Systems Engineering Definition

- Systems engineering can be thought of as the problem-independent principles and methods related to the successful engineering of systems.

- DOD Definition: SE is an interdisciplinary approach encompassing the entire technical effort to evolve and verify an integrated and total life cycle balanced set of system, people, and process solutions that satisfy customer needs.

- INCOSE Definition: Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems...Systems Engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation.
So What?

- The workforce is certainly “problem independent”, a “method”, a “means” and “related to successful engineering”
- By any account, an organization’s engineering workforce is one of the keys to successful systems engineering.
- Rather than the usual ad hoc, target-of-opportunity approach, an organization can apply a disciplined, methodical systems engineering approach to successfully develop the engineering workforce.
327th Aircraft Sustainment Wing
Responsibilities

- 1402 Aircraft Mgd (289 Inactive)
- 28,598 Engines Mgd 50 types
- 203 USAF Bases 42 FMS Nations
- 327 ASW
- 1382 Air Traffic Control & Landing Sys Mgd
- 63 Weapon Systems 33 ATCALS
- FY09 185 Program Depot Maintenance Completed
- FY09 $3.9B Obligation Authority
- $15.7B Contracts Managed In FY09
- 25 Commands
- 1402 Aircraft Mgd
- 28,598 Engines Mgd
- 203 USAF Bases
- 327 ASW
- 1382 Air Traffic Control & Landing Sys
- 63 Weapon Systems
- FY09 185 Program
- FY09 $3.9B
- $15.7B
- 25 Commands
Basic Systems Engineering Process

INPUTS

Verification Loop

Requirements Loop

Design Loop

OUTPUTS

Requirements Analysis

Functional Analysis/Allocation

Design Synthesis

Analysis & Control
Input

- 334 Engineers in the 327 ASW
- Scattered across:
  - 6 different organizational groups
  - 19 different squadron/supervisors
  - 30 different weapon systems
- Composed of:
  - 6 different engineering disciplines
  - 46 various years of experience
  - 0 standardized, comprehensive development plans
Requirements

• Develop the 327 Aircraft Sustainment Wing’s Engineering Workforce
  – All Inclusive..........all engineers
  – Standardized.........consistent throughout org.’s
  – Comprehensive.....covers all tenets of development
  – Individualized.......allows for individual needs
  – Repeatable...........new employees, each year
  – Measureable..........for mngrt & improvement
Basic Systems Engineering Process

**INPUTS**

1. Requirements Analysis
2. Functional Analysis/Allocation
3. Design Synthesis

**Requirements Loop**

**Verification Loop**

**Design Loop**

**OUTPUTS**

1. Analysis & Control
Functional Analysis

• Needed to breakdown what is meant by “Workforce Development”
• Used the Requirements Loop process
• Determined the components are:
  • Education
  • Professional Military Education (PME)
  • Acquisition Professional Development Program (APDP)
  • Career Broadening
  • Promotions
  • Awards
  • Training
Basic Systems Engineering Process

INPUTS

Requirements Analysis

Functional Analysis/Allocation

Design Synthesis

Verification Loop

Requirements Loop

Analysis & Control

OUTPUTS
Design Loop

• Recognized some systems exist
  • Did not cover all 7 components
  • Often not current
  • Difficult to use
• Needed simple means, to look at all components and whole org together
  • Spreadsheet (62 x 354)
  • Cumbersome, but will improve later…
• Horizontal for individual
• Vertical for organization
Design: Personal Data

- Allows sorting by name and org
- Allows usage by supervisors
- Because all data is in one spot, very easy for employee and supervisor to verify data
### Design: Education Data

<table>
<thead>
<tr>
<th>Have Masters?</th>
<th>Degree Type</th>
<th>In Work</th>
<th>No</th>
</tr>
</thead>
</table>

- Everyone is in one of three categories: yes, no, in-work (because can take almost 2 years to complete and DP systems do not show “in-work”)
- Degree Type filled only if “yes” or “in work”
- Post-degree work does not indicate currency
Everyone is in one of three categories: yes, no, in-work (because can take almost 2 years to complete and DP systems do not show “in-work”)

