



Software Economics

Barry Boehm, USC
sd&m Software Pioneers Conference
June 29, 2001

boehm@sunset.usc.edu

<http://sunset.usc.edu>



Outline

- **Early software economics experiences**
 - **General Dynamics, Rand: 1955-1973**
- **Large-scale industrial applications**
 - **TRW, 1973-1989**
- **Conclusions**



Early Software Economics Experiences

- **1955: First day in the software field**
- **1956-68: Blissful ignorance: cost-plus R&D**
- **1966-68: Economics of interactive graphics**
- **1968-70: Rand Computer Systems Analysis Group**
- **1970-71: Air Force CCIP-85 study**

My First Day As A Programmer

- General Dynamics, 1955

- **Manager:** “We’re paying that computer \$600/hour.
We’re paying you \$2/hour.
We want you to act accordingly.”
- **Positive habits:** defensive programming, desk checking, manual execution
- **Negative habits:** overconcern with hardware, saving microseconds



Economics of Interactive Graphics, 1960's

- **Research applications on DARPA-purchased IBM 360/50**
 - **Rocketry, medicine, networking**
- **Used enthusiastically by Rand engineers, analysts**
- **No outside interest at \$50/hour**
 - **Maybe I should learn more about economics**

Systems Analysis at Rand

- **Major defense cost-effectiveness analyses**
 - **Force structure; operational strategies**
- **Established Domestic Studies Division, 1967**
- **Very strong economics, applied math staff**
 - **At least 2 Nobel economists**
 - **Originated much of linear and dynamic programming, game theory**



