



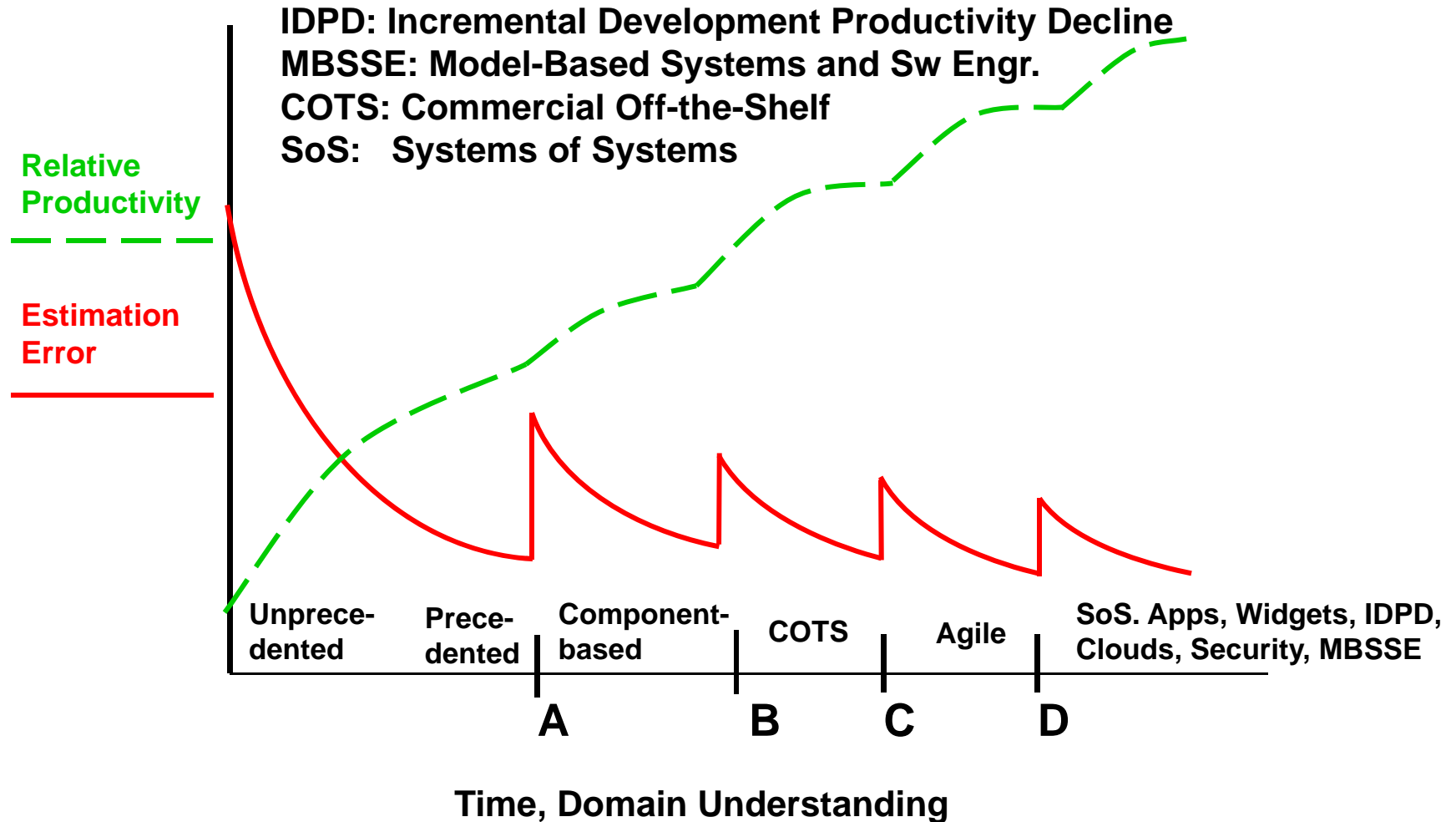
# **Current and Future Challenges for Ground System Cost Estimation**

