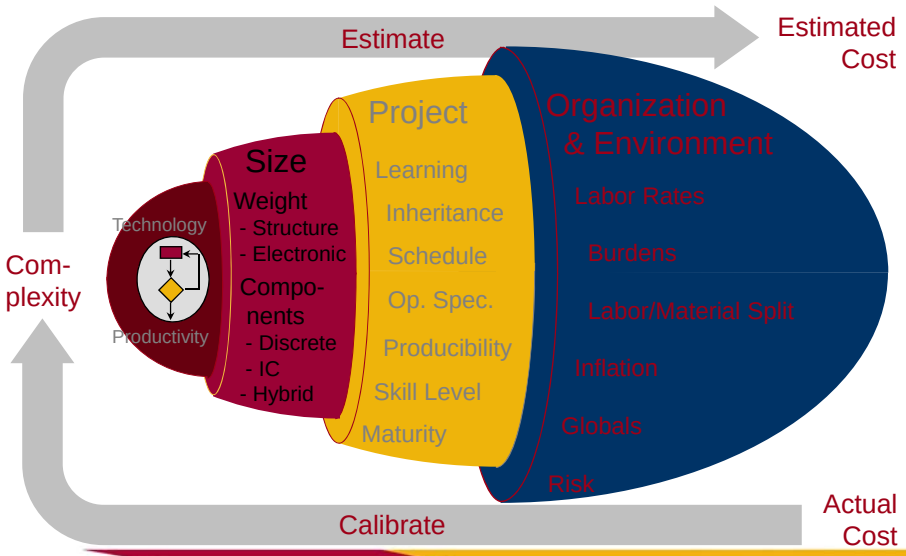
Prediction versus History



Parametric Cost Model (con't)

- **Commercial Cost Model**
  - Requires training for effective use
  - Can be applied at system, subsystem, LRU level
  - Used as an independent cross-check of an estimate, for example procurement agencies
  - Can be calibrated to reflect performance to cost trends
  - Database is required for use as Basis of Estimate

Structure of a parametric model (‘the onion’)



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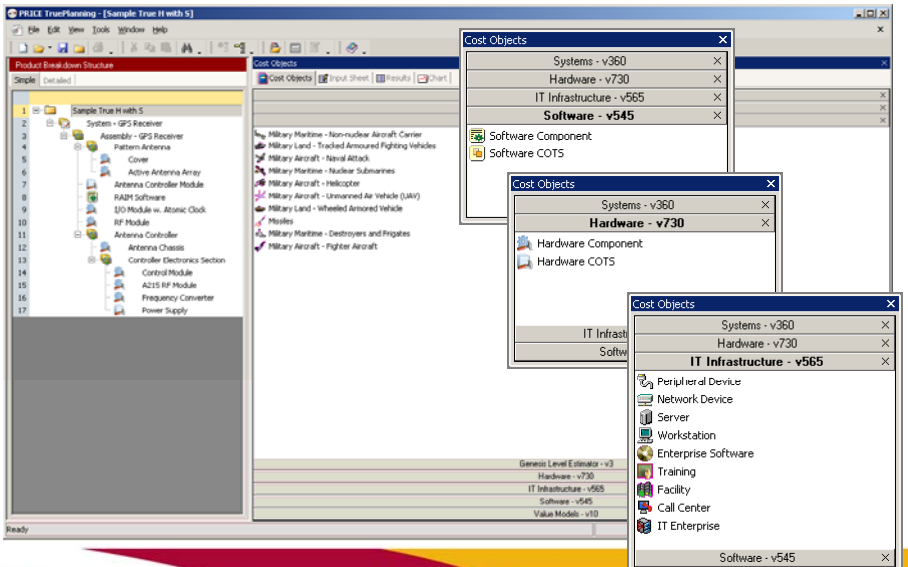
Commercial Parametric cost model example



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Parametric Cost Model (con't)

