Current and Future Challenges for Ground System Cost Estimation

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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

IDPD: Incremental Development Productivity Decline
MBSSSE: Model-Based Systems and Sw Engr.
COTS: Commercial Off-the-Shelf
SoS: Systems of Systems

Time, Domain Understanding

Relative Productivity
Estimation Error

Unprecedented
Preceded
Component-based
COTS
Agile
SoS. Apps, Widgets, IDPD, Clouds, Security, MBSSSE
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

Dates indicate the time that the first paper was published for the model.
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