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CAD Model & Parametric Cost Model Integration – A Case Study

Dr. Christopher Rush

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SEER® by GALORATH

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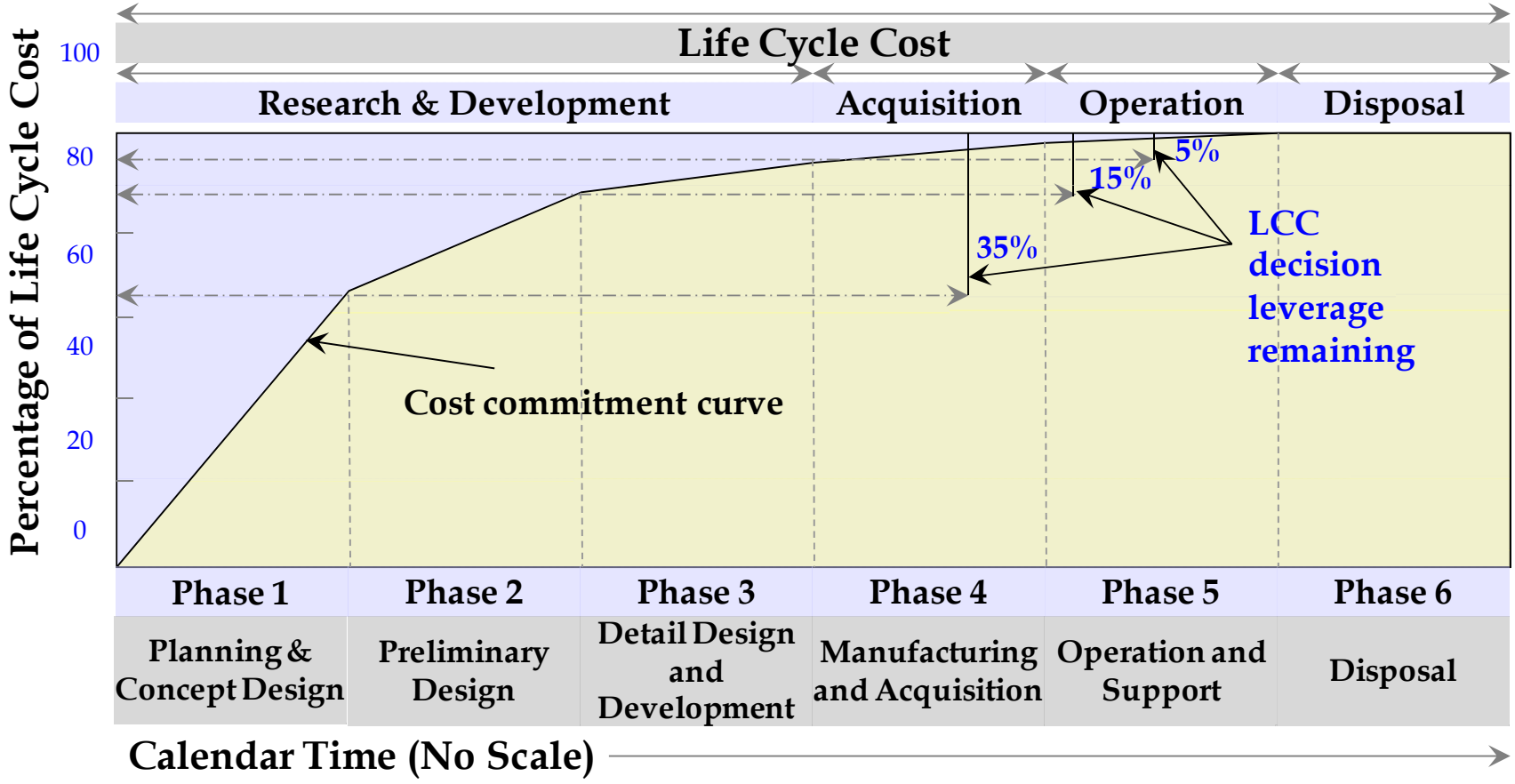
Project Motivation

- Provide real time cost feedback to engineers
- Enable non cost engineers to develop cost models automatically
- Enable engineers and managers to perform more design trade studies in a shorter time frame
- Support decision making when the opportunity to reduce cost is at its highest
- Influence the ‘go’ or ‘no – go’ decisions…
- Cost Engineers Dream..?

Project Motivation Cont...

