Accelerate Performance Improvements:
Systems Engineering Skills Competency Analysis and Training Program Development

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Agenda

- GDLS Overview
- SE Training & Education Program Overview
- Competency Assessment
- Gap Analysis
- Curriculum Development
- Results to Date
- Future Activities

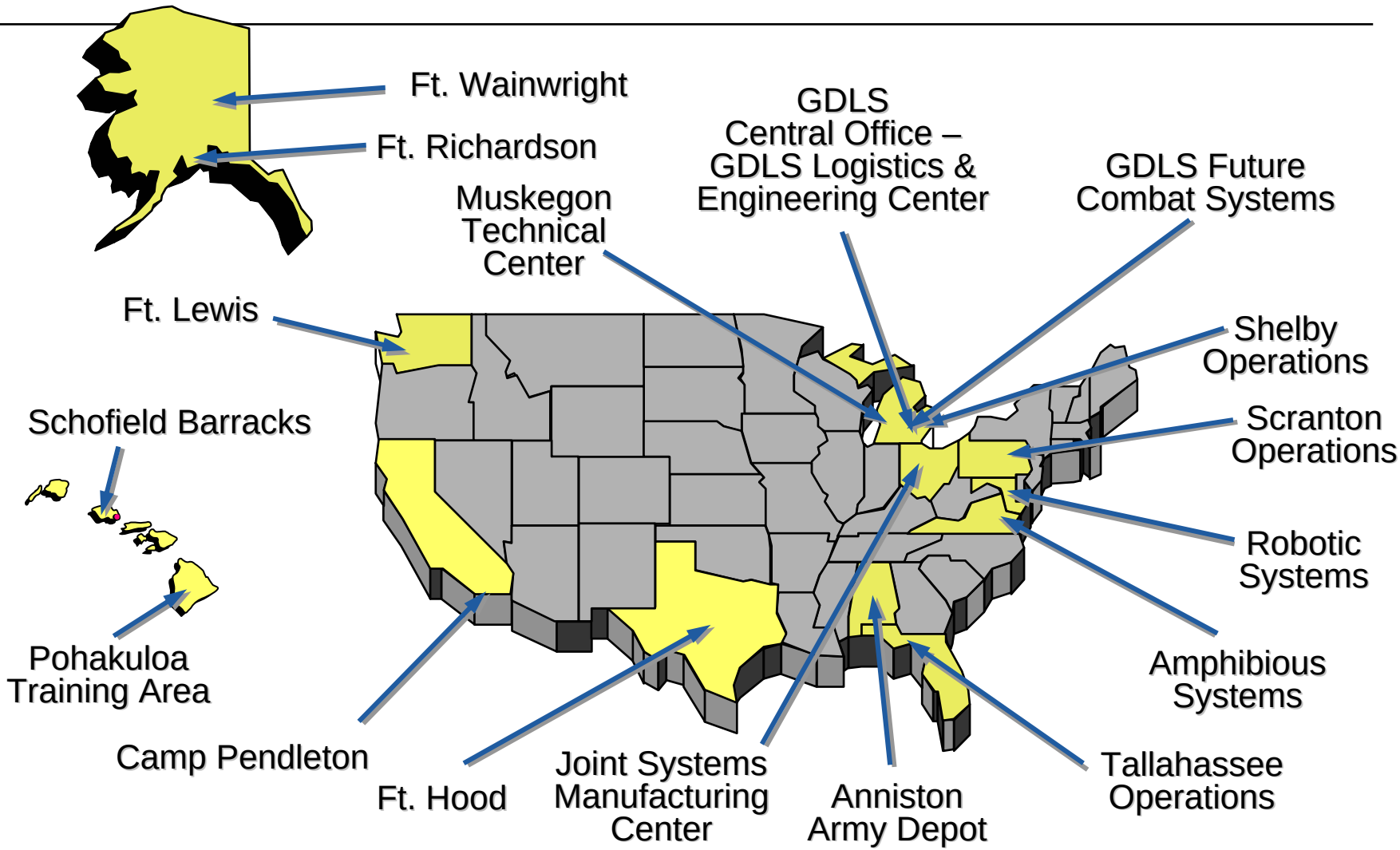
GDLS Mission

General Dynamics Land Systems provides a full spectrum of land and amphibious combat systems, subsystems and components worldwide

Our strengths are world-class design and systems integration, superior production and innovative life cycle support

We will deploy these strengths to meet our customers' needs in a changing world

U.S. Locations



Major Contributors to Poor Program Performance*

- Lack of technical planning and oversight
- Inadequate understanding of requirements
- Incomplete, obsolete, inflexible and Stovepipe Physical and Functional architectures
- Stovepipe developments with late integration
- Lack of subject matter expertise at the integration level
- Low visibility of software risk

Lack of systems engineering discipline, authority, and resources

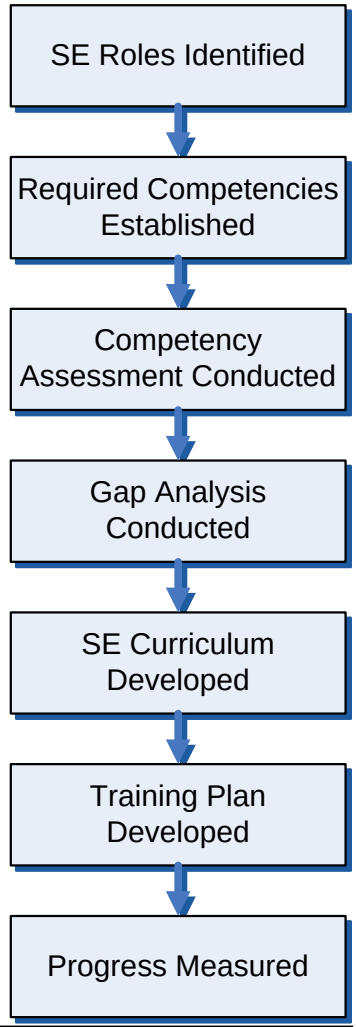
*** DoD-directed Studies/Reviews, 2005**