Rand Computer Systems Analysis Group

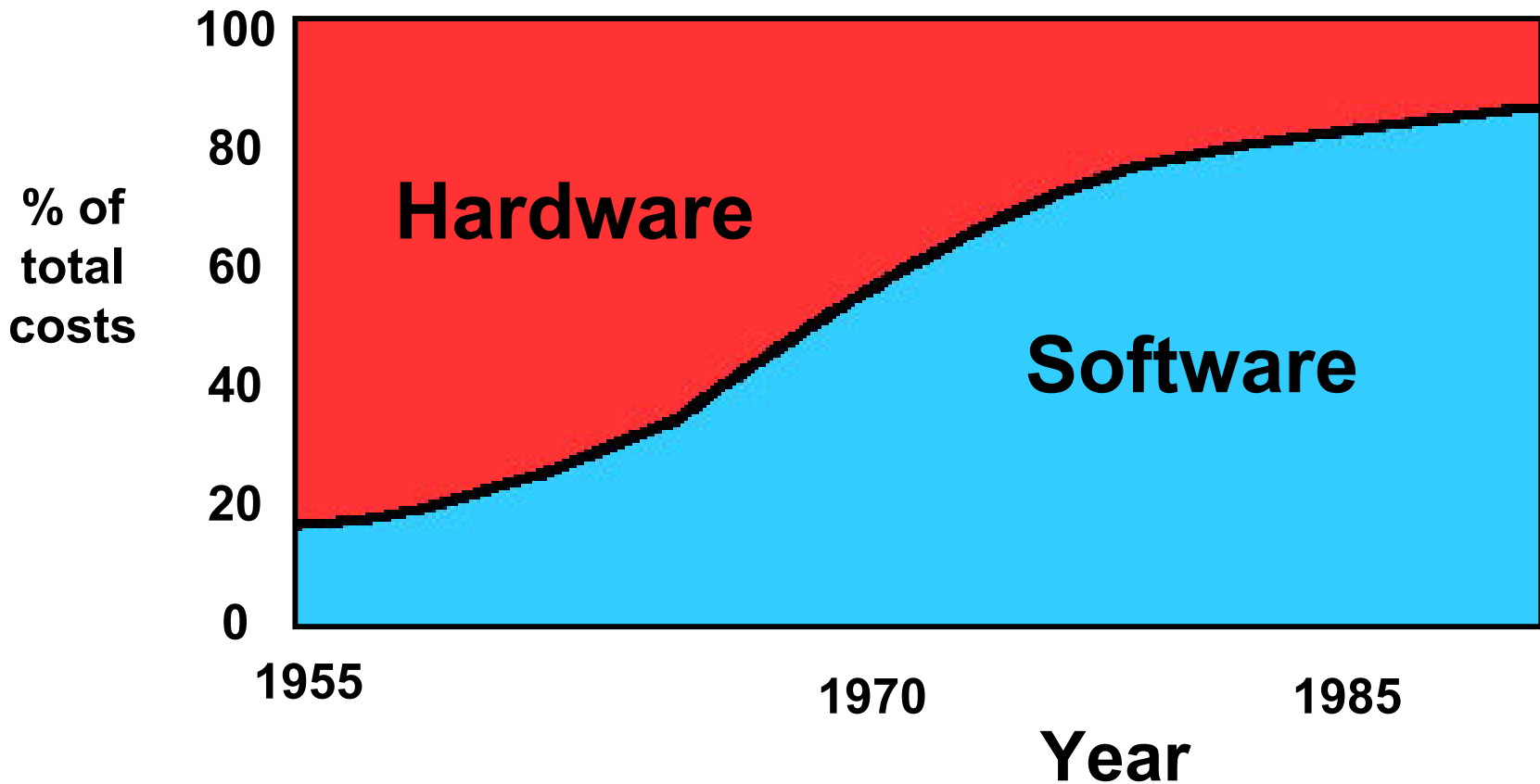
- Experiences, 1968-70

- **Computer slowed down transaction processing**
 - **No cost-benefit analysis, just computerizing**
- **Overrun, delayed fire dispatching system**
 - **Gold-plated geolocation system**
- **Huge expense for archaic file system**
 - **Overconcern with sunk cost**
- **Insecure urban computer centers**
 - **No risk analysis**

