Software Models

What Model is Right for Me?

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by

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DELUSIONS

There is no greater joy than soaring high on the wings of your dreams.
Except maybe the joy of watching a dreamer who has no where to land
but in the sea of reality.

S/W Model History

Fedrick	1974	SLIM	1981
Walston-Felix	1977	JS-1	1983
Jones	1977	SEER	1986
Halstead	1977	SASET	1986
Schneider	1978	REVIC	1987
Freburger-Basili	1979	Sage	1995
PRICE	1979	COCOMO II	1995
COCOMO	1980	CostXpert	1997

Software Estimating Applications

- Bid/No Bid
- Development
- Maintenance
- Modifications
- LCC Analysis
- Risk Analysis
- Should Cost Analysis
- Procurement Quote Analysis
- Negotiation Analysis
- Estimate to Complete
- CAIV Tradeoff Analysis

Software Cost Drivers

- Program Size
- Percentage of New Design/Code
- Documentation Level
- Memory/Timing Utilization in Computer
- Stability of Requirements
- Complexity of Concurrent Hardware Design
- Schedule
- End-Use Environment
- Personnel
- Management

Fundamental Effort Equation

$$E=CS^{a}$$

E = Development Effort

C = Environment Calibration Constant

S = Lines of Source Code (includes reuse effects)

a = Entropy Constant

Typical Software Development Activities

- Planning Phase
- System Requirements
- System Allocation
- Software Requirements
- Preliminary Software Design
- Detailed Software Design
- Code & Debug
- Unit Test
- Software Integration
- System Integration
- Acceptance Testing
- Formal Verification
- Maintenance

Golub's Laws of Computerdom

- Fuzzy project objectives are used to avoid the embarrassment of estimating the corresponding costs.
- A carelessly planned project takes three times longer to complete than expected; a carefully planned project will take only twice as long.
- The effort required to correct the course of development increases geometrically with time.
- Project teams detest weekly progress reporting because it so vividly manifests their lack of progress.

Current Widely Used Models

COCOMO

PRICE

SEER

SLIM

REVIC

SASET

Sage

CostXpert

COCOMO Background

- Developed by Dr. Barry Boehm
- It a Project Based Model
- Based on 63 Programs from 1964 - 1979
- Ten were greater than 100KSLOC
  - Six Embedded
  - Four Semidetached
  - Zero Organic
- One was greater than 500KSLOC
- Has become the basis for many “XYZOMO” models

COCOMO
What it Does

- Has three basic modes of capability
  - **Basic** - Project size input only
  - **Intermediate** - EAF and Project/Component size input
  - **Detailed** - EAF and Component/Module size input
- Allows for application groupings
  - Embedded , Semidetached, Organic
- Estimates optimum schedule as a default
- Provides Maintenance estimates with Annual Change Traffic

COCOMO
Feeding and Maintenance

- Free
- Different Modes can be used throughout the lifecycle
- Should use existing data as a “benchmark” for calibration for your own environment

PRICE Background

- Developed by RCA PRICE Systems with Dr. Bob Park as lead for the PRICE - S and Dr. Bill Kuhn for the PRICE - SL Model
- It is a CSCI Based Model
- Based on Expert Opinions and applied to many RCA programs for validation developed in the 70s
- Hosted on a mainframe with dial-in capability until the late 80s, when a PC based system was released

PRICE
What it Does

- Provides guidance for typical inputs of Application, PROFAC, and Complexity values
- Size inputs can be either LOC or Object Points
- Allows the user to calibrate each of fifteen functional areas within a Matrix type of organization
- Provides an optimal cost and schedule solution
- PRICE SL estimates Maintenance estimates including growth and enhancements

PRICE
Feeding and Maintenance

- Requires an annual Fee for use and updates
- If the model is calibrated to an organization and it "reorganizes" then it must be recalibrated
- Should use existing data as a "benchmark" for calibration of PROFAC and APPL values

SEER Background

- Was based on JS-1 Software equations developed by Dr. Randy Jensen and has been modified by Dan and Judy Galorath to its present form
- It is a CSCI Based Model
- Original model was based on Hughes Data and has been adjusted with data received on recent programs collected by Galorath and Associates
- Is a PC based system