GDLS's Response

- Organize along Product Centers
  → Voice of customer
- 'One Engineering Design and Development Team' for GDLS
  - Integrated Process System across all Locations
  - CMMI Level 3/5
- Revitalize Systems Engineering
  - Process Improvements
    - Gate Reviews, Six Sigma, DFR
  - SE Training & Education Program ← **Today's Topic**

SE Training & Education Program Development Overview

- Roles identified for Systems Engineering
- For each role, required competencies established
- Employees assessed against required competencies for their assigned roles
- Results of competency assessments analyzed to identify gaps
- SE Curriculum developed to address high and medium gaps and to further develop employees with low or no gaps
- Training Plan developed to incorporate SE Curriculum, mandatory courses, and Seminars/Conferences
- Progress to goals and training effectiveness measured by Level 1 evaluations



Competency Assessment

- Supervisor verifies that correct roles are assigned to Employee
- Employee conducts self-assessment of competency levels for each required competency

  Basic - Trained or understands basic concepts of the competency, however still needs help in applying the competency

  Qualified - Has a good command of the competency, no help needed in applying the competency

  Advanced - Has advanced understanding of the competency, can lead and/or teach others in applying the competency

  None – Does not meet basic competency level
- Supervisor verifies assessment
- Training Coordinator compiles all completed assessments
- Training Coordinator evaluates roles to determine which roles represent 80% of the Systems Engineering population

Gap Analysis Methodology

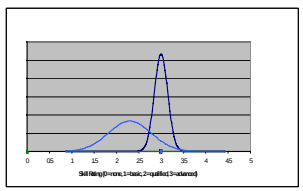
Determined which roles represent 80% of the SE population (top roles)

Identified top 20 required competencies for the top roles

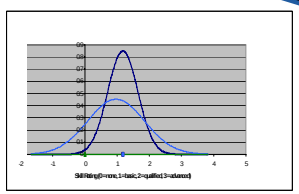
Analyzed results of competency assessments to determine distribution of gaps across the top roles for the top 20 required competencies

Gap Analysis

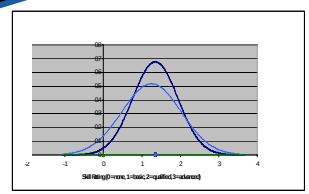
(Compared Required Skill Level to Evaluated Skill Level)



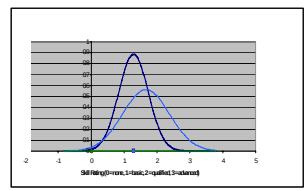
High Gap



Medium Gap



Low Gap

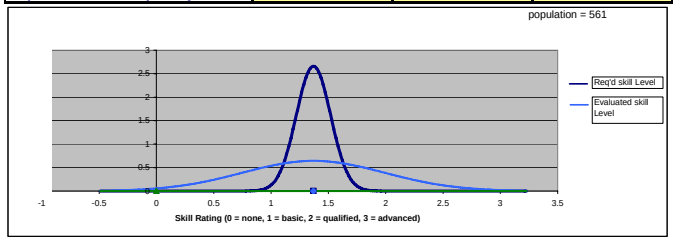


No Gap

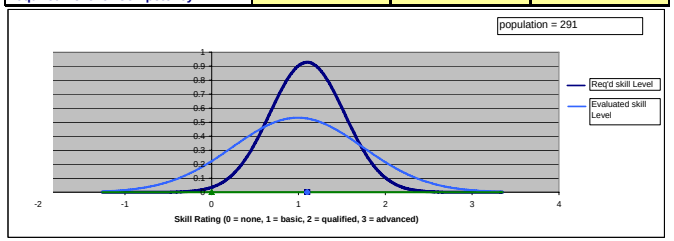
Competency Assessment Results

- Highest Gap
  - SE Principles
  - Project Management
  - Domain Specific Skills
- Medium Gap
  - Risk Analysis
  - Test & Validation Planning
  - Baseline Management (CM)
- Lowest Gap
  - Requirements Management
  - Trade Studies
  - Reliability
  - Design Integration

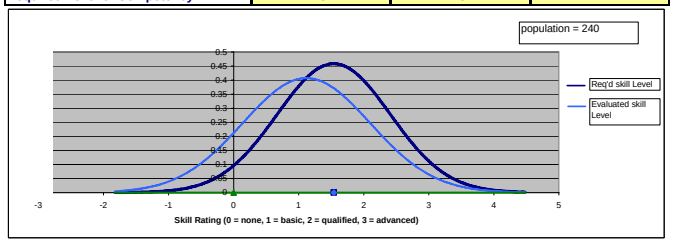
All SE - SE Principles			
User defined parameters	Required Skill	Evaluated Skill	
Mean	1.37	1.37	
Standard Deviation	0.15	0.62	
Required Level of Competency	1.37	1.37	