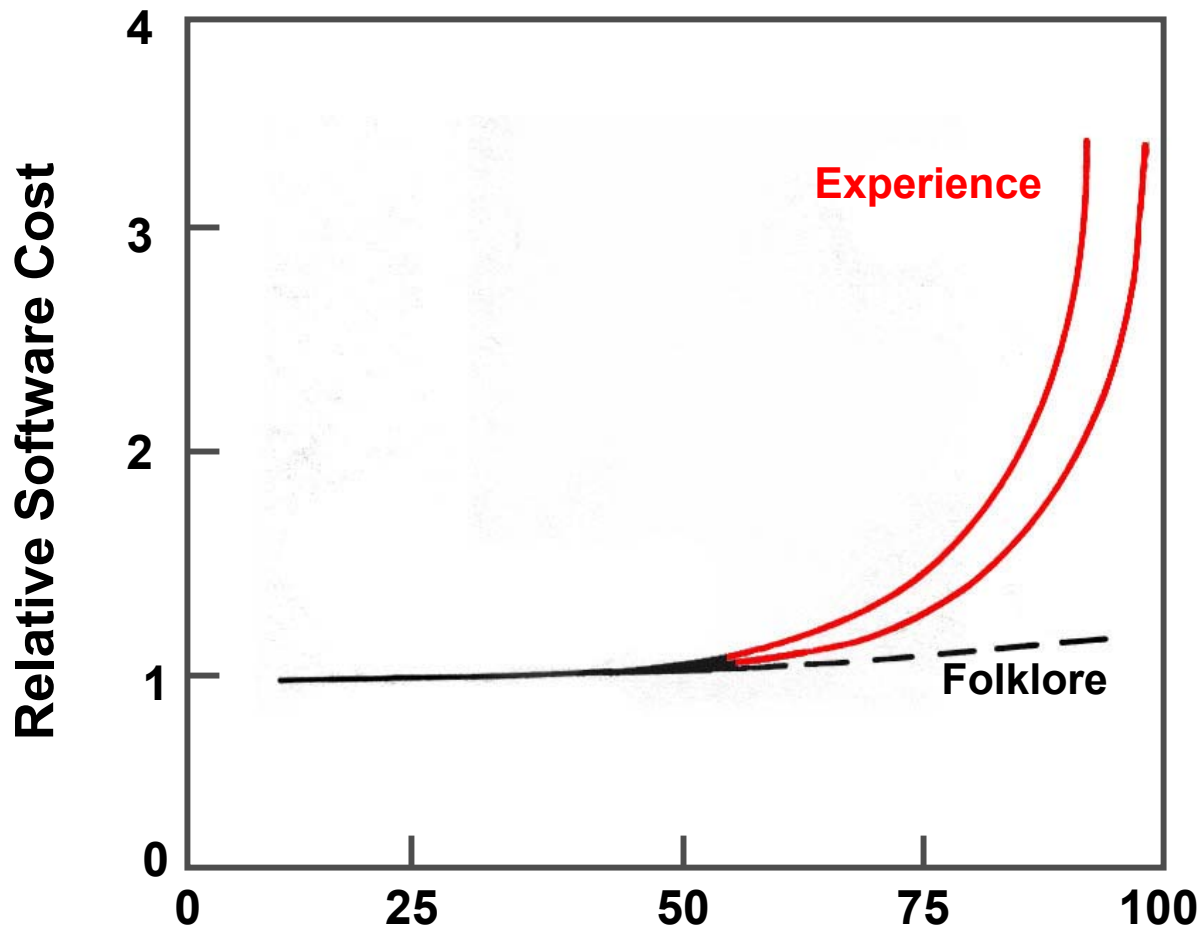
CCIP- 85 Study: Air Force, 1970-71

- **Forecasted 1985 AF command-control needs**
- **Recommended information processing research program**
- **Key needs not in MIPS and displays, but in software**
- **Major recommendations**
 - **Structured methods**
 - **Requirements/exercise technology**
 - **Software certification technology**

Air Force Computing Cost Trends



Risk of Minimizing Hardware Cost



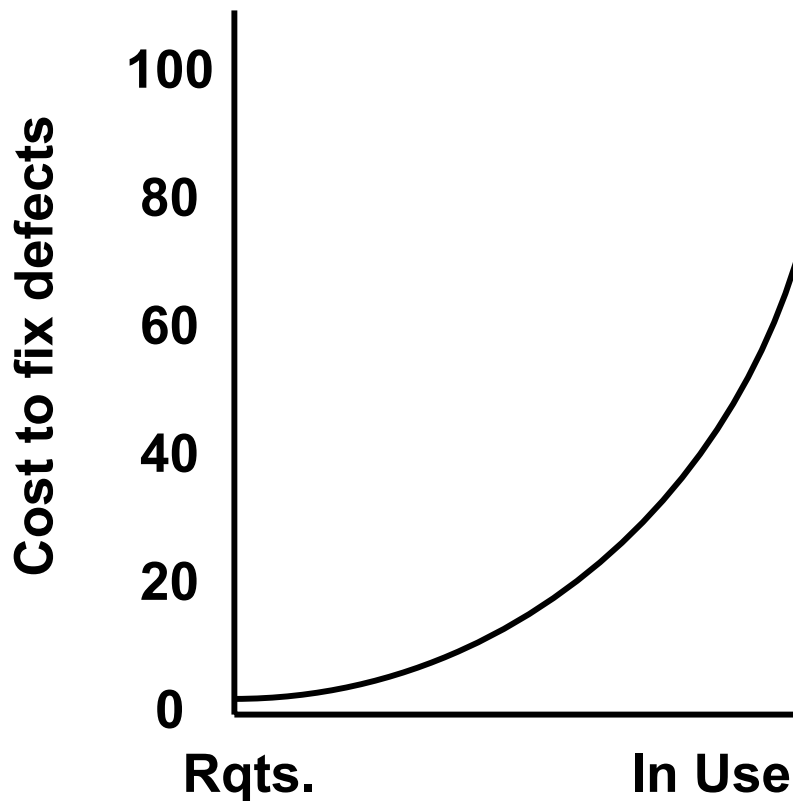
Percent of hardware cycles and memory utilized

©USC-CSE

Career Crossroads

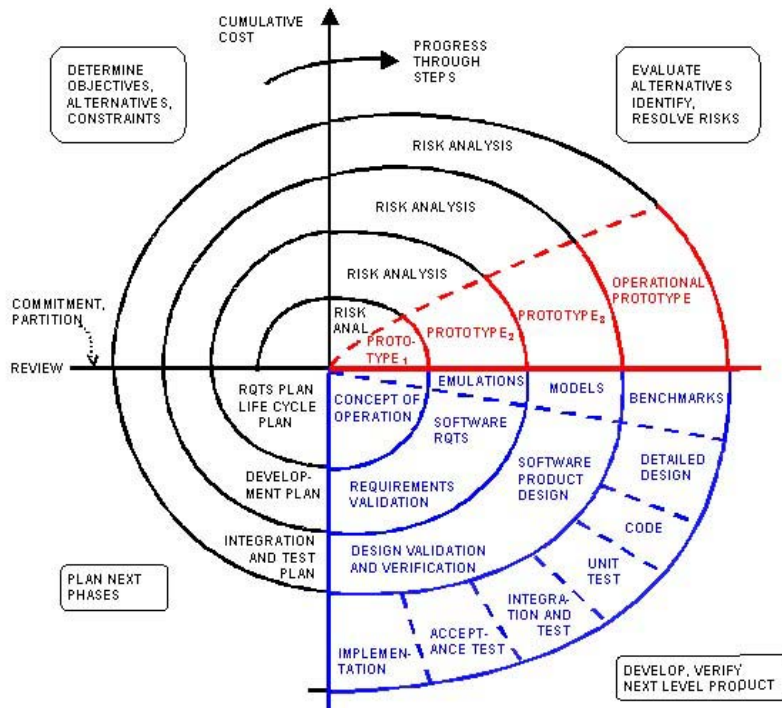
- **Successfully exited software career**
 - Thought the action was in systems analysis
- **Found software a systems analysis challenge**
- **Joined TRW to try to systematize software practice**
 - **Economics-driven processes**
 - **Risk Management and spiral model**
 - **Cost estimation and COCOMO**

