Systems Engineering
Size Measures

Christopher L. Miller
Senior Member Technical Staff
Software Productivity Consortium
Systems Engineering Size Measures

Outline

• Estimation Concepts
• Defining Systems Engineering
• Estimating Systems Engineering
• Thought Experiment
• Selecting Meaningful Size Measures
• Summary
Estimation Concepts

- Objective is to size a system using a unit of measure that correlates to cost and schedule
- Appropriate size measures relate to the amount of intellectual work put into system development
- Size measures vary depending on what work is being performed and how the work gets done
- Examples for different types of work
  - Function points for software life cycle
  - Number of requirements for performing Systems Requirements Analysis
  - Weight of an aircraft to determine total aircraft development cost
Systems Engineering Size Measures

PSM Analysis Model

- Functional Size
- Technical Adequacy
- Overhead Direct Costs
- Product Size
- Effort
- Cost
- Schedule
- Rework
- Quality

= Predictive Estimators
= Performance Factors
What Is Systems Engineering?
Defining Systems Engineering

• A group responsible for translating customer requirements into good requirements for system elements such as sensors, control software, radars?

• An approach anyone takes to making a better product, i.e., electrical engineers perform SE on their boxes by:
  – Understanding how the box will be used
  – Mapping the box’s requirements to the box’s design
  – Selecting an optimal design using trade studies

• A set of roles? A discipline? A philosophy?

Systems Engineering Size Measures

**Systems Engineering Roles?***

1. Requirements Owner
2. System Designer
3. System Analyst
4. V &V
5. Logistics/Ops.
6. Glue among subsystems
7. Customer Interface
8. Technical Manager
9. Information Manager
10. Process Engineer
11. Coordinator
12. Classified Ads SE

“Systems Engineering” may mean any or all of the roles.

Estimating Systems Engineering

- The amount of intellectual work required is the difference between the ‘whole’ and the ‘sum of all the parts’
- Unlike software development, Systems Engineering may not develop tangible products, yet provide great value in terms of the end product (system)
- Measuring system size may not provide meaningful size measures
  - e.g. Requirements
- Definition and tracking of activities SE activities may be required to discern a correlation between size and effort
Thought Experiment

Project A

Project B
Selecting Meaningful Size Measures

- First understand what set of activities make up systems engineering
- Collect some size measures and quantify the predictive relationship between size and effort
  - Correlation and regression
- Acknowledge that most estimation of systems engineering to date has been done via activity based models
Summary

- Objective is to size a system using a unit of measure that captures a meaningful correlation between size and effort
- Consistent definitions needed
  - Across projects and organization
  - With estimation models and methods
- Tailored for project or organization
- Do not blindly accept systems engineering size measures without quantifying the predictive relationship!
Questions?

Christopher L. Miller
Senior Member Technical Staff
Software Productivity Consortium
Chair, INCOSE Measurement Working Group

Phone: (703) 742-7284
Email: miller@software.org