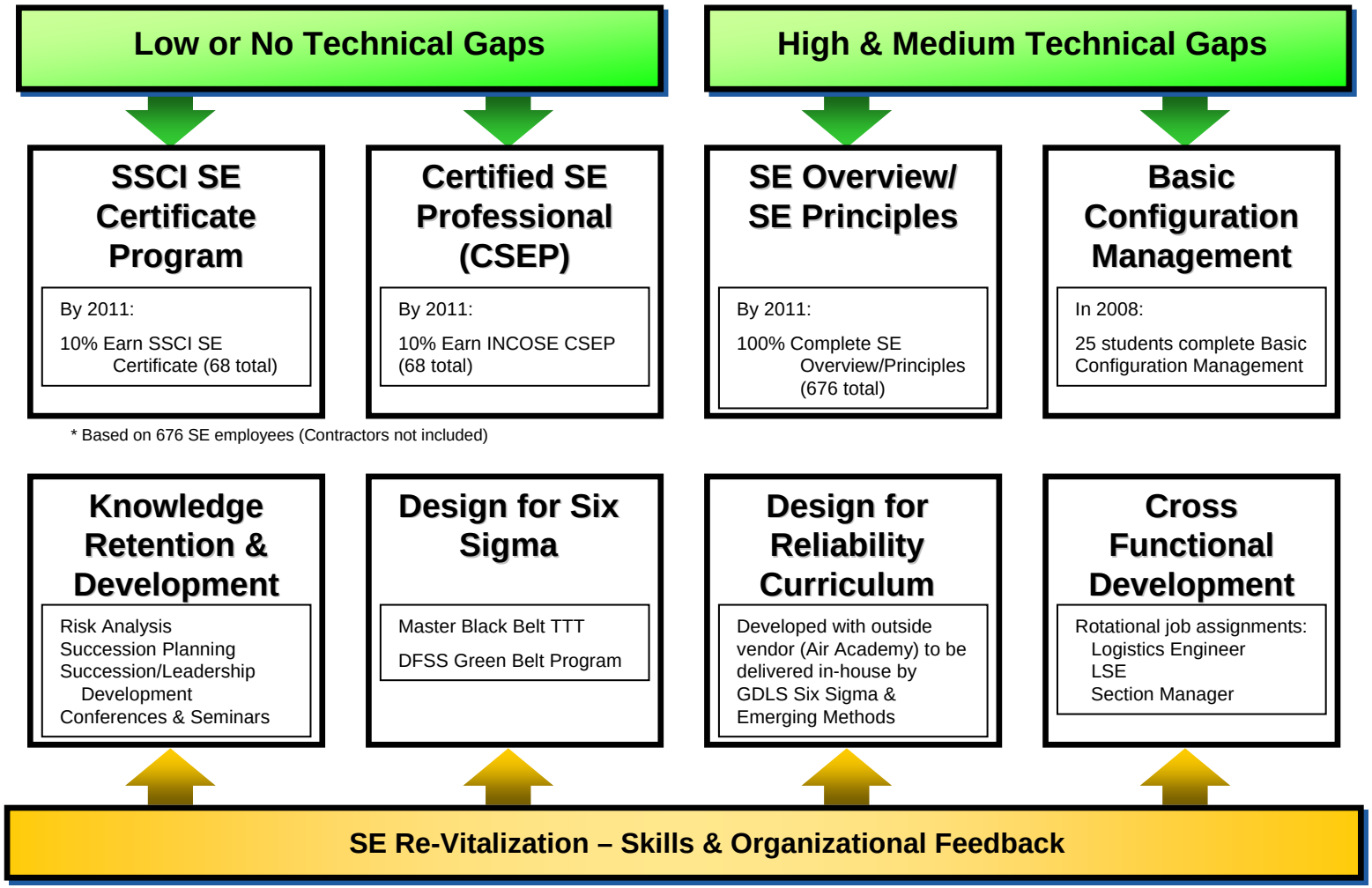
All SE - Risk Analysis			
User defined parameters	Required Skill	Evaluated Skill	
Mean	1.1	0.99	
Standard Deviation	0.43	0.75	
Required Level of Competency	1.1	1.1	



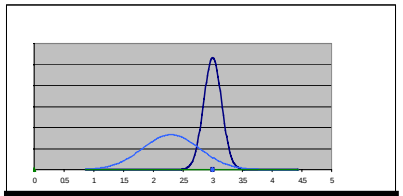
All SE - DOORS			
User defined parameters	Required Skill	Evaluated Skill	
Mean	1.54	1.12	
Standard Deviation	0.87	0.98	
Required Level of Competency	1.54	1.54	



SE Curriculum



Development of SE Training Plan



Technical Competency Gaps

SE Curriculum

ED&D Organizational Training Plan (OTP)

Mandatory Health & Safety, ITAR,

ED&D Imperatives

SE Organizational Training Plan (OTP)