Economics-Driven Processes



- **Early concept validation**
 - **Prototyping**
- **Thorough specifications**
- **Planning and control**
- **Continuous improvement**
- **Risk management**

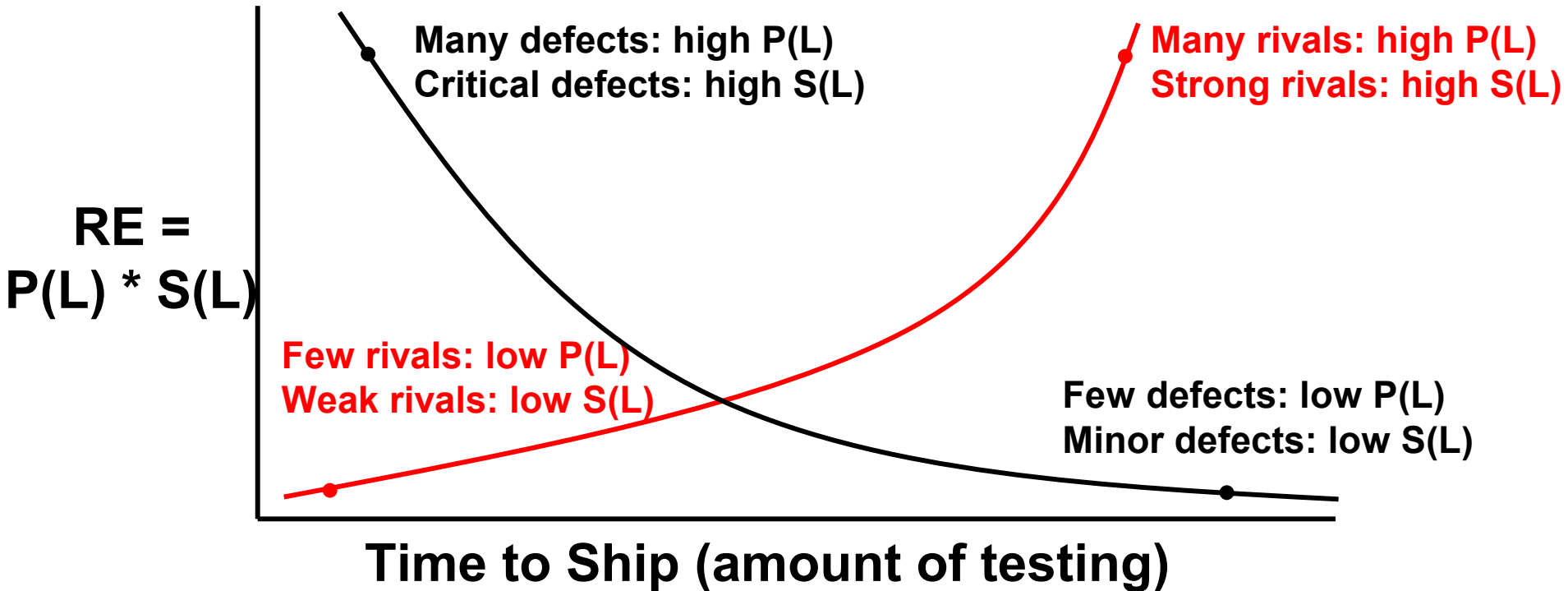
Software Risk Management



- Use Risk Exposure for management priorities
- $RE = Prob(Loss) * Size(Loss)$
- Basis for spiral model decisions
- Helps answer “how much is enough?”
 - Testing, prototyping, COTS evaluation, etc.