SEER-SEM
What it Does

- Variety of pre-determined “Knowledge Bases” to allow for quick “ball-park” estimates
- Sizing inputs can be either LOC or Function Points
- Provides a Minimum and Optimal Schedule Cost Solution
- Allows for Maintenance estimates including growth and enhancements

SEER-SEM
Feeding and Maintenance

- Requires an annual Fee for use and updates
- EAFs need to be adjusted for the developer's environment
- Should use existing data as a "benchmark" for calibration

SLIM Background

- Was based on RADC software data collected in the 60s This data consisted of a cluge of over 1,000 data points.
- Larry Putnam noticed that even though the data was widely disbursed it fit nicely on a Rayleigh-Norden 60/40 distribution curve.
- Is a Project Based Model
- The model is updated regularly with data received on recent programs collected by the Putnams
- Is a PC based system

SLIM
What it Does

- Uses default “Productivity Indexes” to allow for quick “ball-park” System level estimates
- Sizing inputs can be either LOC or Function Points
- Provides a Minimum Schedule Solution
- Allows for Maintenance estimates including growth and enhancements

SLIM
Feeding and Maintenance

- Requires an annual Fee for use and updates
- Should use existing data as a “benchmark” for calibration at the proper Productivity Index

REVIC Background

- This is a derivative of the Intermediate COCOMO Model based on lab developments at Albuquerque New Mexico
- Ray Kyle needed a reliable way to estimate the effort required to develop software in a unique environment where a significant amount of testing was needed
- Is a CSCI Based Model
- This model even had a users' group that met once a year
- It is a PC DOS based application

REVIC
What it Does

- Allows for four application groupings
  - Embedded , Semidetached, Organic, and Ada
- Sizing inputs are only LOC
- Estimates optimum schedule as a default
- Provides Maintenance estimates with Annual Change Traffic

REVIC
Feeding and Maintenance

- Free
- Currently no longer supported
- Should use existing data as a “benchmark” for calibration

SASET Background

- Bill Cheadle & Dr Silver from Martin Marietta in Denver Colorado initiated an SBIR with the Navy and Air Force to develop a DoD Software Estimating Model
- Primary data used was from ESC and Martin Marietta
- Is a CSCI Based Model
- It was developed to be a layered model that would use the level of the development architecture to help determine the level of difficulty for the development
- Is presently maintained by Lockheed Martin

SASET
What it Does

- Uses the Architecture, based on the software type of a system and its size to determine the basic estimate
- Sizing inputs are only LOC
- Basic Architectures include;
  - Ground
  - Avionics
  - Space
  - Commercial

SASET
Feeding and Maintenance

- Free for Government use
- Should use existing data as a “benchmark” for calibration of the Software Type Multiplier

Sage Background

- Developed by Dr. Randy Jensen to account for differences in management philosophies.
- It is a CSCI Based Model
- Based on Data Dr. Jensen has collected over the years
- Is a PC based system

Sage
What it Does

- Uses a set of pre-determined management style "Knowledge Bases" to provide a basic estimate
- Other Effort Adjustment Factors are very similar to SEER
- Sizing inputs LOC only
- Provides a Minimum and Optimal Schedule Cost Solution
- Allows for Maintenance estimates including growth and enhancements

Sage
Feeding and Maintenance

- Requires an annual Fee for use and updates
- EAFs need to be adjusted for the developer's environment
- Should use existing data as a "benchmark" for calibration

CostXpert Background

- Developed by Marotz, Inc. In San Diego Calif.
- This is a combination of a derivative of the COCOMO II Model and a Database driven model
- Is a Project Based Model
- Relativity new model with a high potential

CostXpert
What it Does

- Allows for a wide range of sizing/volume inputs, SLOC, Function Points, Feature Points, GUI Metrics, Object Metrics, Bottom up, Top Down
- Allows the user to define their own effort, schedule and distribution equations
- Provides Development and Sustainment Estimates

CostXpert
Feeding and Maintenance

- Requires an annual Fee for use and updates
- Should use existing data as a “benchmark” for calibration

Which One Should I Choose?