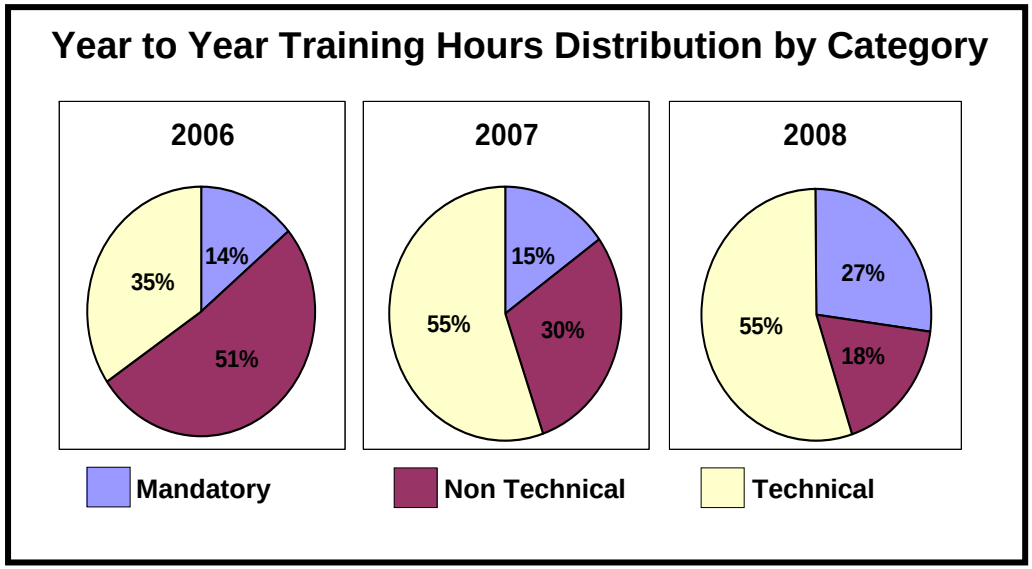
Technical Conferences & Seminars

(Debriefs Conducted)

Available budget

Training Budget Distribution

- Training represents 6% of the Systems Engineering overhead budget.



- **Mandatory Training** includes health, safety and security courses.
- **Non Technical Training** includes courses such as leadership development, teaming, CMMI and ISO.
- **Technical Training** includes courses such as SE Certificate Program/Overviews, GD&T, Soldering and Welding.

Development of SE Courses

2006

- Training Gap Analysis of Systems Engineering employees revealed need for Systems Engineering courses.
- Completed trade study and selected Center for Systems Management (CSM) based largely on their affiliation with Stanford University.
- Delivered first sessions of SE courses with CSM.

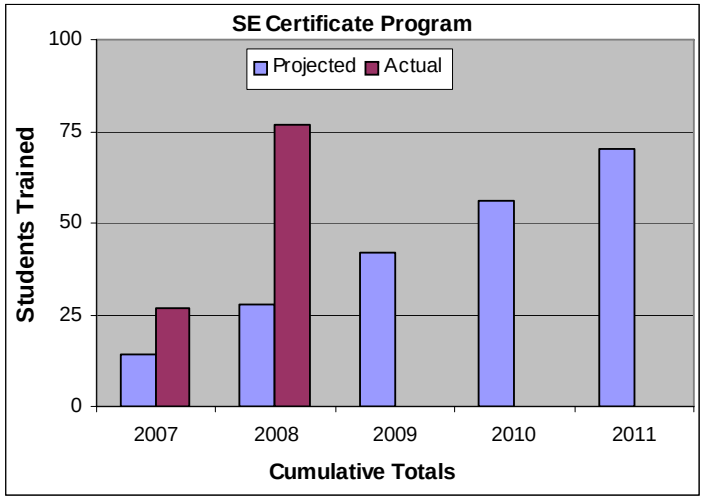
2007

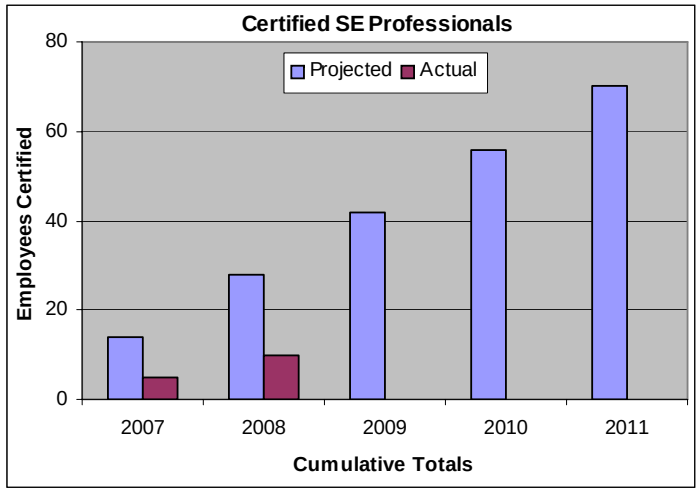
- CSM/Stanford University no longer affiliated.
- Second trade study conducted to determine if vendor change best option for future course delivery.
- Systems and Software Consortium (SSCI) selected based on reputation and prior relationship.
- Collaborated with SSCI to tailor standard course materials for GDLS.
- Delivered first sessions of 12-day SE Certificate Program (SECP).