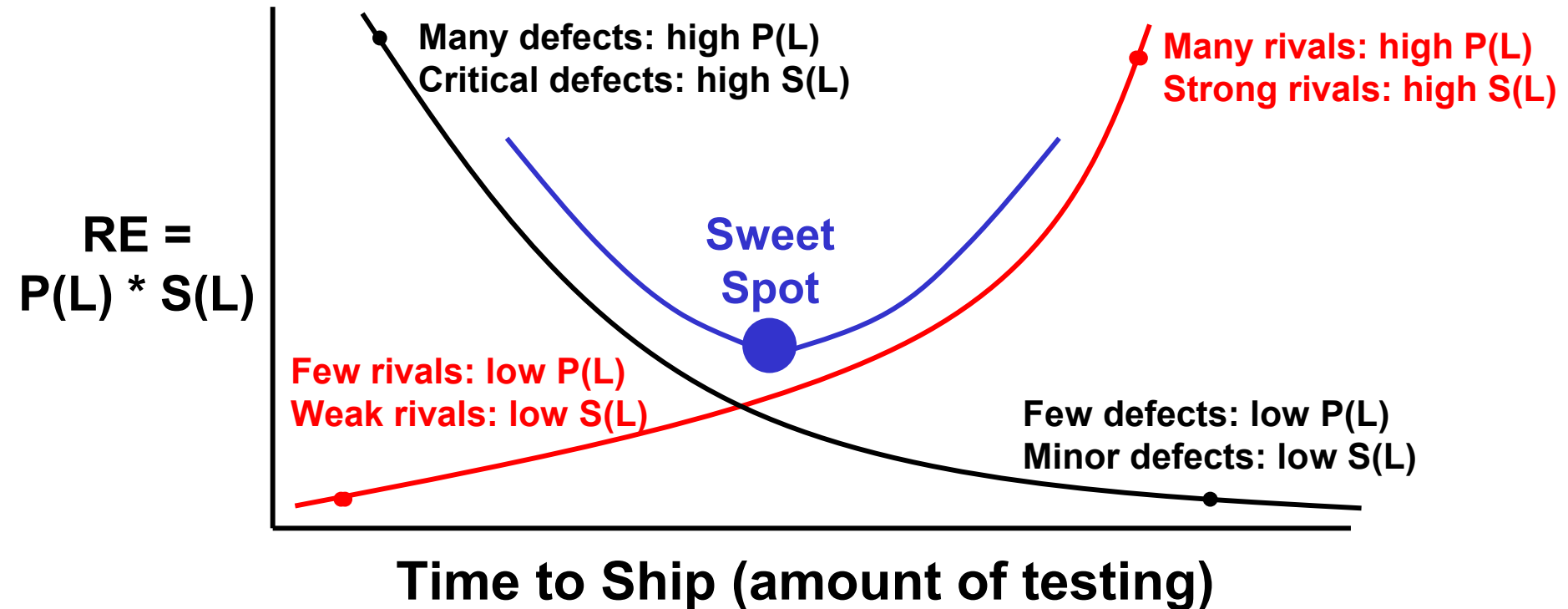
Example RE Profile: Time to Ship

- Loss due to unacceptable dependability
- **Loss due to market share erosion**

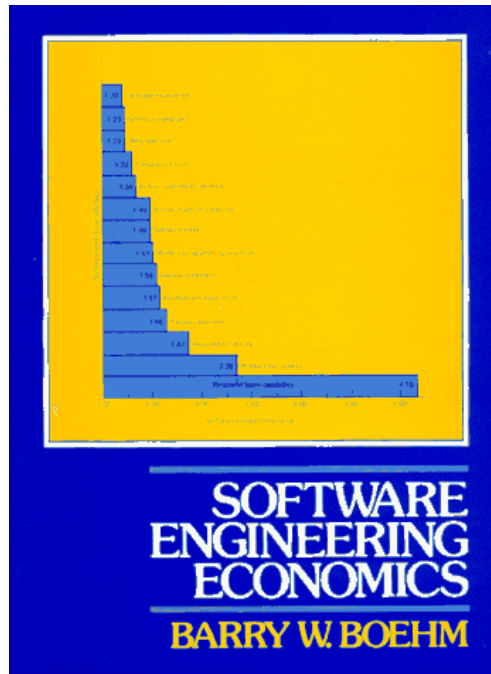


Example RE Profile: Time to Ship

- Sum of Risk Exposures

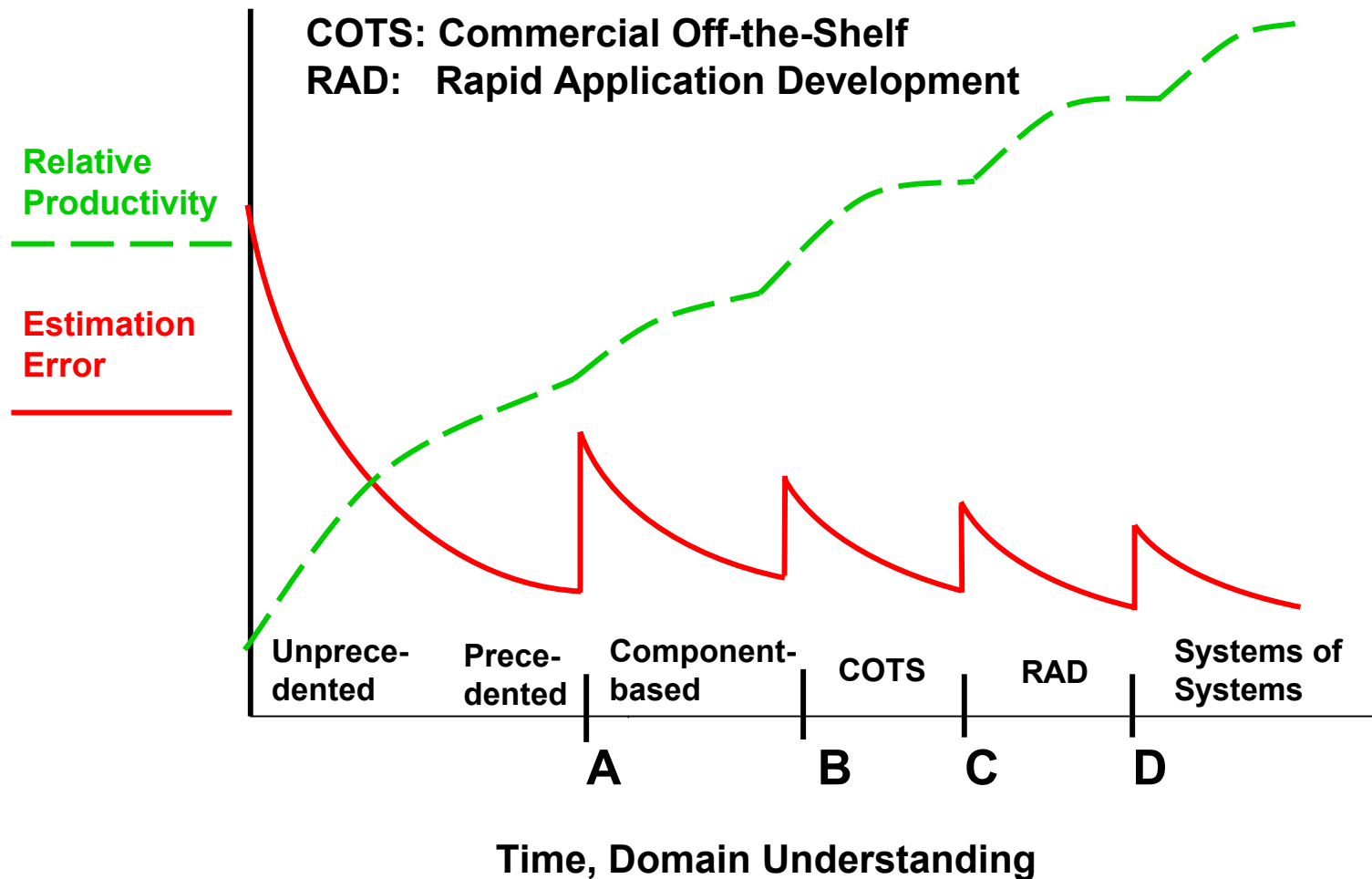


Constructive Cost Model (COCOMO)



- Motivated by TRW proposal commitments
- Drew on good previous work
 - SDC, Aron, Wolverton, Doty, Walston-Felix
- Published in SW Engr. Economics, 1981

Software Estimation: The Receding Horizon



Conclusions

- **The software field exists because processed information has value**
- **Understanding and working with information-value effects is in our enlightened self interest**
- **Be prepared to adapt to continual change in value propositions**