Distributed Learning
Master of
Cost Estimating
and Analysis

ICEAA
Denver, CO June 2014

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Agenda

- Background
- Who we are: NPS and AFIT
- Why is this program important?
- What we are doing: Overview
  - Master's Overview
  - Curriculum Overview/Capstone Projects
  - First Three Cohort Demographics
- Challenges and Issues
- Solicit your Questions and Feedback

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Background

- Jointly developing a Distributed Learning Cost Estimating and Analysis Master's Program between AFIT and NPS
  - Master's Program (16 courses)
  - Certificate (4 courses)
- Leveraging strengths of both AFIT and NPS
- Open to all personnel
  - DoD Civilians
  - Military (officers and enlisted)
  - Defense Contractors
  - Foreign Officers
  - Civilians from Ministry of Defense

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Background

- Initial Request from NAVSEA in Winter 2010
  - Specific interest in collaboration between AFIT and NPS

- Initial development funding received from NAVSEA and NAVAIR, Summer 2010

- Strong Stated Interest/Support
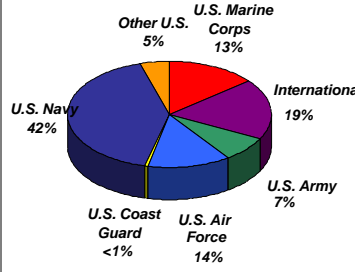 - All Services, OSD
  - Service Cost Centers

We have received and incorporated numerous ideas concerning course content

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NPS--100 Years of Graduate Military Education

- **Accredited:**
  - □ **WASC, ABET, AACSB, NASPAA**
- **Operationally Relevant**
  - □ **Unique advanced education and research programs increasing the combat effectiveness of U.S. and Allied armed forces**
- **Accomplishing the Mission**
  - □ Program of Record focused graduate schools, institutes, and research centers.
  - □ Education built on operational experience
  - □ An innovative environment: solutions to current, near-term and long-term national security needs.
  - □ Opportunity to experiment with the latest operational technologies in an academic environment.

Pie chart:
- U.S. Navy 42%
- International 19%
- U.S. Air Force 14%
- U.S. Marine Corps 13%
- U.S. Army 7%
- Other U.S. 5%
- U.S. Coast Guard <1%

- Postgraduate Masters, Engineering and Doctorate Degrees
- Programs renewed every two years based on emerging requirements
- Clear focus on military systems and applications

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NPS Alumni

- **43,000 Graduates**
  - Representing all U.S. Military Services and many U.S. Government agencies
  - 4031 international officers from 84 countries
  - 34 Astronauts
  - 25% of U.S. active-duty Flag and General Officers
- **More than 50,000 Nondegree Participants**

ADM Michael Mullen
Chairman, JCS

General Michael Hagee
Commandant
U.S. Marine Corps
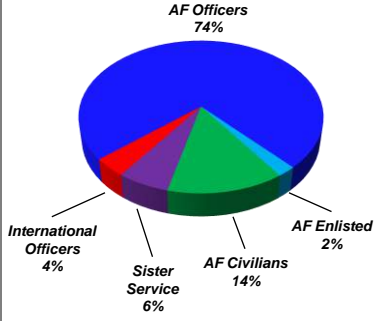
H.M. KING ABDULLAH II

King Abdullah of Jordan

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AFIT—93 Years of History
67 years of Graduate Military Education

- **Accredited:**
  - □ **NCA, ABET**
- **Operationally Relevant**
  - □ **Advance air, space, and cyberspace power for the Nation, its partners, and our armed forces by providing defense-focused technical graduate and continuing education, research, and consultation**

- **Accomplishing the Mission**
  - □ The military is technologically focused and technologically focused education is essential
  - □ Uniqueness: Military and civilian faculty, defense-focused research
  - □ Vital, connected, and relevant to current operations across the globe
  - □ Unmatched speed and flexibility to adapt to changing mission focus

AF Officers 74%
International Officers 4%
Sister Service 6%
AF Civilians 14%
AF Enlisted 2%

- Postgraduate Masters and Doctorate degrees
- Programs reviewed by stakeholders and external review panel every three years
- Clear focus on military systems and applications