Advantages

- Produced in a fraction of the time of other methods
- Eliminates single point failures (one person understands the spreadsheet)
- Consistent
- Data Base
- Performance can be related to cost

Disadvantages

- Special training normally required
- Calibration should be accomplished to keep model current

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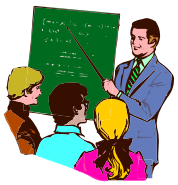
Outline



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Which estimating methodology? - General selection criteria

The "most appropriate" methodology is generally based on considerations such as:

- Program phase
- Program requirements stability/maturity
- Availability of relevant historical data
- Type of estimate required
- Customer requirements and/or preferences
- Time and/or manpower to complete estimate

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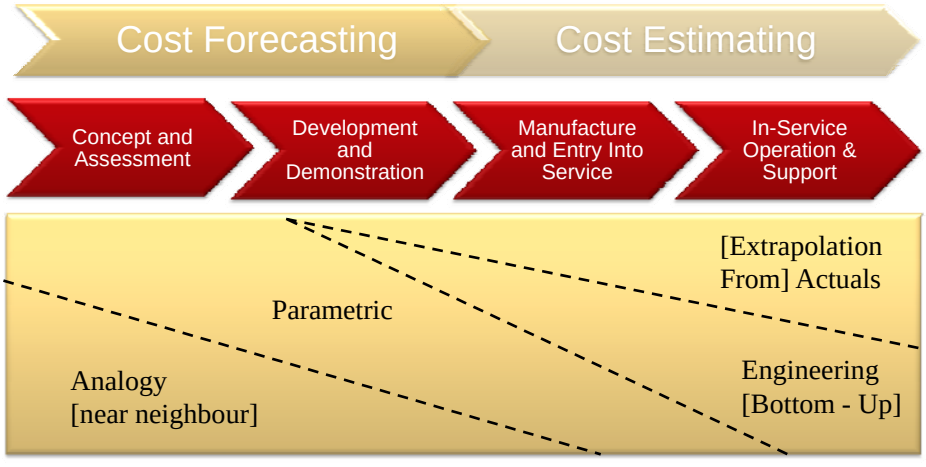
Appropriate methodology for delivery



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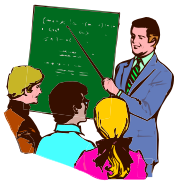

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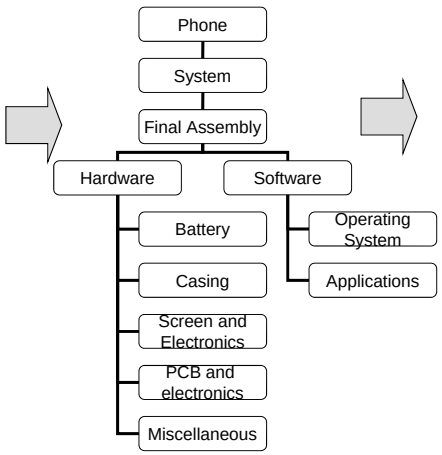
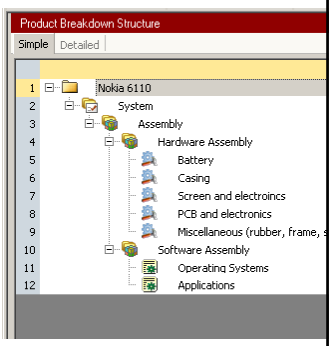
Parametric Estimating process - Step one