COCOMO

SEER

PRICE

SLIM

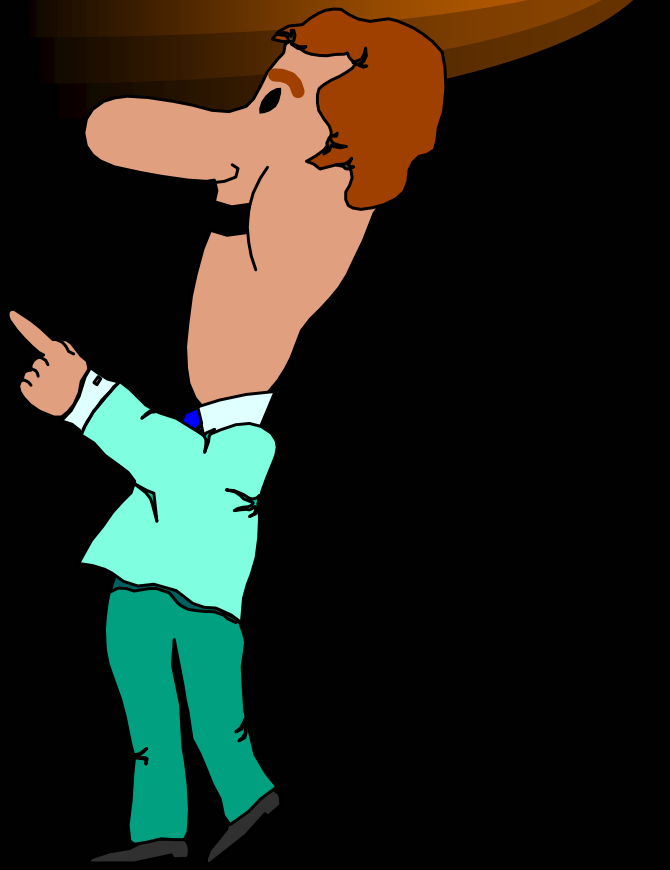
REVIC

SASET

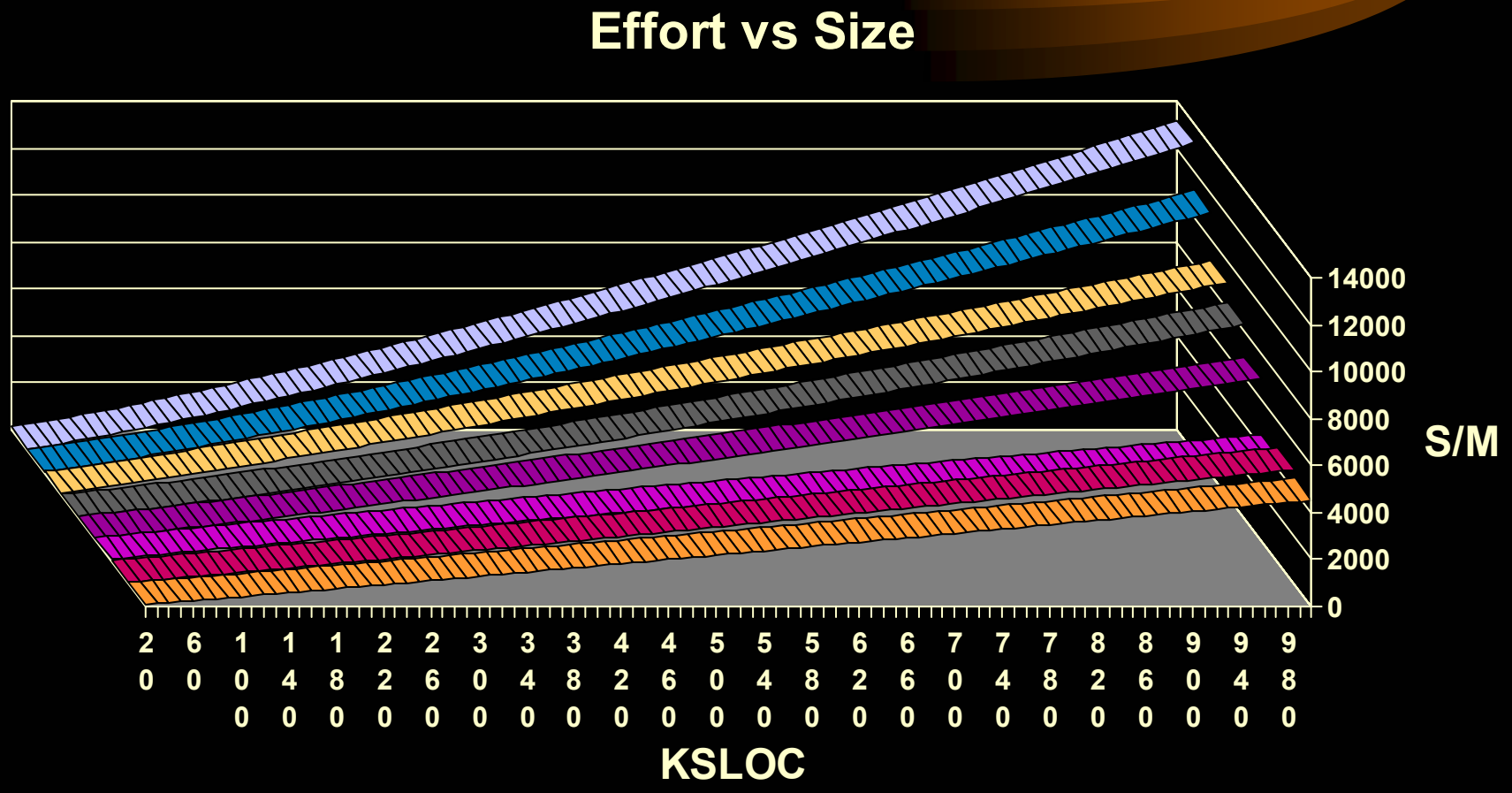
Sage

CostXpert

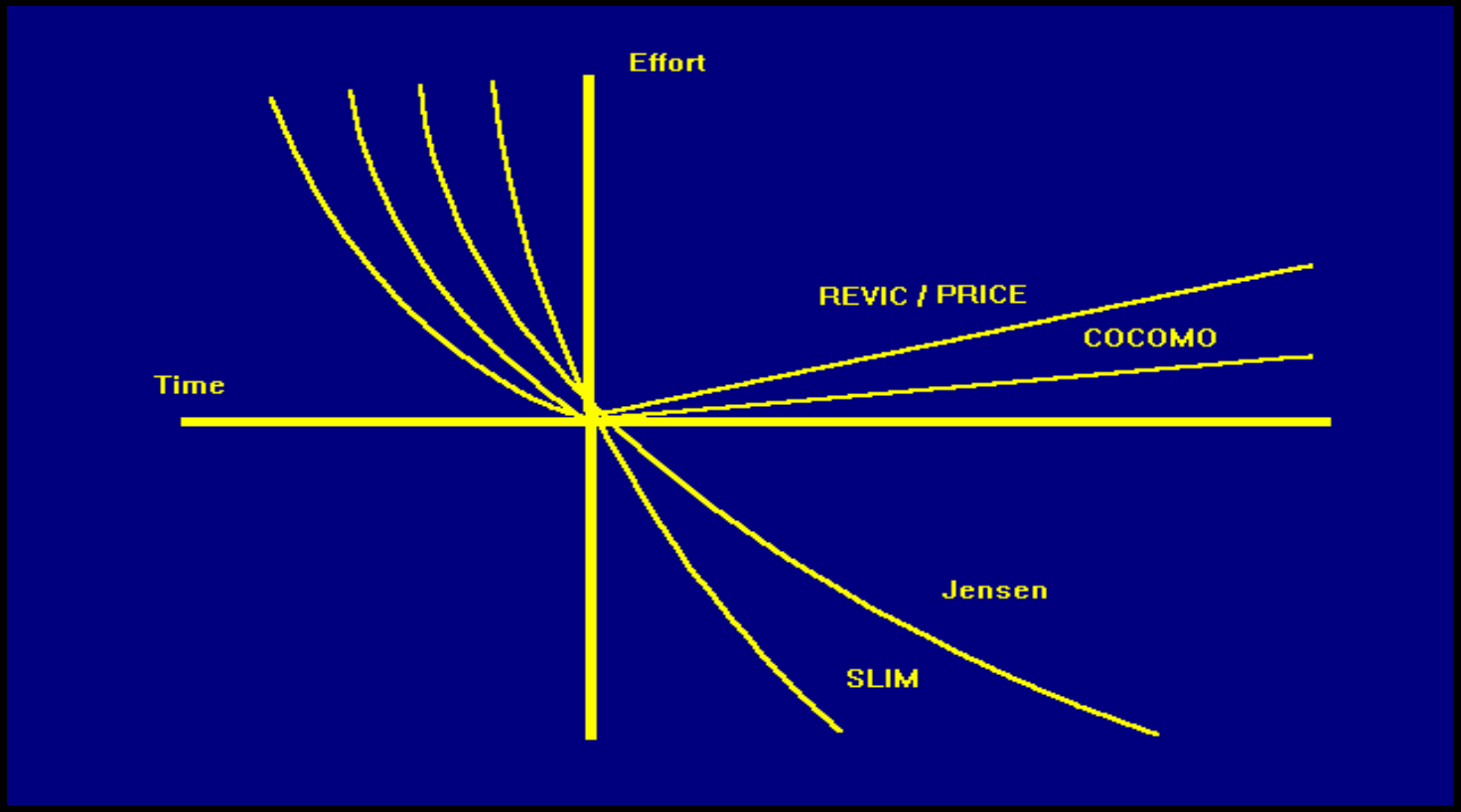
TBD



Which Model Do I Choose?



Which Model Do I Choose?



Software Productivity
The Covert Agenda

- **Apply pressure to developers to get them to work longer and harder.**
  - Promote an ethic of workaholism
  - Get project members to sacrifice personal lives
  - Gull members into accepting hopeless schedules
  - Hold members feet to the fire to make them deliver