- Cost Commitment Curve



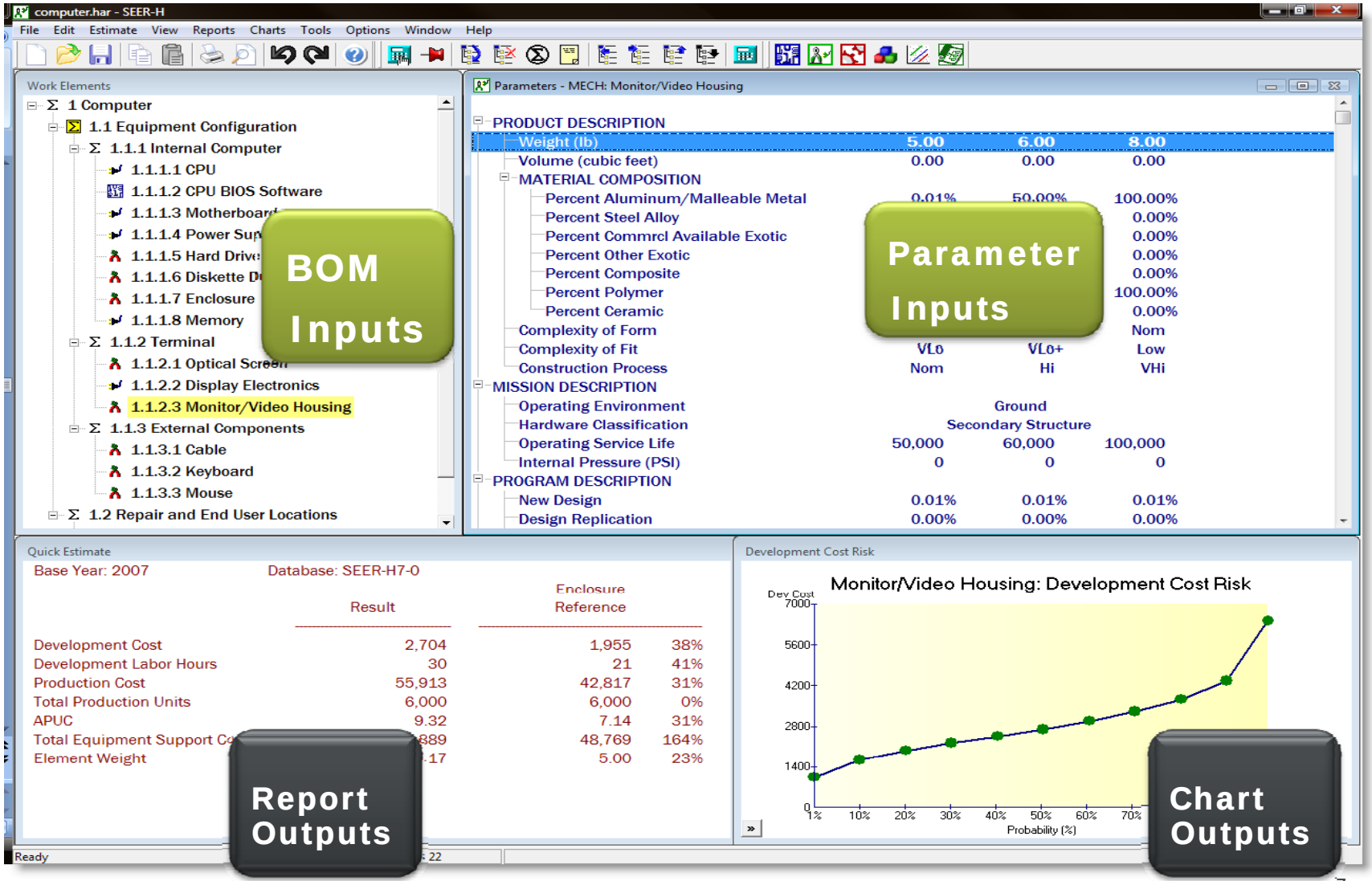
Parametric Cost Modeling

- Dates back to the 1950's;
  - Introduced by the RAND Corporation for the US Air Force
  - Widely used by Government and Industry
- Uses historical samples to establish statistical relationships
- Uses the past to predict the future
- Linear regression most popular & simplest technique $y = a + b(x)$
- Typically used during the product development stages
- Reduces time required to produce estimates