- Recently big push to have
- Employee should pursue “grade appropriate” PME level
• Several key issues:
  – Do they have an APDP Certification
  – Are they in an Acq Coded job and what level?
  – Is employee current?
  – Are they ready for “next level”?
• Interesting note: found huge organizational gaps when compared
  – Ex: org A at 95% acq coded, while org B is 34%
“Awards and Recognition” always cited in surveys as a top 3 problem area

Unfortunately, tough to keep up with

- Information has to be updated by awards monitors manually
- Labor intensive effort
- Looking for org trend
## Design: Career Broadening

<table>
<thead>
<tr>
<th>Career Broadening Done?</th>
<th>When?</th>
<th>Date Arrived in Current Job?</th>
<th>Employee Promoted?</th>
</tr>
</thead>
</table>

- Chief Engineer decides if Career Broadening vs just a move
- Date Arrived in Current Job is color indexed (cell is filled)
  - Green if <3 years
  - Yellow if >3 years but <5 years
  - Red if >5 years
- Promotions tracked separately
### Design: Continuous Learning

- **16 courses**
- **4 per year**
- **All CBT so no travel expenses**
  - Minimize time away from job
- **Once 16 completed, individualized training/specialization starts**

<table>
<thead>
<tr>
<th>Year 1 Courses</th>
<th>Year 2 Courses</th>
<th>Year 3 Courses</th>
<th>Year 4 Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYS 182</td>
<td>SYS 155</td>
<td>CLE009</td>
<td>CLC041</td>
</tr>
<tr>
<td>SYS 155</td>
<td>SYS 028</td>
<td>SYS 161</td>
<td>FPM101</td>
</tr>
<tr>
<td>SYS 028</td>
<td>SYS 165</td>
<td>SYS 138</td>
<td></td>
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<tr>
<td>SYS 165</td>
<td>SYS 172</td>
<td>SYS 185</td>
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<td>SYS 172</td>
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<td>SYS 116</td>
<td>CLE003</td>
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<td>SYS 185</td>
<td></td>
<td></td>
<td>CLE011</td>
</tr>
</tbody>
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Basic Systems Engineering Process

**INPUTS**

- Requirements Analysis

**Requirements Loop**

- Functional Analysis/Allocation
- Design Synthesis

**Design Loop**

- Analysis & Control

**Verification Loop**

- OUTPUTS
Analysis and Control

• Several methods used for analysis and control:
  – Annual meeting to standardize/adjust entire program
  – Metrics for each all 7 components
  – Metrics for years to track trends
  – Metrics to compare organizations
  – Tool to be used by supervisor twice a year with employee
  – Metrics displayed to upper management at least quarterly
Control Metric: 327 ASW Training

Personnel on Acquisition Coded Positions

327 ASW Goal 80%  
Stretch Goal 90%

327 ASW Training

327 ASW Goal 80%  
Stretch Goal 90%
Control Metric: Acq Certifications

Personnel on Acquisition Coded Positions

AFMC Standard 68%
AFMC Goal 86%
Basic Systems Engineering Process

**INPUTS**

- Requirements Analysis
- Functional Analysis/Allocation
- Design Synthesis

**Verification Loop**

**Requirements Loop**

**Design Loop**

**OUTPUTS**

- Analysis & Control
Outputs

- A trained, developed Workforce

- Workforce Development Plan provides:
  - Individualized attention
  - Standard baseline
  - Comprehensive look
  - Repeatable process
  - Measureable data
  - Monitored by upper management

- Example: ASW achieved 96% training goals for FY09
Summary

- 327 ASW developed tangible systems engineering process/plan to develop the engineering workforce
- Clear-cut, tangible process
  - Will apply to 1300 ALC engineers in FY10
  - Plans to use for other disciplines (PM, loggies, etc…)
- Metrics to measure progress for management
- It works!

In Place and In Use Now
Questions?