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# ***Practical Software and Systems Measurement***

***Objective Information for Decision Makers***



System & Software  
Architecture Performance  
Measurement Workshop  
***31 July 2012***

***Paul Kohl – Lockheed Martin  
Alejandro Bianchi – Liveware IS s.A.***



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# OUTBRIEF



# Participants

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- Cheryl Garrison
- Gary Roedler
- Greg Nieman
- Paul Kohl
- Alejandro Bianchi
- Kim Angstadt
- Richard Mabe



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- **Outgrowth of a NDIA/PSM study<sup>1</sup>**
    - Identify a set of leading indicators that provide insight into technical performance
    - Build upon objective measures in common practice in industry, government, and accepted standards.
    - Select objective measures based on essential attributes (e.g., relevance, completeness, timeliness, simplicity, cost effectiveness, repeatability, and accuracy).
    - Measures should be commonly and readily available
  - **Results published as NDIA System Development Performance Measurement Report, December 2011**
  - **Architecture was a high priority area but no indicators were identified that met criteria**
  - **This is an attempt to define measures that can become the leading indicators**
    - Introduce them into common practice
    - Using means that are easy to implement

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<sup>1</sup>NDIA System Development Performance Measurement Report, December 2011



# Summary

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- **Reviewed information needs or program / project managers**
- **Reviewed measurable concepts**
- **Voted on potential base measures**
- **Discussed relationships between program level base measures and enterprise needs**
  - ROI related enterprise needs
  - Architecture initiatives and how to measure change at the program levels to measure architecture value
- **Discussed a potential suite of measures for use on programs**



# Conclusions, Recommendations, and Results

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- **Conclusion:**
  - Architecture is measurable at the program / project level
- **Result:**
  - The Workshop resulted in the consensus that architecture is measureable
  - A preferred set of base measures was voted on and is being integrated into ICTM tables
- **Recommended:**
  - Complete the ICTM tables and define the resulting indicators



# Potential Base Measures (Page 1)

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- **Size**
  - **Number of elements**
  - **Number of relationships/interfaces (external)**
  - **Number of requirements**
  - Number of mission / system scenarios / use cases
  - Number of artifacts produced
  - Number Data points
  - Number of Function points
  - Number of Use Case points
- **Complexity**
  - **Number of relationships/interfaces (internal & external)**
  - **Number of interactions**
  - Number of functions/methods
  - **Number of states**



# Potential Base Measures (Page 2)

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- **Completeness**
  - Requirements ~~satisfied~~ addressed
  - Artifacts produced
  - Artifacts total expected
- **Quality of Solution**
  - Number of defects in the baseline
  - **Degree of requirements satisfaction**
  - Degree of coupling
  - **Degree of “pick an ‘ility”**
  - Cost of the solution (@some confidence level)
  - # of open TBx
- **Quality of representation**
  - Number of defects
  - **Degree of consistency of representation\***
  - **Degree of standards compliance**





# Next Steps/Action Items

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- **Define the indicators using the base measures**
- **Coordinate with the ISO/IEC/IEEE 42030 effort**



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# System & Software Architecture Performance Measurement



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# WORKSHOP DESCRIPTION



# Objectives of the Workshop

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- **Identify the key attributes of architecture to be measured**
  - **Define a set of architecture measures that provide insight into the architecture**
    - Support program leadership needs for leading indicators
    - Are quantitative
    - Are readily obtainable
    - Base and/or composite (derived)
  - **Recommend means/methods for obtaining the measures**
    - Modeling tools
    - Requirement tools
    - Outputs from related processes
  - **Fill in the PSM template for the measures**
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# BACKGROUND



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- **Outgrowth of a NDIA/PSM study<sup>1</sup>**
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# Program Manager Leading Indicator Needs

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- **Does the architecture provide the right solution to the problem and does it meet all the requirements?**
  - Best (or at least sufficient) architecture
  - Requirements Traceability
- **Is the architecture going to be done on time?**
  - Progress/Complete
  - Stability
- **Will the architecture be low in defects?**
  - No missing data
  - Entered data is correct
  - Data is consistent between artifacts and/or system elements?



# Additional Measurement Needs

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- **Process efficiency**
  - Can the process be done better to reduce cost or improve quality?
- **Size / Complexity**
  - How big and/or complex is the architecture effort so I can compare to other efforts?
- **Cost**
  - What was the Total effort?
  - What effort was required for each task / system element/ artifact?