**Barry Boehm, Jim Alstad, USC-CSSE  
GSAW 2015 Working Group 11D  
March 4, 2015**

# Summary

- ➔ **Current and future trends create challenges for ground system cost estimation**
  - **Mission challenges: emergent requirements, rapid change, net-centric systems of systems, COTS, clouds, apps, widgets, high assurance with agility, multi-mission systems**
- **DoD Systems Engineering Research Center researching ways to address challenges**
  - **Beginning with space systems (COSATMO models)**
  - **Extendable to other DoD domains**
- **Workshop objectives**
  - **Understand, prioritize ground system cost estimation needs, opportunities**
  - **Identify sources of expertise, data**

# Software Estimation: The Receding Horizon



# Current and Future Estimation Challenges

- **Emergent requirements**
  - Cannot prespecify requirements, cost, schedule, EVMS
  - Need to estimate and track early concurrent engineering
- **Rapid change**
  - Long acquisition cycles breed obsolescence
  - Need better models for incremental development
- **Net-centric systems of systems**
  - Incomplete visibility and control of elements
- **Model, COTS, service-based, Brownfield systems**
  - New phenomenology, counting rules
- **Major concerns with affordability**
  - Multi-mission ground system challenges

# COSATMO Concept

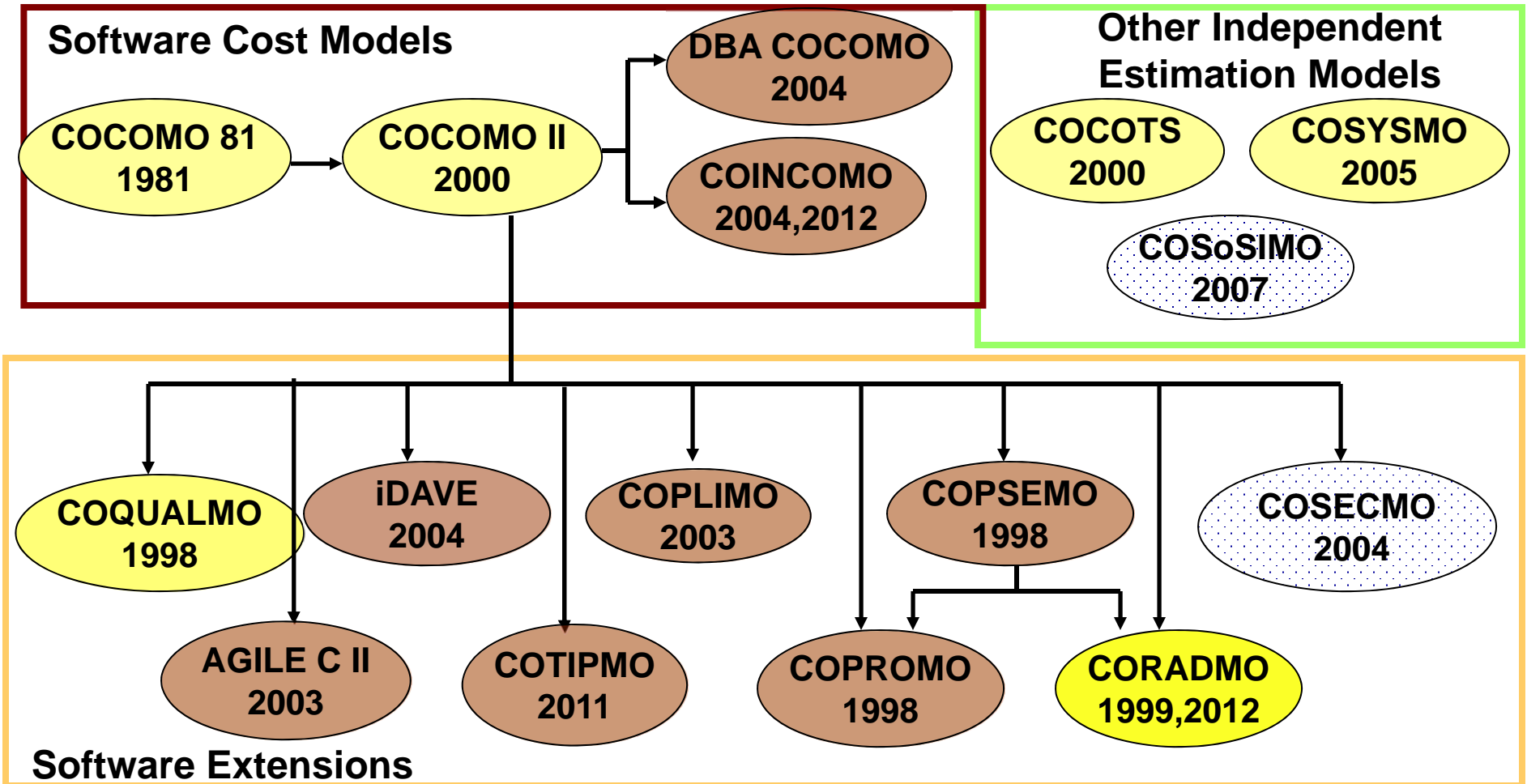
- **Focused on current and future satellite systems**
  - **Accommodating rapid change, evolutionary development, Net-Centric SoSs, Families of systems, DI2E SWASe's**
    - **Software, Widgets, Assets, Services, etc.**
  - **Recognizes new draft DoDI 5000.02 process models**
    - **Hardware-intensive, DoD-unique SW-intensive, Incremental SW-intensive, Accelerated acquisition, 2 Hybrids (HW-, SW-dominant)**
  - **Supports affordability analyses (total cost of ownership):**
    - **Covers full life cycle: definition, development, production, operations, support, phaseout**
    - **Covers full system: satellite(s), ground systems, launch**
    - **Covers hardware, software, personnel costs**
- **Extensions to cover systems of systems, families of systems**
- **Several PhD dissertations involved (as with COSYSMO)**
  - **Incrementally developed based on priority, data availability**

