Systems Cost Modeling

CIF 15 Workshop
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Basic Source Information

GT Position Paper
NASA Systems Eng'g Guidebook
PSP Size Estimating
Mil Std 881b: WBS
Sw Cost Estimation with COCOMO II
DOD 5000.1, 5000.2, 5000.2R
EIA 632 & IEEE 1220 (SE process);
and EIA 731 (assessment)
ISO 12207
CMMI
Pages 48 to 58 of Barry's COCOMO II & MBASE
Approach for estimating system engineering cost (by
Katherine J Tilton, Virginia Tech 1992)
The Issues

Scope: All the SE activities

Goals: Size? Effort? Schedule?
   Educated SysEs about Sw cost estimating?
   Better integration with SwEng’g plans & estimates?

[Need early success]

[Maintain mapping to DOD terminology]
Scope

All the activities encompassed/called systems engineering: breaking system down functionally, physically distributing, ...

If the system is an Aircraft (flow-down of requirements):
- Level 1 = aircraft (take-off, land, carry, launch, ...)
- Level 2 = avionics (sense, detect, control, ...)
- Level 3 = radar (sense, detect, track, ...)
- Level 4 = antenna, signal processor, display,
Scope is at Level 4, maybe Level 3, but not Level 2.

Full life cycle: idea to production
MBASE Project Start (PS) to Product Release (PR)

System engineering activities

Development Cost
Anchor points

May need to go beyond [modify] MBASE (IOC misunderstanding; PRR; ...)

Look at ISO standard

Life Cycle Phases – MBASE vs WF
New Parameters

Modeling complexity

New algorithms

What Needs to be Added

To cover the "decomposition" of the system

To cover "integration" (the distinctly different) activities
Scope (Cont.) & A Plan of Attack

The total system engineering effort for the next larger, software-intensive system than the software-only system

- Increment 1: expand COCOMO II to software system engineering
  - including software systems engineering and software engineering activities covering the MBASE phases of Inception, Elaboration and Construction (but not including hardware integration in an embedded system during construction)
  - excluding system engineering related to the hardware system engineering; and software & Systems and Software Engineering in Transition
Plan of Attack (cont.)

- Increment 2, Alt. 1: expand to cover the hardware and software integration in both Construction (embedded hardware) and the Transition phase of the MBASE

- Increment 2, Alt. 2: expand to cover hardware developmental system engineering, hardware prototype construction, and hardware/software integration

- Increment 3 ...
Sizing

Requirements? (domain specific? Level of detail?)

- Countable? [system spec "shall"s]
  - Explicit? Implied?
  - Before Inception¹ (IRR)? At IOC (PR)?
    Need Early Design & Post Architecture models?

- May need a complexity factor?
  - May need adaptation/reuse
  - May "equivalent shalls"
  - Clarity? Linkages or hidden dependencies?

Number of Subsystems

¹ MBASE
Sizing (cont.)

Need requirements volatility & evolution (REVL) [volatility or stability]; requirements maturity; Stability of the "environment" [for the requirements volatility]

Have estimation techniques:

- Analogy
- HCA
Other Suggested Parameters (5 years old)

# of requirements
TBD, TBR (resolved)
# of internal and external interfaces
# of documents
Types of documents and relative difficulty factors
Number of [customer attended formal] reviews recommend for the program and relative complexity regarding preparation
Amount of customer oversight [help?] imposed [BUSB]
Schedule for the program
Cost of material to be delivered to customer
Other Suggested Parameters (5 years old; cont.)

Cost of the software development
Program type?
Design maturity [precededness? of host system]
Program staff experience
Tasks

1. Delphi to ID "top" parameters (cost drivers)
2. Map how to size to where you are in development cycle
3. Identify Industry (customer) needs: Propose user screens (input/output) and/or use-cases for operations
4. ID initial data sources [and get some]
5. Consider major Block Change treatment
6. Relationship of USC/CSE – INCOSE (find a "home" in INCOSE?)
7. Assessment Data Repository proposal and this SE estimation effort
8. Scope & Define the Model
Tasks

9. Software system of systems cost model(?) And tools (and/or what if games)

10. Compare & contrast MBASE (as is today) with MBASE extended to cover systems engineering tasks

11. Apply MBASE tools and techniques in Systems and Software Systems Engineering

* OCD & "Inception"

* EasyWinWin (requirements elicitation/clarification)

* Results Chain
Difficulty/Importance

![Difficulty/Importance Diagram]

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