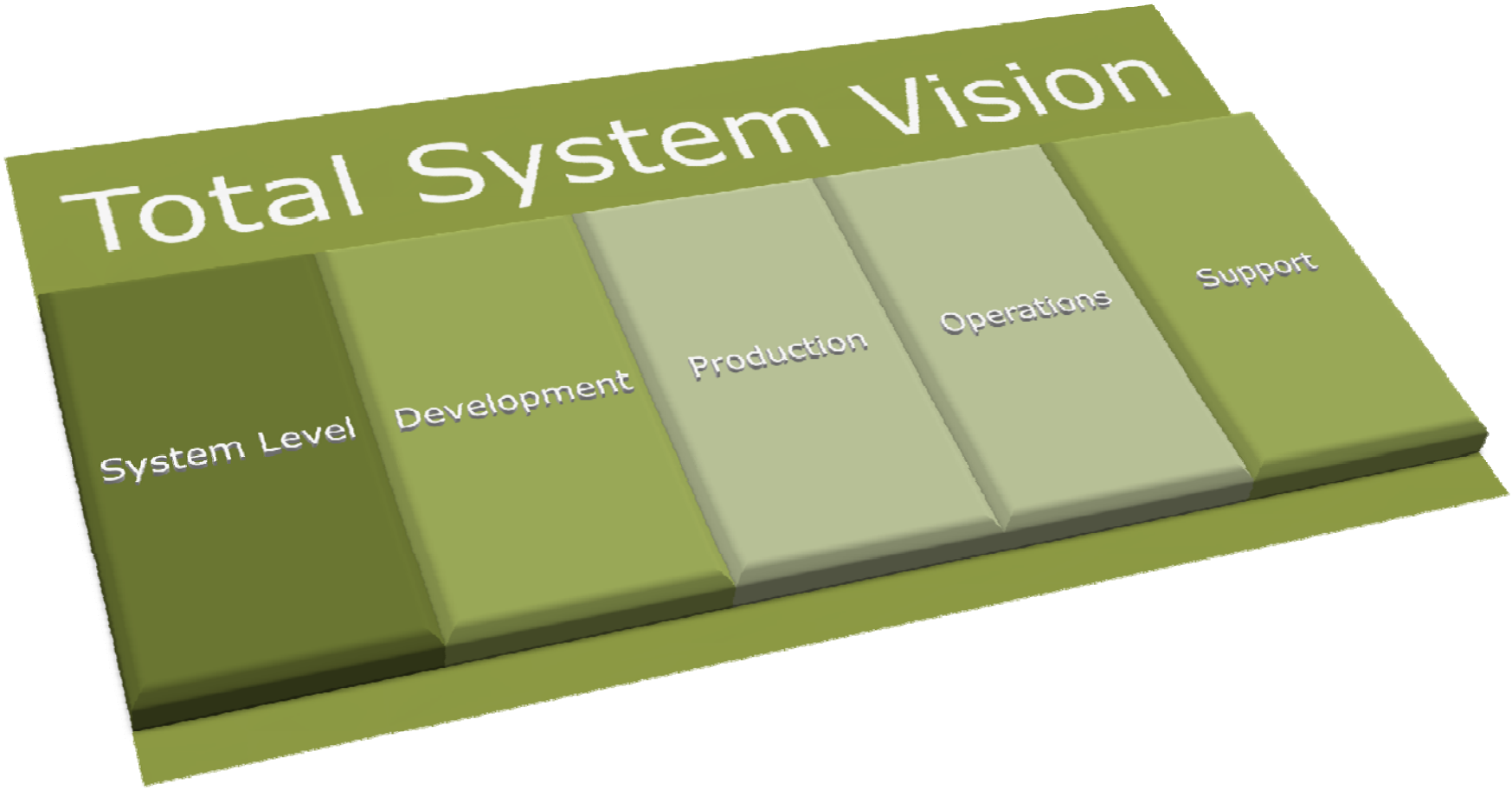
SEER for Hardware Cost Model

- Uses Parametric Algorithms
- Provides estimation of product development, production, operations, support, and system costs to Government & Industry
- Built in Knowledge Bases
  - Provide parameter inputs before you know details
  - Excellent for quick estimation and tradeoffs
  - Contain relevant ranges of inputs, calibration, and sanity information
  - Create User Defined Knowledge Bases
- Calibration Tools enable Customization to particular experience and expertise

SEER for Hardware User Interface

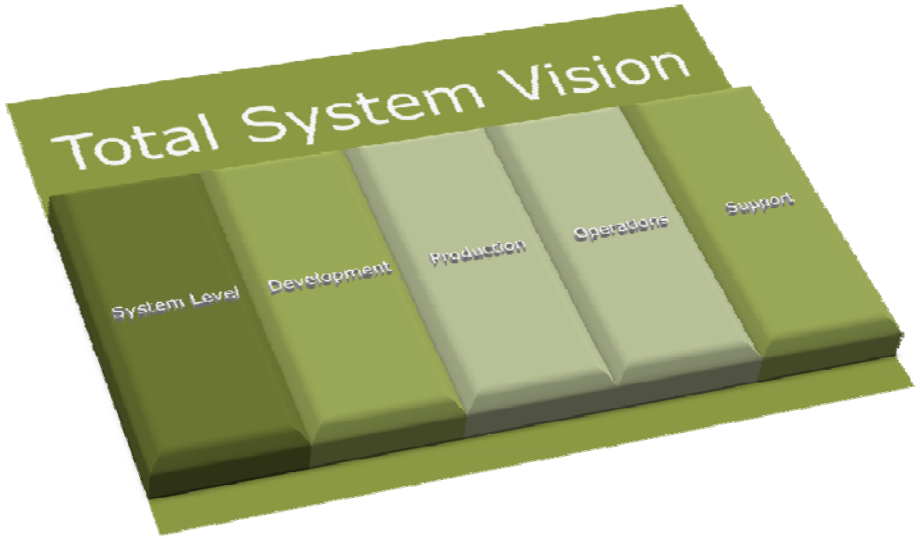


What does SEER for Hardware Estimate?