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AFIT's History …

Spans the Entire Aerospace Age

1919	1930	1940	1950	1960	1970	1980	1990	2000	2010

26 27   47   50   54 55   63 65 69 78   83   04 08

CE School

Degree Authority

1st EN Degrees

1st PhDs

1st LS Degrees

537 PhD … 16,849 MS … and 920 BS

Moved to Wright Field

Graduate and PCE Courses In Environmental Engineering Management

Air Service Engineering School

Air Corps Engineering School

AFIT (AFMC)

AFIT (Air University)

AFIT (ATC)

AFIT (Air University)

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AFIT's Graduate School of Engineering and Management

- 6 traditional academic departments
- 5 centers of excellence
- 13 PhD, 23 MS, and 8 graduate certificate programs
- Research facilities
  - 12 aerospace research labs
  - 33 applied physics labs
  - 11 radar, electronics, and computer labs
  - 3 environmental sciences labs
  - Base infrastructure also available to AFIT

| Mathematics & Statistics | Electrical & Computer Eng | Engineering Physics | Operational Sciences | Systems & Engineering Mgt | Aeronautical & Astronautical Eng |

AFIT: Graduate Cost Analysis Education, & DL

- Leveraging Our Strengths:

- Experience + Expertise = High Quality Program
  - This is the 32nd Anniversary of our In-Residence Cost Program
  - 325 Graduates and Counting

- AFIT: We Aren't New to Distance Learning, Either
  - First AFIT DL Class Began in 1995

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Why is This Program Important?

- ## Cost Estimating is in the DoD spotlight

  - ☐ Weapons System Acquisition Reform Act of 2009
    - Combines OSD PAE and the Cost Analysis Improvement Group (CAIG) into Director of Cost Assessment and Program Evaluation (DCAPE), with two deputy directors:
      - ☐ Deputy Director for Cost Assessment.
      - ☐ Deputy Director for Program Evaluation
    - The Director [DCAPE] established in 2009, Senate confirmable, reporting directly to SECDEF, with annual Congressional reporting requirements.

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Why is this program important?

- ☐ Large expansion underway in DoD cost estimating cadre.

- ☐ Target Population:

  - Most new hires will be recent college graduates, untutored in DoD/clueless about cost estimating.

  - There are also cadres of GS12-15's who are already cost estimators, but who lack formal education in the field.

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High Level Visibility

" I don't need <u>more</u> cost estimators; I need <u>better</u> cost estimators" [Hon. Sean Stackley, ASN(RD&A)]

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What We Are Doing: Overview

- **Two year program**: 2 cohorts (50 students) have graduated!
  - 2 classes per quarter
  - 4 quarters per year
- Delivery modes
  - Asynchronous (computer based; no face-to-face instructional time, one class each quarter)
  - Synchronous (one class each quarter)
    - VTE / VTC / Elluminate / DCO
    - Third cohort: Classes meet Wednesdays, 1400-1700 (EST), same time slot for two years
    - Fourth cohort: Classes meet Thursdays, 1400-1700 (EST), same time slot for two years
    - Fifth (next) cohort: Classes will meet Wednesdays, 1400-1700 (EST), same time slot for two years

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Benefits

- All graduates will earn a Master of Cost Estimating and Analysis upon completion.
- Intent is for Master's Program to Fulfill the Educational Requirements for DAWIA Level I, II, and III Certification (BUS-CE) for all services. Seven years of experience still needed for completion.
- Air Force has granted its approval
- Army has granted its approval
- Navy approval for first two cohorts. NAVSEA heading working group

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Curriculum Overview

- Foundational courses
  - Probability and Statistics (2 Courses)
  - Operations Research for Cost Analysts
  - Acquisition of Defense Systems
  - Defense Financial Management and Budgeting (2 Courses) (one on policy, one on practice)
  - Systems Engineering (2 Courses)
- Cost Estimating
  - Cost Estimating I, II, and III: Methods, Techniques, Risk and Uncertainty
  - Cost Estimating IV: Applied Cost Analysis
  - Cost Estimating V: Case Studies; Cost Economics
  - Cost Estimating VI: Decision Analysis
- AFIT and NPS each teach half of the courses
- Capstone Project (final two quarters)

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Capstone Projects

- Final two quarters of program
- Students will work in groups of 3 to 5 students and will be assigned real projects needed by the cost organizations (OSD CAPE, NAVSEA, NAVAIR, AFCAA, DASA-CE, NCCA, etc)
- Either work on part of a larger program, or work on a small program: "Bite-sized and focused"
- Project Deliverables: Research paper, and ppt presentation to sponsoring command.
- Published?