System ***Product Tree*** ***TruePlanning PBS***





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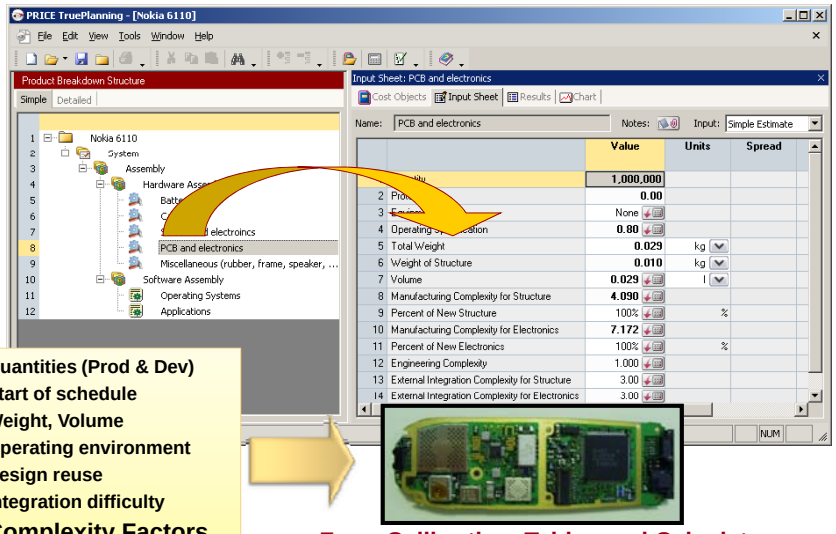
Parametric Estimating process - Step two



- Quantities (Prod & Dev)
- Start of schedule
- Weight, Volume
- Operating environment
- Design reuse
- Integration difficulty
- **Complexity Factors**

From Calibration, Tables and Calculators

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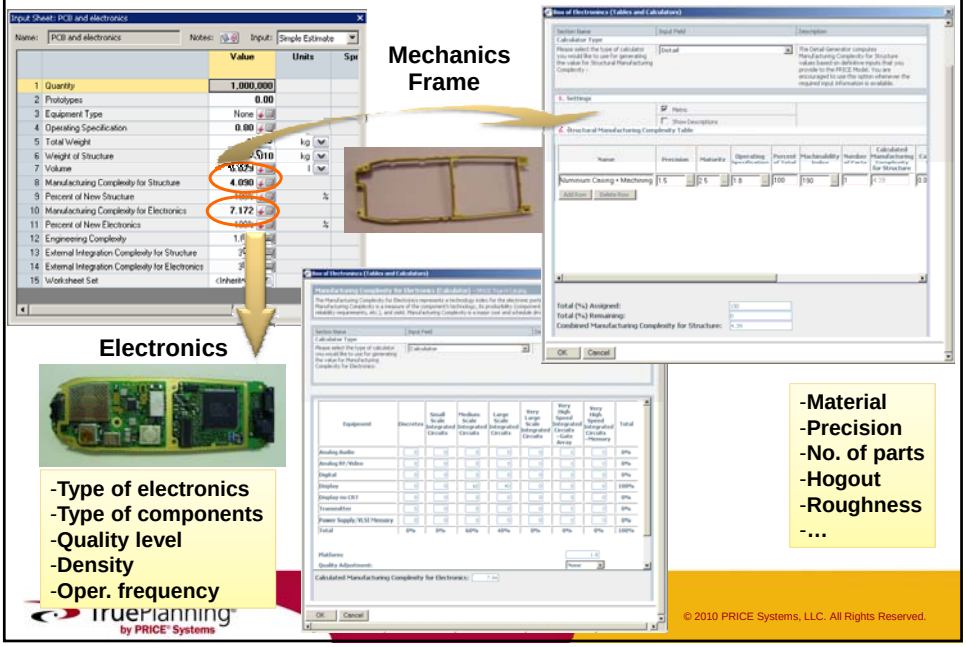
Parametric Estimating process - Step three



-Type of electronics
-Type of components
-Quality level
-Density
-Oper. frequency