What does SEER for Hardware Estimate?

- System Level Cost estimation
  - **System program management**
  - **System engineering and integration**
  - **System test operations**
  - **System integration, assembly and test**
  - **System support equipment**
- Development estimation
  - **Design**
  - **Prototypes**
  - **Tooling**
- Production estimation
  - **Direct Labor--fabrication, integration, assembly**
  - **Indirect Labor-**
  - **Material--raw materials, purchased components**



- Operations & Support scenario estimation
  - **Program schedule**
  - **Product reliability**
  - **Product maintainability**
  - **Product availability**

CAD Models

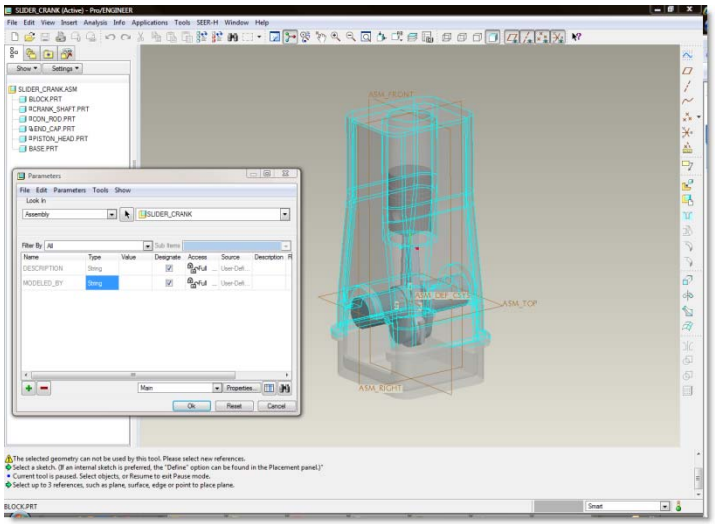
- Pro Engineer Wildfire 3.0
  - Parametric Technology Corporation (PTC)
- CATIA
  - Dassault Systemes
- Unigraphics NX
  - Siemens PLM Software
- Which CAD model?
  - To use a CAD API, one must become a CAD Vendor 'Partner'
  - PTC (Pro Engineer) was selected as the first system with which to integrate

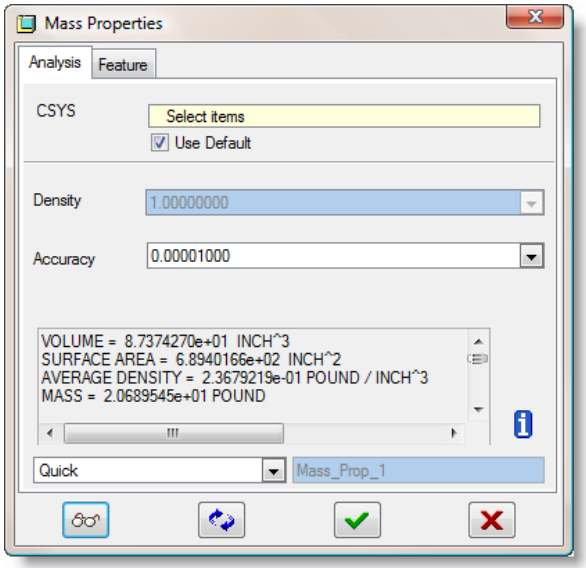
Methods of Integration

- Export data from CAD to a third party tool, analyze/format data and then import to Cost Model
- Use a third party tool such as iSight, or Model Center
- Direct integration using CAD Application Programming Interface (API) and cost model (API)
  - Used in this Case Study
  - Provides the most seamless integration

Understanding Pro/E

- Pro/E is used to develop both Parts and Assemblies
- Third party tools are integrated using Pro/E API
- Example interfaces and dialogs users are familiar with (shown right)
- CAD models provide key parameter values that a parametric cost model such as SEER-H requires e.g.
  - Material, Part Extents, Mass Properties (mass, volume, weight, etc.)