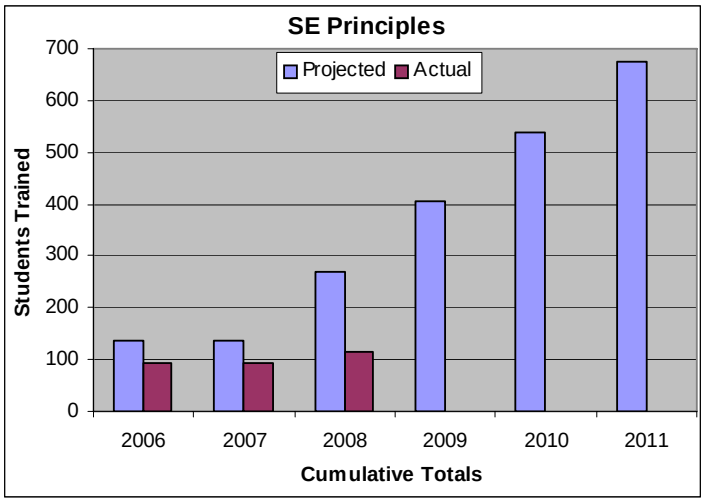
2008

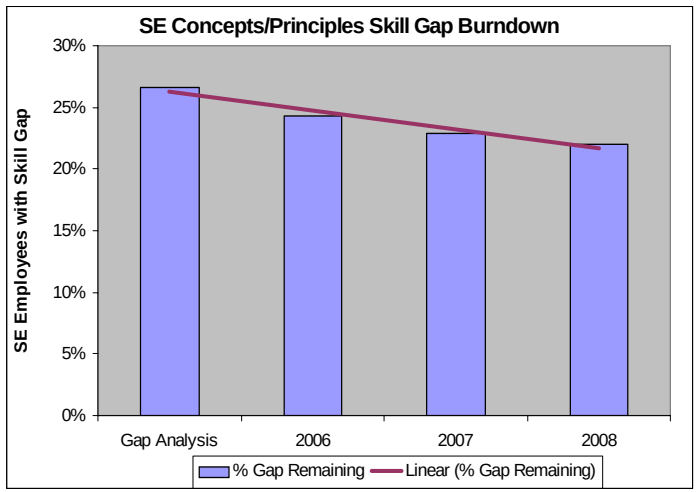
- Continued offerings of SECP and added 5-day and 2-day SE Overview course to training plan.
- Utilized Michigan Economic Development Grant