-Material
-Precision
-No. of parts
-Hogout
-Roughness
-…

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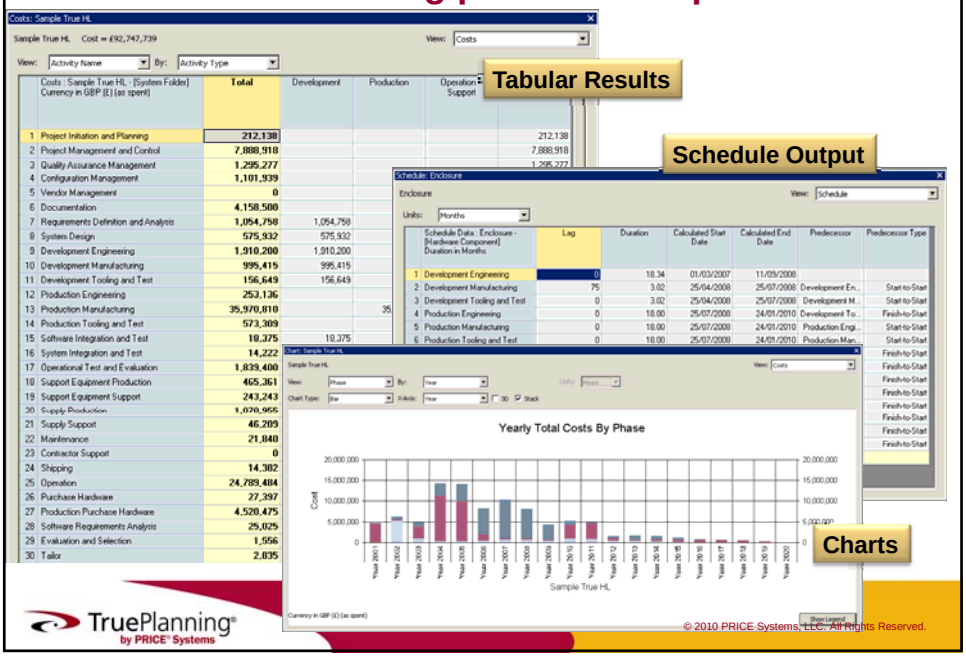
Parametric Estimating process - Step four



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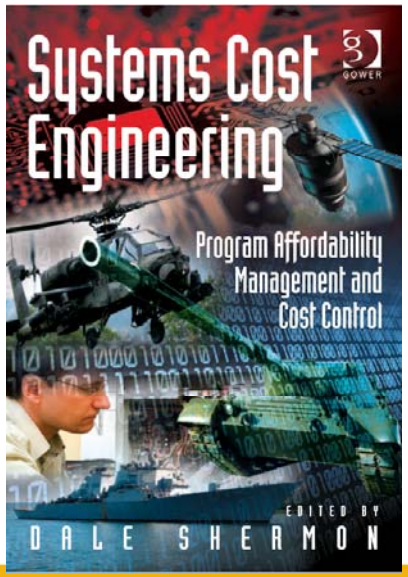
Systems Cost Engineering

Systems Cost Engineering will help cost engineers, the project and program directors, and champions that support them, to understand and apply parametrics to ensure that their programs:

1. **offer a credible analysis of alternative cost options;**
2. **are never initiated with insufficient funding because of inaccurate estimates of cost or quantification of risks;**
3. **are never diverted from their objective because of a lack of credible cost management;**
4. **share and communicate knowledge of realistic and dynamic cost and productivity metrics amongst the program team;**
5. **are never derailed by surprise cost overruns or schedule delays.**



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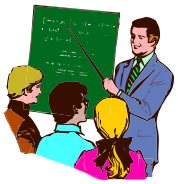
Outline



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Summary

- Comparison of estimating techniques
- An appreciation of parametric estimating
- Demonstration of a high level parametric model
- Appreciation of applications of parametrics

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Who Are PRICE Systems?

- **Worlds leading provider of cost measurement, cost modelling and cost forecasting solutions**
- **Independent employee owned software licensing and professional services company**
- **Serving the Aerospace, Defence, Commercial Aircraft Industry for over 30 years**
  - Now including the corporate banking industry
- **Over 70 people worldwide in 8 locations**

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Where is PRICE Systems?

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Parametric Cost Estimating

What is it and how is it useful to you?

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Any Questions?

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