- **Minimize product quality**
  - Over constrain projects to force compromised quality
  - Establish unwritten standard that nothing beyond Minimum quality acceptable to customer will be tolerated

What Will Future Models Address?

4GL

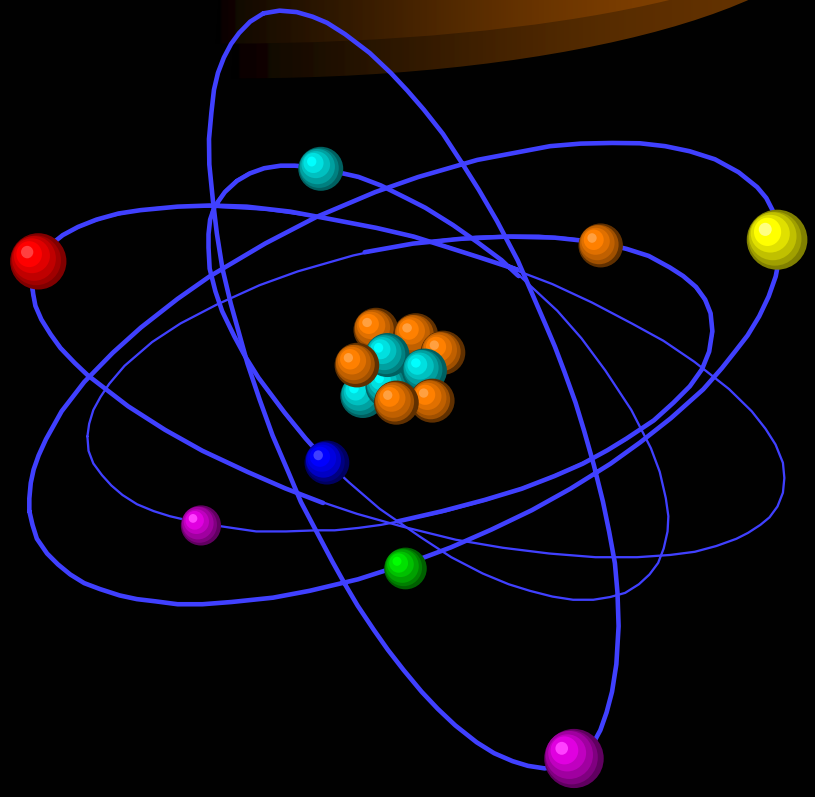
5GL

COTS

GOTS

NDI

Modernization



Using Existing Models 4 & 5GL Adjustments

- If using LOC, estimate only the to be developed code, not the generated code
- Extra effort may have to be added to the design and I&T portions of the model

Using Existing Models COTS, GOTS & NDI

- Estimate the "Glue" code needed to interface the packages to each other and to the operating environment
- Be careful of estimating the code "breakage"

Using Existing Models Modernization

- Estimate new and modified code for the new functionalities
- Estimate the breakage code for the new operating system

Conclusion

- SELECT a model that best suits your environment
- LEARN the model inside and out
- SEARCH and collect data that fits your environment
- VALIDATE & CALIBRATE the model or models you have selected

Think of me as Software