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Capstone Projects from Cohort #1

- "Simple Software Cost Estimation Model Without Adaptation Adjustment Factor". Sponsor: AFCAA
- "Profit": Current Deficiency: Estimates have limited basis for fee/profit. Typically use what was on the last contract or similar contract with no appreciation for the greater economic environment. Solution: Develop a CER that relates fee/profit to an economic indicator by phase of acquisition. Sponsor: NCCA
- "Analyze/Update SE/PM Analysis": An original study used EVM data from historical programs, and was limited to monthly burn rate and % relationships; further analysis could be explored based on commodity, contractors, pooled analysis, distribution shape over time, and man-year count by task. Sponsor: NAVAIR

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Capstone Projects from Cohort #1 (cont)

- "Analysis of Contractor Cost Structures and Rates". Evaluate impacts of factors such as business base changes, evolution away from defense work to commercial, and pension impacts. Sponsor: NAVAIR

- "Future Exchange Rates Predictor": Researching the best predictor of future exchange rates (1-2 years out). Sponsor: AFCAA

- "Developing a new Modifications CER": An in-depth update of a previous analysis. Sponsor: AFCAA

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Sample *from* Capstone Projects from Cohort #2

- *"Fixed Price-type Contracting Impacts on Program Pricing"*: Are we really saving money when we use FP contracts? Sponsor: USAF (AFLCMC)

- *"Deriving a Better Aircraft Cost Metric"*: Typically cost per flying hour is the one primary metric for aircraft. However, with the anticipated change in training delivery and possible change in rating requirements for operators, there will likely be a significantly lower number of training flight hours required for operators/crew. Should the "cost per flying hour" metric change? Would "cost per mission hour" be better? Is there something better? Sponsor: NCCA

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Sample *from* Capstone Projects from Cohort #2 (cont)

■ *"Survey of DoD Major ACAT Program ILS Analysis*:" This topic entailed documenting the types of cost data used to substantiate estimates, as well as recommending types of data needed to improve quantitative analysis of Integrated Logistic Support (ILS) requirements across DoD. Sponsor: NAVAIR

■ *"Predicting Future Technical Data and Publications Costs*:" Using several recent NAVAIR aircraft programs as a reference, develop a model to predict future Technical Data and Publication costs. Sponsor: NAVAIR

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Timetable

■ Cohort #1: Commenced Spring Quarter 2011
  □ Graduated March 2013 (+ Feedback Forum)
■ Cohort #2: Commenced Spring Quarter 2012
  □ Graduated March 2014 (+ Feedback Forum)
■ Cohort #3: Commenced Spring Quarter 2013
  □ Will graduate March 2015
■ Cohort #4: Commenced Spring Quarter 2014
  □ Will graduate March 2016

■ *Our Intent:*
  □ One cohort per year
  □ 27 – 33 students per cohort

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Demographics of First Cohort

- Selected: 32   Graduated: 26
- Mostly Navy and Air Force represented, plus a few contractors

  □ NAVSEA: 5
  □ NAVAIR: 5
  □ NUWC-Newport: 2
  □ NSWCDD Dahlgren: 2
  □ Pentagon: NCCA, OSD (CAPE), AFCAA: 4
  □ AF Space and Missile Center, Los Angeles: 5
  □ Contractors: 3

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Demographics of First Cohort

  □ All applicants were working in the cost estimation field at their respective commands

Rank/Grade Breakdown:

  □ GS 7 – GS 15

  □ One Active Duty Navy O-6
  □ One Active Duty Air Force O-2

  □ Three contractors (Boeing, Cask Technologies, Wyle Aerospace)

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Demographics of Second and Third Cohorts

- Cohort 2: Selected: 33   Graduated: 26
- Cohort commenced late March 2012 and graduated in March 2014.
- Navy, Air Force, Army, JHU/APL, and contractor involvement this cohort

- Similar demographics for Cohort 3.
  - Selected: 27   Remaining: 22
  - Slightly fewer students this cohort due to funding issues

- Beginning selection for Cohort 4 at time of this submittal

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Certificate Program Available, as well

- A four course sequence leading to a Certificate in Cost Estimating and Analysis.
- You will take one class per quarter for four consecutive quarters.
- Next Class commences Summer 2014.