Understanding Pro/E API

- C++ Programming language was required
- Types of API documentation
  - HTML, and PDF documents (sometimes difficult to follow)
- API technical support
  - Phone (indirect access), emails & website (slow to respond)
- The API can be used to control and access most of the common application functions
  - Material properties, mass properties, etc.
- Basic dialogs and controls can be used via the API e.g. Combo boxes, list boxes, text boxes etc.
  - Advanced controls were not available in version 3.0, e.g. Tree Controls

Understanding SEER API (Server Mode)

- Server Mode is an alternative to the SEER interactive, graphic, user interface
- It uses a stream of commands that are run from either the clipboard, a text file, or an Automation Interface
- It is typically used to Integrate, Run, and/or Create SEER estimates from applications such as requirements tools, spreadsheets, project management tools, ERP systems, or CAD tools
- Is based on simple to use commands making it quick and easy to learn:
  - ProjectCreate, WBSCreate, Exit etc.

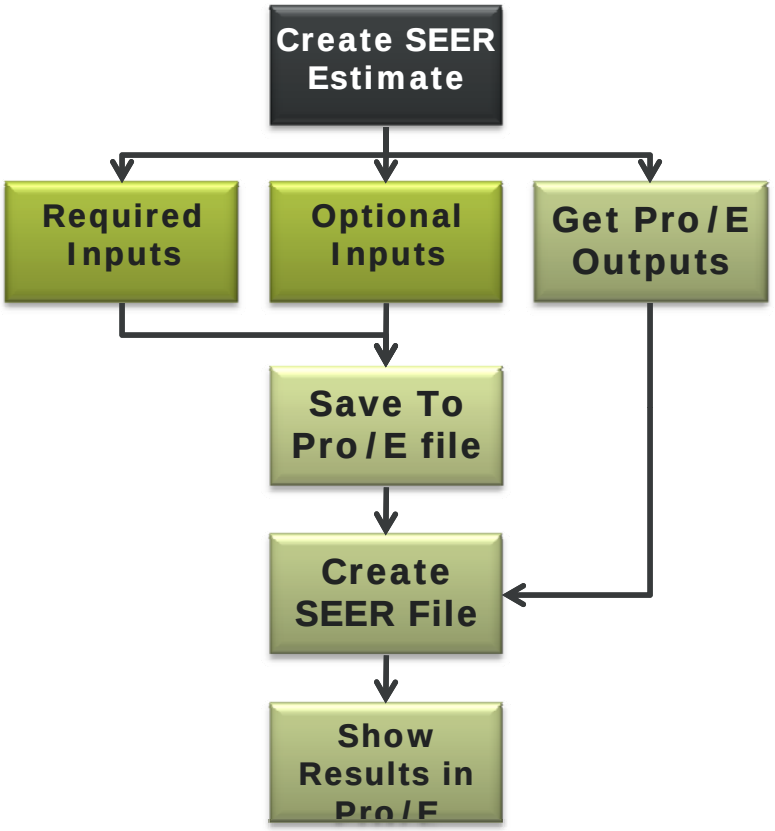
SEER Automation Interface

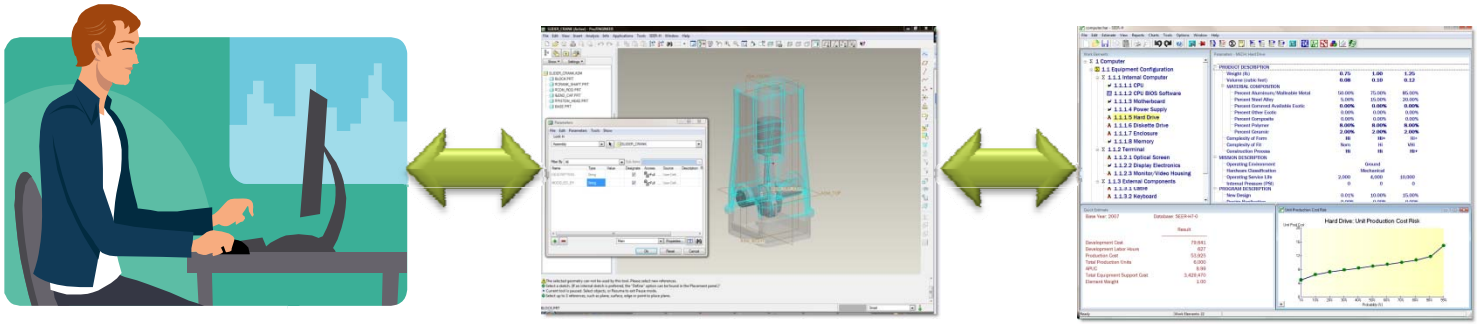
- Automation Interface (Preferred Integration Method - Used in this Case Study)
  - The OLE Automation interface allows you to run SEER directly from an OLE-compatible application
  - Uses the RunCommands() method
  - Example:

```
Sub RunSEER()
  Dim Seer as Object
  Set Seer = CreateObject("SEER-DFM.Document")
  Seer.RunCommands ("LoadFile" & vbTab & "samples\gfault.dfm")
  Seer.RunCommands ("FlexportOutput" & vbTab & "OUTSUMM.flx" &
  vbTab & "C:\temp\Results.txt")
End Sub
```