Training Goals



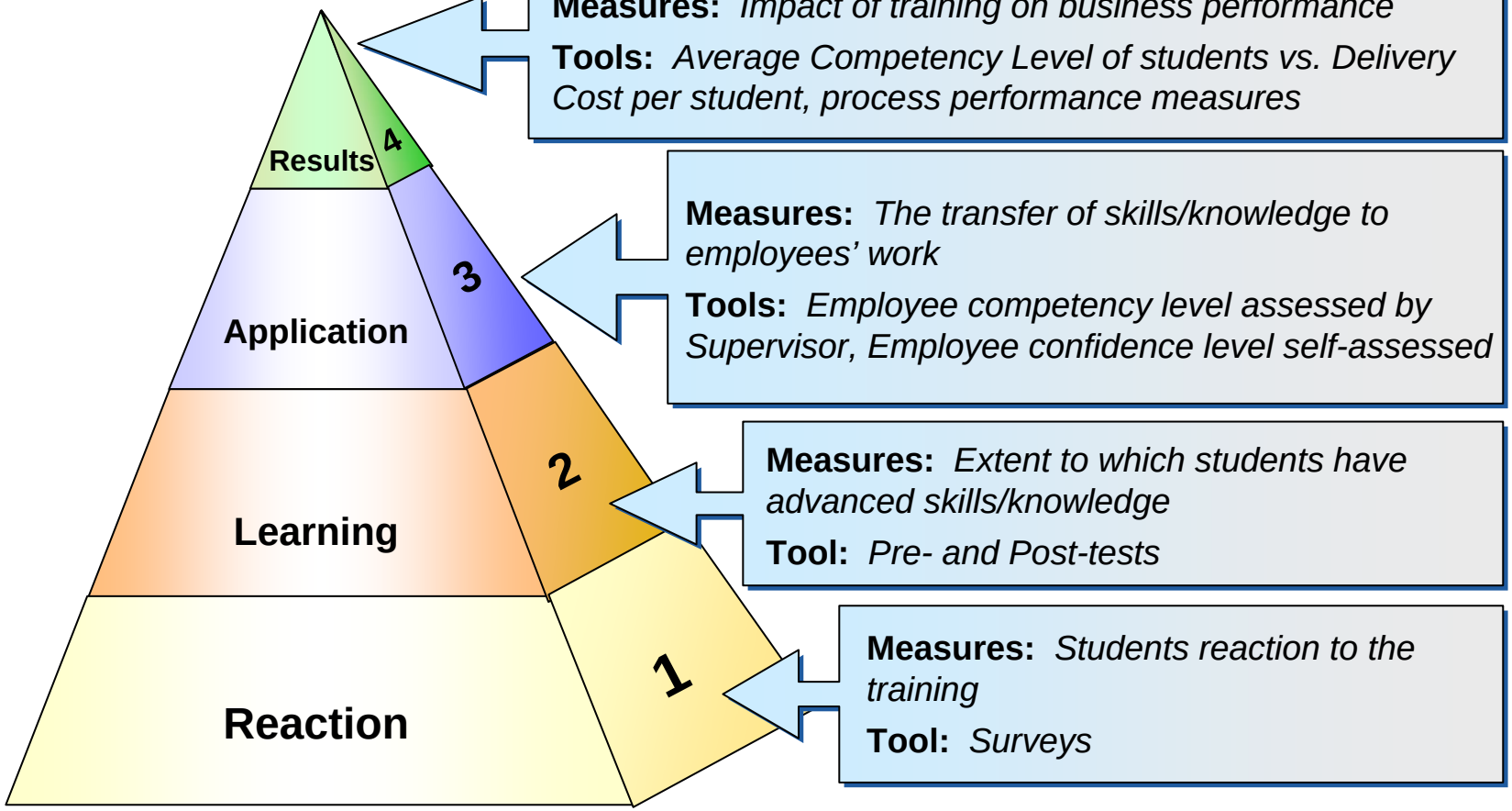






Training Evaluation

Levels of Evaluation



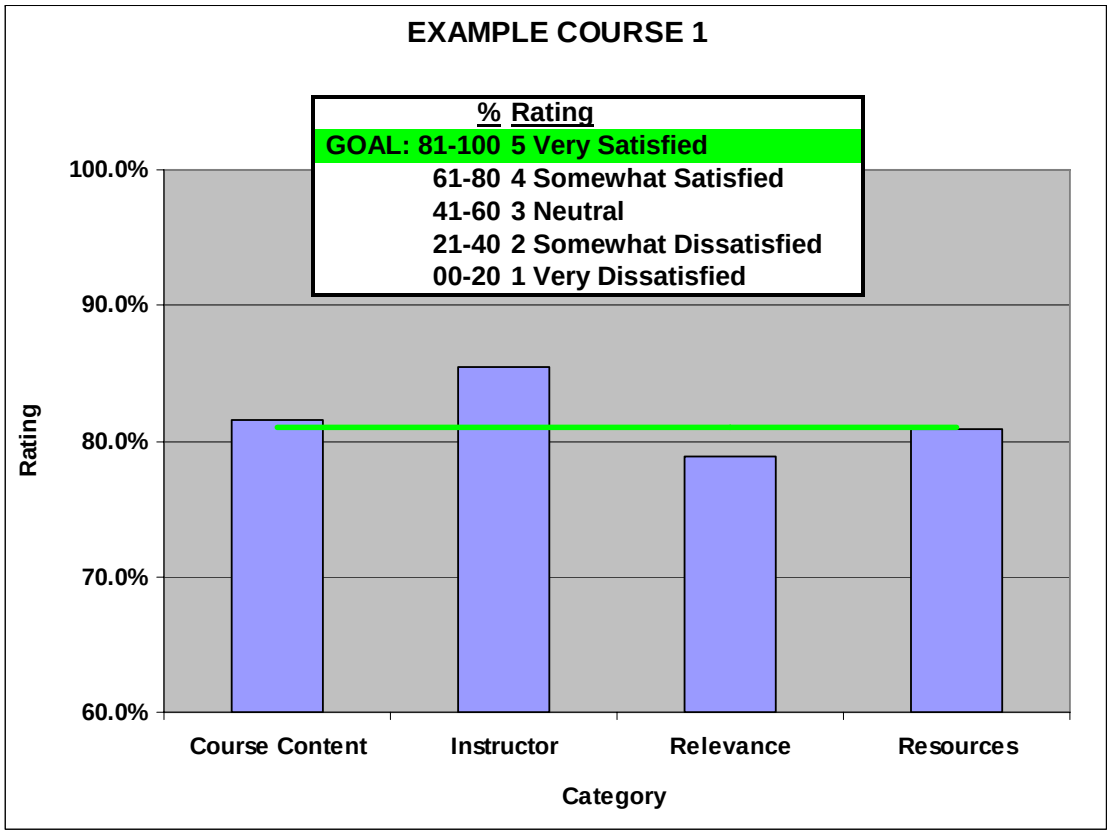
Results to Date

- Development of evaluation methods: surveys, pre/post testing, 90-day evaluations
- Evaluations reveal effectiveness of courses
- Student comments used to improve future course delivery
- Modest changes to 2006 SE Training Gap

SE Training Effectiveness

- **Level 1 Evaluation: Course Surveys administered at end of class**

  17 question survey used to evaluate students' satisfaction with the course content, instructor, resources, and relevance of course to their jobs.



EXAMPLE COURSE 1:

ANALYSIS

- Some attendees were employees with many years of experience and felt that the course was not relevant to them.
- Course material needs to be made more relevant to SE. Too much focus on Software.

CORRECTIVE ACTION

- One time offering. No action to be taken at this time. If future offerings to be scheduled, consider tailoring course material to SE and use updated gap analysis data to identify attendees.

SE Training Effectiveness

- **Level 2 Evaluation: Pre/Post Testing**

SE Overview 5 Day Pre/Post-Test
Class Held: 8-18-22-08 – VIS Room

Employee # _____ ☐ **Pre-Test** ☐ **Post-Test**

Please take a few minutes to answer the questions below to the best of your ability. This is a two-part exercise with the purpose of measuring the basic skills/knowledge gained through this course. You will be asked to complete this same test at the end of the course. There is no penalty for wrong answers.

Possible Answers:			
	Maintenance	Process Control	State
	Measures of Effectiveness	Quality	Systems Engineering
	Mode	Reliability	Validation
	Planning	SEMP	Verification

Fill in the blanks using the choices above.

1. _____ is an interdisciplinary approach and means to enable the realization of successful systems.
2. _____ are used to quantify the performance of system products and processes.
3. _____ is the condition of the system.
4. _____ is the manner in which the system operates.
5. _____ and _____ are elements of Logistics Support.
6. _____ answers the question, "Did we build the right thing?"
7. _____ describes engineering specialty integration, the SE work to be done, and the management of this work.
8. _____ and _____ are engineering specialties.

9. How would you rate your current knowledge of Systems Engineering? *(Check one.)*
   - ❑ Advanced – Have an advanced understanding of the skill, can lead and/or teach others in applying it.
   - ❑ Qualified – Have a good command of the skill, no help needed in applying it.
   - ❑ Basic – Understand basic concepts, but still need help applying it.
   - ❑ None – Have no knowledge of this skill/topic.

10. What did you gain from this course? *(Check one.)*
    - ❑ New ideas related to Systems Engineering
    - ❑ Build on my existing knowledge of Systems Engineering
    - ❑ Basic knowledge of Systems Engineering
    - ❑ Nothing

Please return this test to the instructor when you have completed it.