# Measurement Beyond the Program

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- **Enterprise type metrics related to architecture**
  - Process efficiency
  - ROI in architecture
  - Market Share (meeting customer/stakeholder needs)
- **Need to identify base measures of architectures that can support the above**



# Intended Output

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- **Set of architecture measures that provide insight into the architecture**
- **Supporting Draft PSM Templates**

**Time permitting –**

- **Recommend means/methods for obtaining the measures**
  - Modeling tools
  - Requirement tools
  - Outputs from related processes



# Workshop Format

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- **Presentation of initial recommendations for:**
  - Key architecture attributes
  - Candidate Base Measures
  - Candidate Measures Set
- **General Discussion**
  - Flip Chart data collection
- **Multi-voting / rating of Base Measures**
- **Multi-voting / rating of Set contents**
- **General Discussion of means of obtaining measures**
  - Flip Chart data collection



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Discussion Topics

# KEY ARCHITECTURE ATTRIBUTES



# Potential Key Attributes (i.e. Measurable Concepts)

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- **Size**
- **Complexity**
- **Degree of completeness**
- **Quality of solution**
- **Quality of representation**
- **Cost or effort of the architecture**



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Discussion Topics

# POTENTIAL BASE MEASURES



# Potential Base Measures (Page 1)

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  - **Degree of standards compliance**





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Discussion Topics

# A MODEST PROPOSAL

## A BASIC ARCHITECTURE MEASUREMENT SUITE



# Measures by Attribute – Size

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- **Known at program or architecture initiation**
  - Number of Mission Scenarios
  - Number of External Interfaces
  - Number of requirements
- **Calculated from above and initial architecture effort**
  - Estimated Number of Scenarios for each level of decomposition (i.e. OV-6c or SV-10c equivalents) & associated diagrams needed
  - Number of architecture elements at each level of decomposition & associated diagrams
- **Captured / reported from architecture tools**
  - Number of objects on diagrams / artifacts
  - Number of data elements / fields associated with artifacts and objects
  - Number of artifacts by type



# Measures by Attribute – Complexity

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- **Known at program or architecture initiation**
  - Number of external interfaces
- **Calculated from above and initial architecture effort**
  - Number of relationships/interfaces at each level of decomposition
  - Number of states for each architecture element
- **Captured / reported from architecture tools**
  - Number of classes / objects
  - Number of functions/methods
  - Number of interactions
  - Number of functional requirements traced to an architecture element or artifact (e.g. scenario)



# Measures by Attribute – Completeness

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- **Known at program or architecture initiation**
  - Size Measures
  - Number of {Size Measure} complete
  - % of {Size Measure} complete or at a given approval state
- **Calculated from above and initial architecture effort**
  - Size Measures
  - Number of {Size Measure} complete
  - % of {Size Measure} complete or at a given approval state
- **Captured / reported from architecture tools**
  - Size Measures
  - Empty required data fields
  - Number of {Size Measure} complete
  - % of {Size Measure} complete or at a given approval state
  - Quantity and trend (of closure) of empty required data fields (definition of required will change by milestone)
  - Number of functional requirements traced to an architecture element or artifact (e.g. scenario)
  - % of functional requirements traced to an architecture element or artifact (e.g. scenario)
  - Number & trend of closure of architecture TBx
  - Number & trend of closure of requirement TBx



# Measures by Attribute – Quality of Representation

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- **Known at program or architecture initiation**
  - N/A
- **Calculated from above and initial architecture effort**
  - Existence of Architecture Practices Standards and Conventions (APS&C)
- **Captured / reported from architecture or process tools**
  - # of Defects in baselined artifacts
    - External standards compliance
    - Consistency of representation (i.e. adherence to APS&C)
  - Quantity and trend (of closure) of empty required data fields (definition of required will change by milestone)
  - Stability of architecture artifacts (number of changes across time)



# Measures by Attribute – Quality of Solution

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- **Known at program or architecture initiation**
  - N/A
- **Calculated from above and initial architecture effort**
  - Existence of a documented architecture concept (AV-1)
- **Captured / reported from architecture or other tools**
  - # of Defects in baselined artifacts
    - Solution error (e.g. doesn't work)
  - Number of functional requirements traced to an architecture element or artifact (e.g. scenario)
  - % of functional requirements traced to an architecture element or artifact (e.g. scenario)
  - Number & trend of closure of architecture TBx
  - Number & trend of closure of requirement TBx
  - Degree of TPM satisfaction based on modeling or other method
  - Degree of satisfaction of 'ilities (could be based on checklist or other tools)
  - Stability of architecture artifacts (number of changes across time)
- **Reviewer comments**
  - Design Assessments before or at milestones



# Measures by Attribute – Cost or Effort

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- **Known at program initiation**
  - Size Measures
  - Skill Mix / Experience levels
  - Labor Rates
  - Estimated Productivity
- **Calculated from above and initial architecture effort**
  - Size Measures
  - Updated Productivity Estimate
- **Captured / reported from architecture or process tools**
  - Size Measures
  - Experienced Productivity
  - CPI/SPI
  - Estimate at Completion (EAC)



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Discussion Topic

# MEASUREMENT MEANS

**Ran out of time**