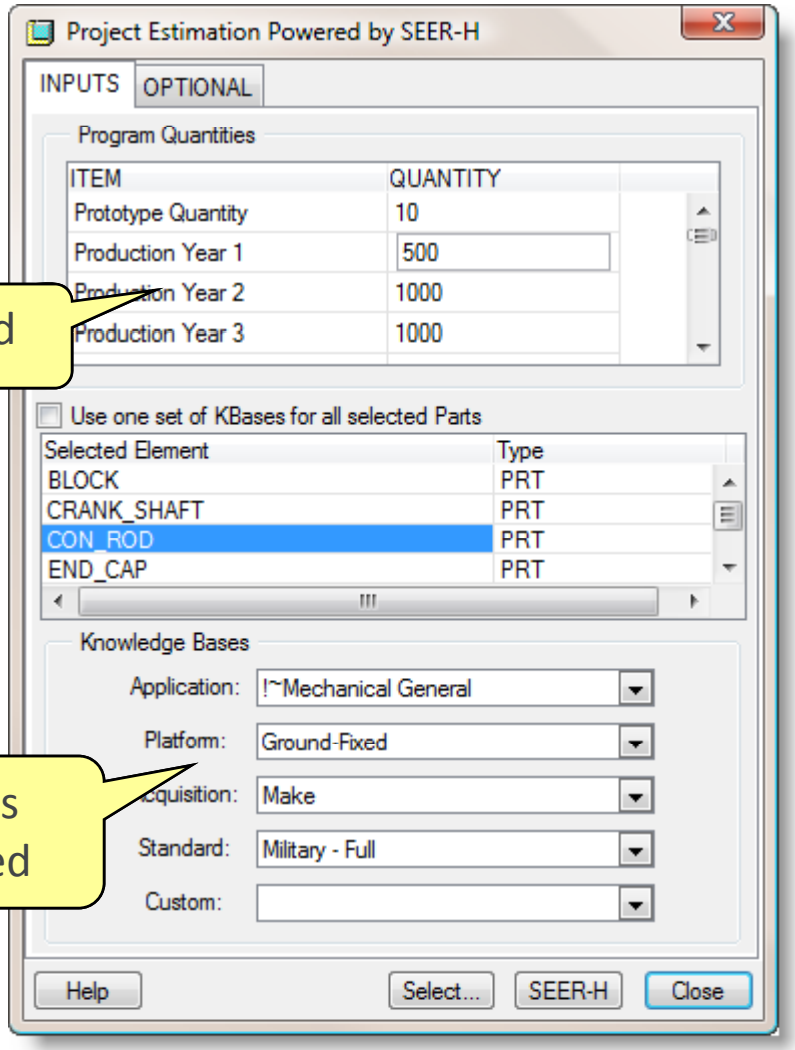
Integration Process Overview

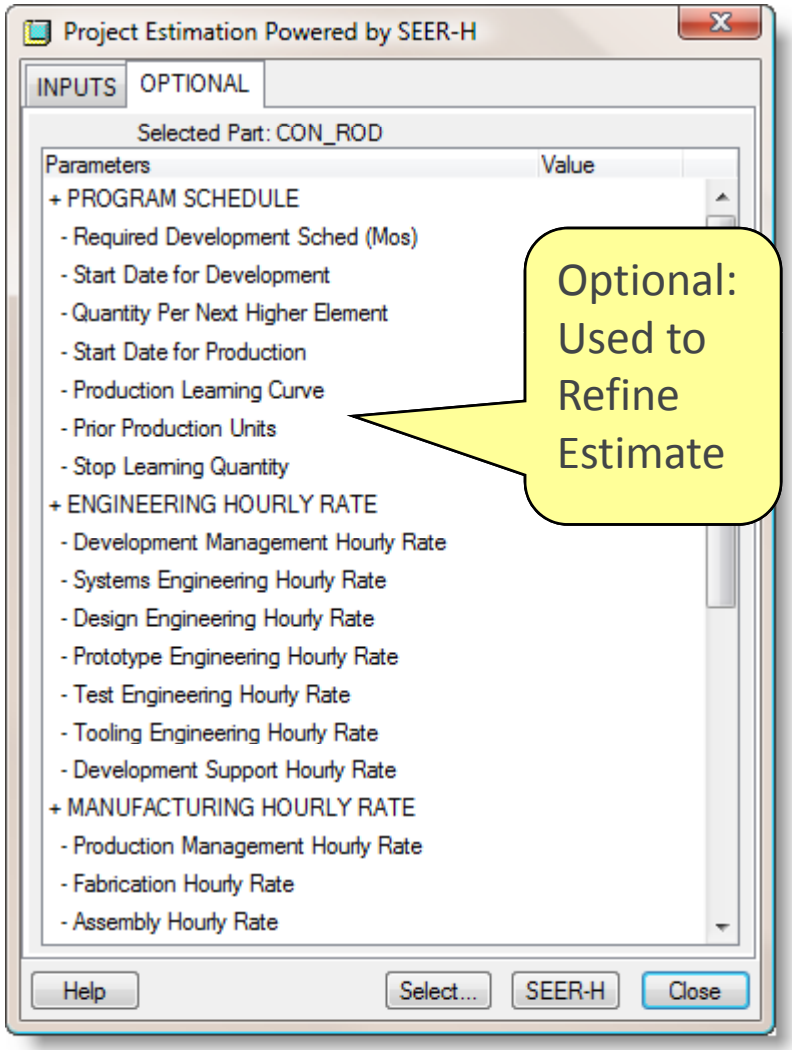
- Develop Requirements Spec
- Design New Pro/E Menu Option
- Logic Flow Diagrams
- Rules & Error Traps
- Dialogs