Test of 10 questions based on course content administered at start and end of courses to measure initial effectiveness of course delivery.

EXAMPLE COURSE 2:

ANALYSIS

- Few students scored higher on Post Test
- Focus of course did not match pre/post test questions well.

CORRECTIVE ACTION

- Prior to next course offering, work with course instructor to develop a Pre/Post test that is more relevant to the topics reviewed during the course.

SE Training Effectiveness

- **Level 3 Evaluation: Application – Post-Course Evaluation**

Use standardized evaluation form to collect data.

Send via email to students 60-90 days following course.

Measures frequency of skill use, value of skill on job, self-assessed proficiency rating, barriers to use on job.

PI-TMP 2.2.6, Post Training Effectiveness Survey template
Issue 2: January 27, 2006

Course Title: _____

Date Attended: _____

Instructor: _____

Several months ago, you attended the course listed above. We would like to know the effect this training has had on how you perform your job. Please take a few minutes to respond to the following questions, even if you haven't had the opportunity yet to use the training on the job.

Instructions: Please check the appropriate response after each statement.

1. I have had the opportunity to apply this training on the job. — ***Yes*** ☐ ***No*** ☐

a. If yo

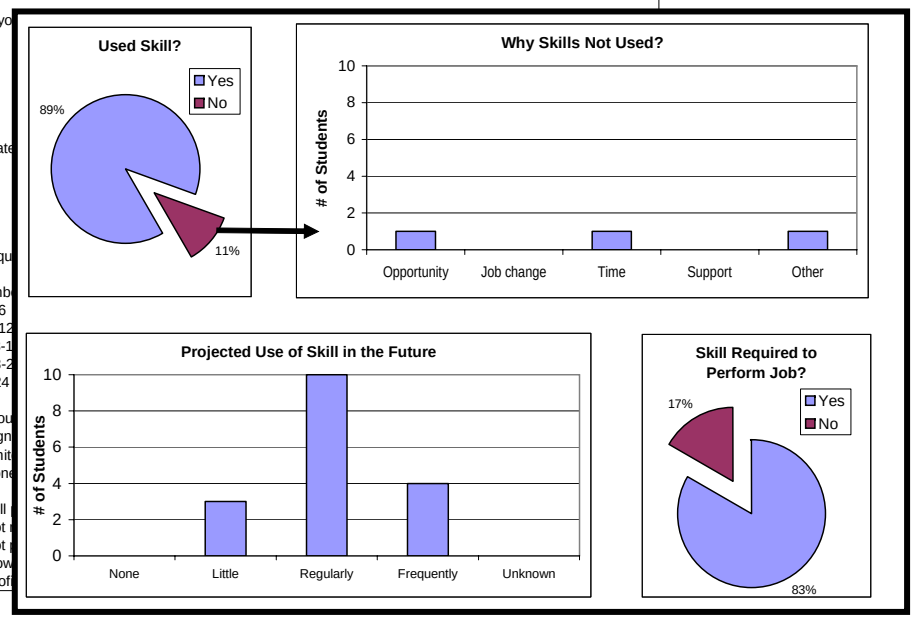
b. Rate

2. Is the skill requ

3. Rate the numb
   a. 1-6
   b. 7-12
   c. 13-1
   d. 18-2
   e. >24

4. How would you
   a. sign
   b. limit
   c. none

5. Rate your skill
   a. not
   b. not
   c. slow
   d. profi



EXAMPLE COURSE 3:

ANALYSIS

- Analysis of preliminary data shows course is well received and is perceived by attendees to have value in their day to day activities. Most students would recommend this course to coworkers and managers.

Path Forward

- Complete follow up Training Gap Analysis by year-end
- Renew focus on closing identified training gaps
- Continue to tailor/modify course delivery based on student feedback
- Continue to develop and improve evaluation methods to assess improved business performance

Contact Information

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BACKUP

Roles & Competencies

ROLES REPRESENTING 80% OF SE POPULATION		
Requirements Engineer	Configuration Management (CM) Engineer	Specialty Engineer - Embedded Training Analyst
Section Manager	Team Lead	Administrative Assistant
Systems Analysis Engineer	Corrective Action Engineer	Environmental Test Technician
Physical Architect	CM (Configuration Management) Analyst	Process Engineer
Specialty Engineer	System Integration Engineer	Provisioning Analyst
Field Test Engineer - Vehicle Test Engineer	Environmental Test Engineer	Training Content Developer
System Architect	CM Technician	Requirements Management Analyst
Logistics Engineer	Field Material Supply Specialist	Field Test Engineer - Supply Support Engineer
Lead System Engineer	Maintenance Engineer	Logistics Engineering Liaison
Reliability Engineer	Department Manager	System Safety Engineer
Technical Writer - Operations and Maintenance	Diagnostics Engineer - Troubleshooting Developer	