The Four Courses Include:
- Operations Research Methods for Cost Analysts
- Cost I: Methods and Tools
- Cost II: Advanced Concepts in Cost Estimating
- Cost III: Risk and Uncertainty Analysis

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Challenges and Issues

- Tuition MUST be paid for by student's command, with Command Endorsement a requirement. GI Bill and personal funds cannot be used for tuition. Funding programs available include 852 funds and Tuition Assistance – availability varies by service.

- VTC Limitations: NPS IT can handle a maximum of 20 VTC sites dialing in for one class. Ten needed for first cohort, 15 for second and third

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Advertising

- Tri-folds available

- Website URL: www.nps.edu/mcea

- MCEA Video on website

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BACK UP SLIDES

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Cost Estimation I: Subject Areas

- Introduction to Cost Estimating
- Cost Processes
- Data Collection and Sources (CSDR/CPR/SAR/SRDR, …….)
- Data Bases Used (VAMOSC, DCARC, DAMIR,…….)
- Introduction to EVMS
- Data Normalization
- Statistics for Cost Estimators
- Methodologies (Analogy, Parametric, …….)

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Cost Estimation I: Subject Areas (cont)

- Regression Analysis
- Learning Curves (Unit Theory, Cum Average Theory, Production Breaks, Step Down Functions, Production Rates)
- Cost Factors
- Wrap Rates
- Expert Opinion
- Introduction to Software Cost Estimating
- Introduction to Risk and Uncertainty Analysis

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Cost Estimation II: Subject Areas

- Cost Estimate Documentation
- WBS, Data Requirements
- Labor and Overhead Rates
- Direct Materials and other Support Costs
- Operating and Support Costs
  - PBL, CLS, Organic
  - Total Ownership Cost
  - Cost per Flying Hour
- Earned Value Management Systems
  - Estimates at Completion
  - Cost and Schedule Overruns
- Two Major Cost Estimating Projects

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Cost Estimation III: Subject Areas

- Introduction to Cost and Schedule Risk and Uncertainty
- Review of Probability for Cost Analysts
- Monte Carlo Simulation with @Risk
- Understanding the Nature of CER and Cost Driver Uncertainty
- The Impact of Correlation
- Schedule Risk Analysis
- Phasing the Cost Estimate
- Putting It All Together: Project Preparation: Examining the technical and programmatic description of an acquisition program, then develop appropriate WBS's for cost estimating
- Course Project

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Cost Estimation IV: Subject Areas

- Source Selections
  - Cost Evaluation and Modeling
- Economic Analysis
  - Capital Budgeting
  - Discounted Cash Flows
  - NPV, IRR
  - Payback
- Business Case Analyses, Analysis of Alternatives
- Commercial Derivative Systems
- Aging Aircraft Cost Issues
- Software Cost Estimating (3 Weeks)
- Two Major Cost Estimating Projects

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Cost Estimation V: Subject Areas

- Case Study Process Theory
- Multi-value Attribute & Utility Theory
- Logistics Cost Case Studies
  - PBL vice Organic modeling
- C-17 BCA
  - In-depth Analysis and Critique
- Portfolio Analysis
  - Best Practices
  - Enterprise Risk
- Visual Basic For Cost Modeling (three weeks)
- Two Major Cost Estimating Case Study Projects
  - Littoral Combat Ship

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Cost Estimation VI: Decision Analysis

- Decision Making under Certainty
- Decision Making under Uncertainty
- Decision Making under Risk
- Means Objectives
- Fundamental Objectives/Hierarchies
- Mean-Objectives Networks
- Influence Diagrams
- Decision Trees/Decision matrix
- Expected Monetary Value (EMV)
- Expected Value of Perfect Information.

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Cost Estimation VI: Decision Analysis

- Risk Curves
- Risk Measure
- Utility Functions
- Bayes' Theorem
- Two-way Sensitivity Graphs
- Probability Distributions
- Risk Tolerance Measures

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