SEER Inputs – Required and/or Optional



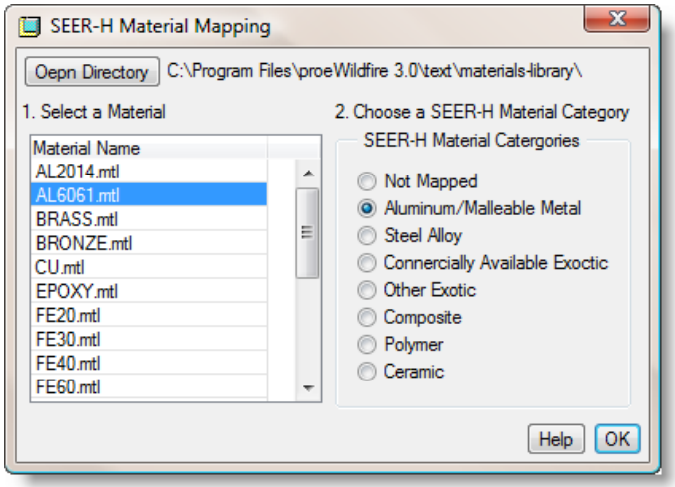


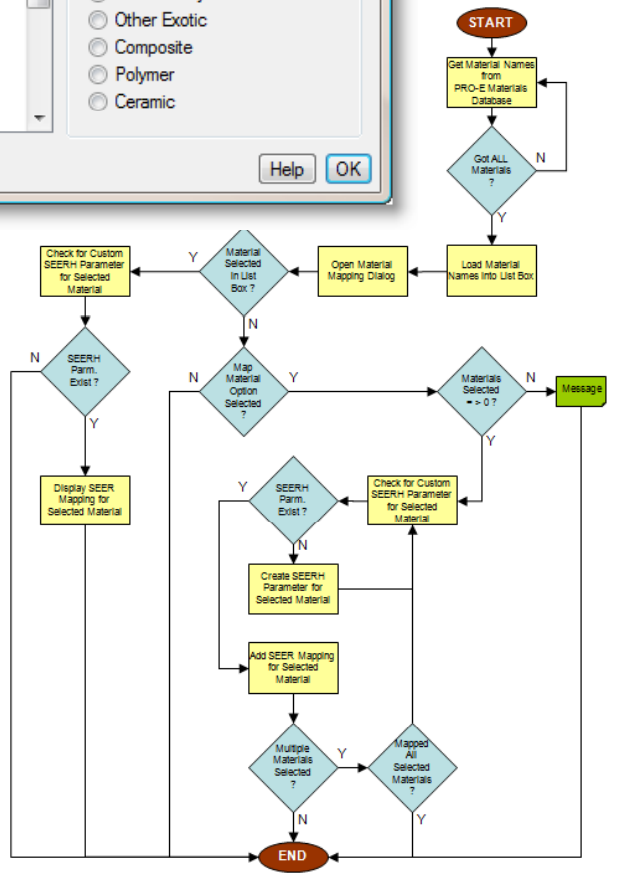
Pro/E Outputs used as SEER Inputs

- Mass
- Volume
- Unit of Measure
- Assembly 'Tree' Structure
- Material Types (See Material Mapping)
- Number of Parts in Assembly (For Integration)
- Previously Saved Data
  - Each time an estimate is Run from Pro/E, the inputs used to generate the estimate are saved with the Pro/E file
  - Especially useful when building Assemblies from Parts