# COSATMO Tentative Model

- **Total satellite system cost =**
  - System engineering cost**
  - + Satellite software cost**
  - + Satellite vehicle hardware development and production cost**
  - + Launch cost**
  - + Initial ground software cost**
  - + Initial ground facility cost**
  - + Operation & support cost**
- **Model as sum of submodels is new structure in COCOMO family**

# COSATMO Submodel Starting Points

- **System engineering: COSYSMO, perhaps with add-ons**
- **Satellite vehicle hardware development and production: Current Aerospace hardware cost model(s); exploring extensions of COSYSMO for hardware cost estimation**
- **Satellite vehicle, ground system software development: COCOMO II, COCOTS, perhaps with add-ons**
- **Launch model: similarity model, based on vehicle mass, size, orbit**
- **Ground system equipment, supplies: construction, unit-cost, services cost models**
- **Operation & support: labor-grade-based cost models, software maintenance models**
- **Prioritized on need, available data**
  - High priority for ground systems



**Legend:**

Model has been calibrated with historical project data and expert (Delphi) data

Model is derived from COCOMO II

Model has been calibrated with expert (Delphi) data



# Summary

- **Current and future trends create challenges for ground system cost estimation**
  - **Mission challenges: emergent requirements, rapid change, net-centric systems of systems, COTS, clouds, apps, widgets, high assurance with agility, multi-mission systems**
- **DoD Systems Engineering Research Center researching ways to address challenges**
  - **Beginning with space systems (COSATMO models)**
  - **Extendable to other DoD domains**
- ➔ **Workshop objectives**
  - **Understand, prioritize ground system cost estimation needs, opportunities**
  - **Identify sources of expertise, data**