



# *Systems Engineering Size Measures*

**Christopher L. Miller**  
**Senior Member Technical Staff**  
**Software Productivity Consortium**

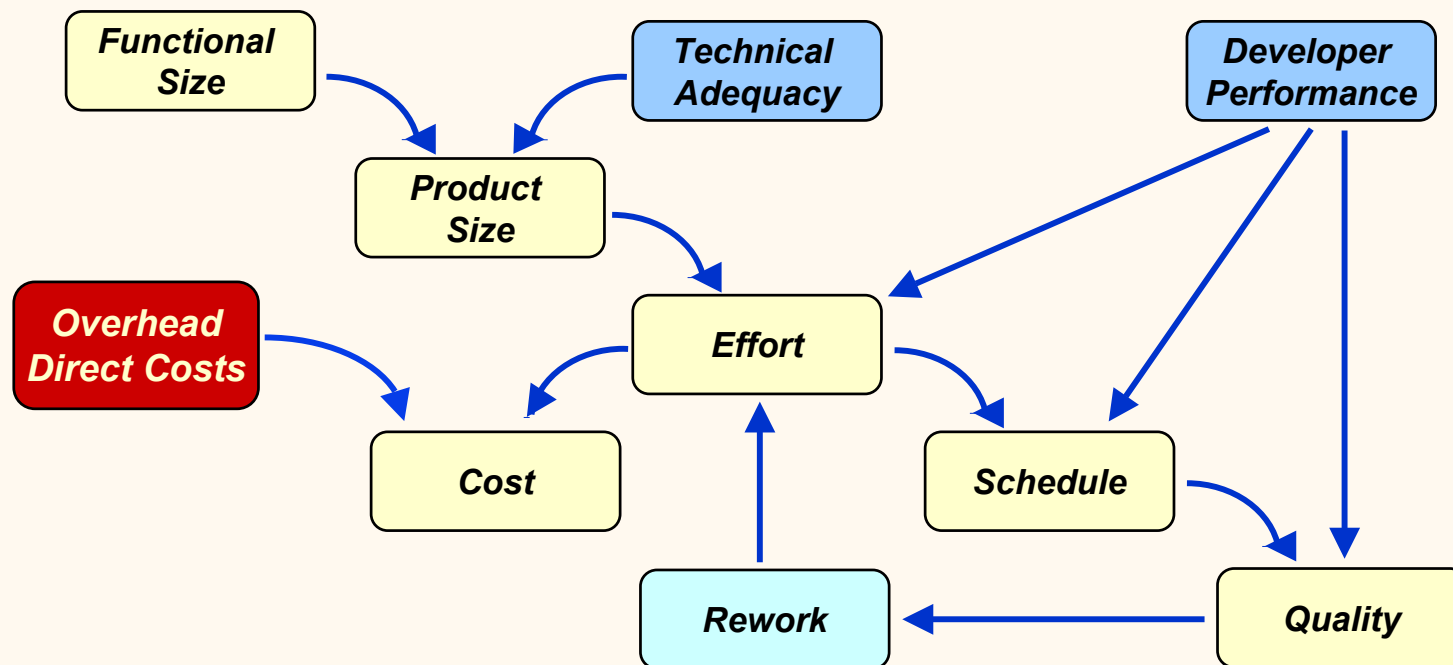
## *Outline*



- **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

# PSM Analysis Model

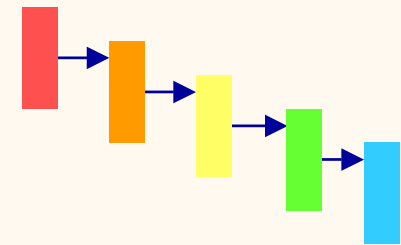


-  = Predictive Estimators
-  = Performance Factors

## What Is Systems Engineering?

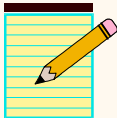
# Defining Systems Engineering

- 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 Roles?\*

1. Requirements Owner



7. Customer Interface



2. System Designer



8. Technical Manager



3. System Analyst



9. Information Manager



4. V &V



10. Process Engineer



5. Logistics/Ops.



11. Coordinator



6. Glue among  
subsystems

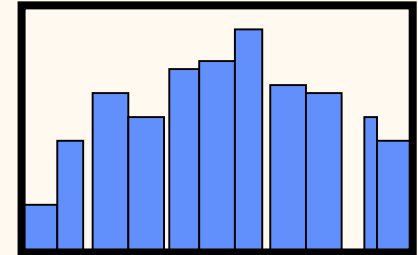


12. Classified Ads SE

**“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

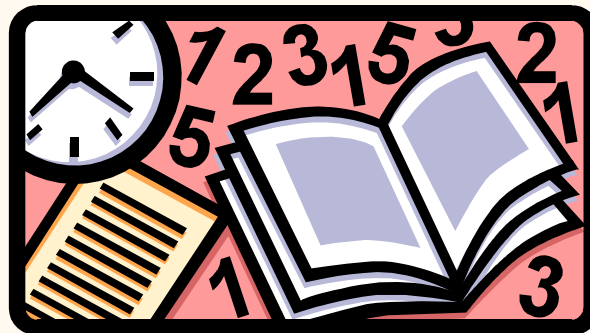


## Project B



# 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](mailto:miller@software.org)**