Material Mapping Feature

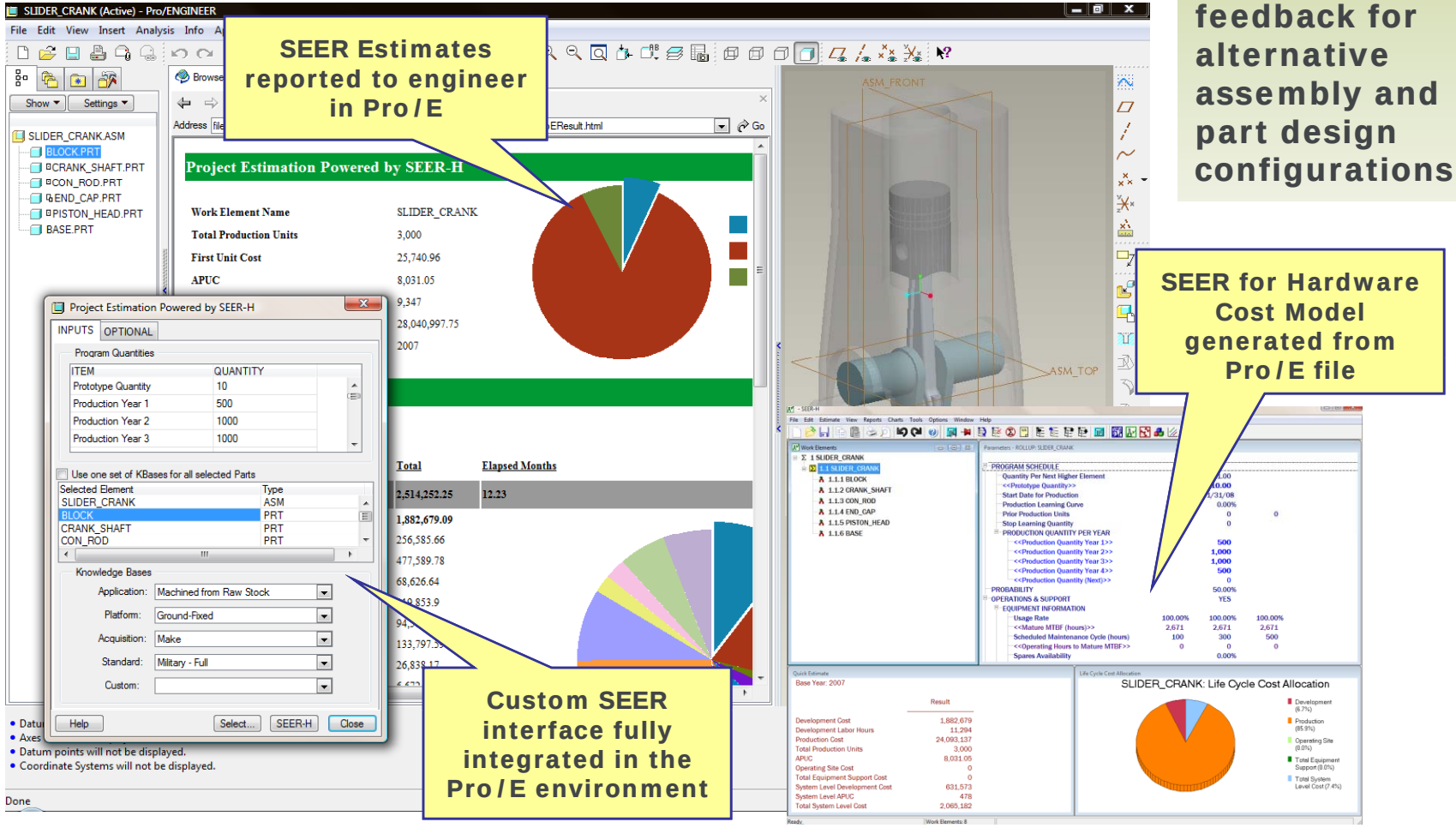
- SEER-H uses Material Categories
- User dialog developed for mapping materials to SEER-H material categories
- Required additional programming logic to determine percentage of material types in an assembly





Pro/E to SEER for Hardware Live Demo

Provide Engineers with immediate cost feedback for alternative assembly and part design configurations



Summary

- The SEER for Hardware Parametric Cost Model is well suited for CAD model integration – as proven by this case study
- Direct integration to a CAD model means you must have a separate integration for each CAD system (API) you integrate with
- Integrating Parametric Cost Models with CAD models:
  - provides engineers with immediate cost feedback during the design process
  - enables automatic cost model generation, which can be modified and refined by cost engineers
  - facilitates the design trade study process

Contact Details

Dr. Christopher Rush

Phone: (310) 414-3222 xtn. 621

Fax: (310) 414-3220

E-mail: CRush@galorath.com