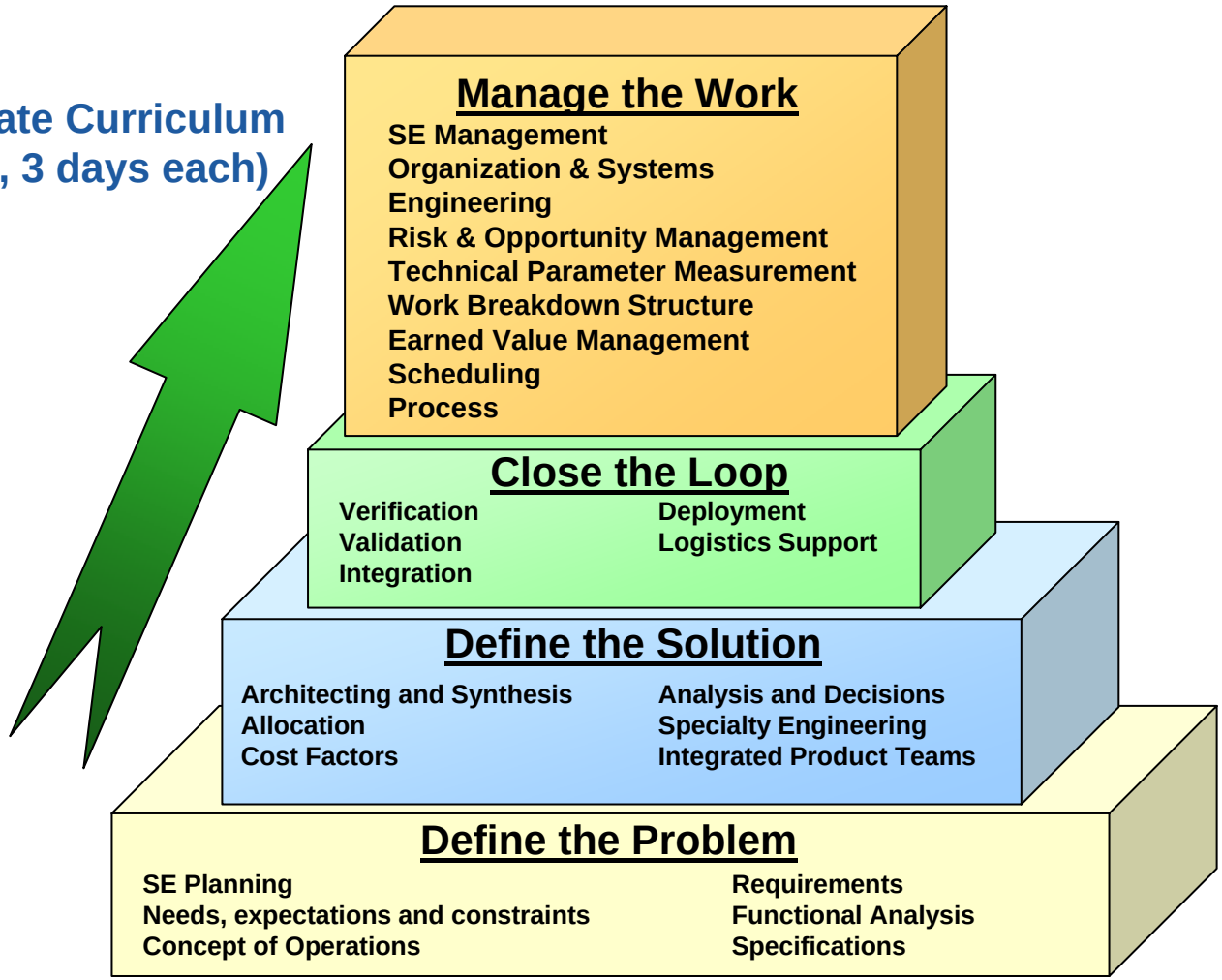
TOP 20 COMPETENCIES	
1	System Engineering Principles
2	Job Specific Process knowledge
3	Product knowledge - (Tracked, Wheeled or FCS as applicable)
4	Customer Satisfaction
5	Communication
6	Effective meeting / reviews
7	EVMS
8	Risk Analysis
9	Trade Studies
10	Reliability theory
11	Pro E
12	DOORS
13	Requirements Generation & Documentation
14	Metric development
15	Program Management
16	Test & validation plan development
17	Cost estimating / proposal development
18	DFMEA principles & techniques
19	XFMEA (reliasoft suite of tools - Vmetric, Weibull, blocksim)
20	Project Planning

SE Certificate Program (SECP)

- Is an on-site program leading to a **Systems Engineering Certificate** from the Systems and Software Consortium, Inc. (SSCI).
- Is an intensive, graduate-level learning curriculum for experienced, practicing engineers.
- Is a 12 day program delivered in a building block approach of four 3-day modules over a two to three month period with self-study, classroom, and team project work.
- Is a program that integrates INCOSE SE Handbook material in an effort to help participants who are interested in pursuing the INCOSE Certified Systems Engineering Professional (CSEP) certificate.
- Provides the ability to address skill/competency gaps through training
- Supports SE Revitalization

SE Certificate Program (SECP)

SE Certificate Curriculum
(4 classes, 3 days each)



Other SE Courses

SE Principles

- Is an on-site courses developed by the Systems and Software Consortium, Inc. (SSCI).
- Offered as 2 and 5 day courses
- Provides overview of SE for inexperienced engineers (high or medium technical competency gap).
- Describes the basics of systems engineering – what it is, how it proceeds through the life cycle and why it needs to be done.

Basic Configuration Management

- Is a two-day, on-site course developed by the Systems and Software Consortium, Inc. (SSCI).
- Provides a foundation in basic Configuration Management principles and skills

Certified SE Professional

Certified Systems Engineering Professional is a recognized certification that confirms that an individual has the basic skills to perform fundamental Systems Engineering tasks and is able to make a productive contribution to work efforts.

Benefits of CSEP Certification

- Formally recognizes SE capabilities
- Distinguishes CSEP holder from others within a professional field
- Provides a competitive advantage
- Furthers professional SE development
- Helps advance the art and practice of SE

Certification Process