Finding Opportunity in an Uncertain Future



Helpful Changes

- Costs are lower
- Greater risks can be taken
- Spacecraft design becoming more like mainstream design
- Simplified design tools
 - FPGA toolflows
 - Spacecraft specific tools (SPA, SatDB, Pumpkin, ...)

Result of These Changes

- Any mid-sized organization can make a spacecraft
- Spacecraft design can be mastered within one head



- Lower skill base and preparation level required to design spacecraft
- Skills are shared with commercial/open-source practice
- With proper effort, good designers should be plentiful



Challenges

- World economy in the tank
- Space technology funding substantially reduced
- Layoffs common throughout the high-tech sector
- Finding something "new" to do in space
 Is there a space "killer app"?

Questions for the Future

"Predictions are always hard, especially if they're about the future" – Yogi Berra

- Are the "traditional" space electronics skills what will be needed in the future?
- What is the best preparation and level of preparation for future engineers?
- How do we best advise and direct these new engineers in terms of opportunity?



Mike Wirthlin

Brigham Young University

NSF Center for High Performance Reconfigurable Computing (CHREC)



Panelists

- Steve Suddarth, COSMIAC
- Mike Wirthlin, BYU
- Doug Carssow, NRL
- Craig Kief, COSMIAC
- Tim Gallagher, LCMO



Trends in Engineering Higher Education

- Greater Accountability Learning Assessment
- Greater demand for engineering skills
- Broader undergraduate base soft skills

 Lifelong Learning
- Post-graduate training required for many engineering careers



Learning Assessment

- Feedback from constituents
 - o Students
 - o Alumni
 - o Employers



Measure and document student learning

ASSESSMENT

- Learning outcomes and course competencies
- Testing and measurement
- Modify curriculum and teaching based on feedback
- Accreditation concerned more about process than specific skills



Greater Demand for Engineering Skills

Undergraduate engineering degree valuable for many non-engineering careers Provide students with engineering fundamentals





Broader Educational Base – Soft Skills

- Skills requested by employers
 - o Teamwork
 - Project based learning
 - o Communication
 - Problem solving skills
 - o Ethics
 - o Lifelong learning



- Teaching of these skills comes at a cost . . .
 - Limited number of credit hours per degree
 - Less technical preparation
- Innovative teaching methods in practice



Lifelong learning – ABET requirement

"engineering graduates must demonstrate a recognition of the need for, and the ability to engage in lifelong learning"

- demonstrate reading, writing, listening, and speaking skill
- demonstrate an awareness of what needs to be learned;
- follow a learning plan;
- identify, retrieve, and organize information;
- understand and remember new information;
- demonstrate critical thinking skills; and,
- reflect on one's own understanding.



Engineering Career - Additional Education Required





University Faculty Can Become Obsolete ...

- Engineering faculty must keep up
 - Architectures
 - o Tools
 - Design methods
- Research results become practice . . .



 Challenge: keep up with latest trends while avoiding too much change





Lessons from 5 years of Space Plug & Play Avionics (SPA) Device Development with High School Students

Paul Jaffe, Sean Lynch, Jolyon Zook U.S. Naval Research Laboratory 202-767-6616

Presented by Douglas Carssow





- To reduce spacecraft development time and cost, hardware and software interface standardization has been proposed
- Space Plug & Play Avionics (SPA) is one such effort, and has been ongoing since about 2004, led by the Air Force Research Laboratory (AFRL)
- Many of the original concepts are described in the 2005 paper by Lyke, et al., "Space Plug-and-Play Avionics", presented at the 3rd Responsive Space Conference
- Devices using non-standard interfaces can operate as part of a SPA network by employing Appliqué Sensor Interface Modules (ASIMs) to act as intermediaries
- Since 2006, there has been an ongoing (high school) student effort at the Naval Research Laboratory (NRL) to develop SPA device prototypes





- □ Assess student knowledge and experience
- □ Assess student interest and motivation
- □ Realize contextual awareness is paramount
- Assemble a collection of tutorials and appropriate background material
- □ Emphasize note taking
- Give students a task that is at least somewhat new to the mentor



Equipment





Data Designs ASIM Development Board



I2C Bus Analyzer



Lab Notebook



Multimeter



Function Generator



Atmel USB Key



Power Supply



Logic Analyzer



Oscilloscope



Cosmiac NanoSPA Development Cubeflow Kit



Software





Data Designs ASIM Utility



iMPACT Device Programmer







Atmel Flip

Satellite Data Model (SDM)

-



O Space Dynamics

Application Drvice Info
 Add Interfaces
 Add Interface
 Notification Messages

Command Messag Request Messages

> App/Device Info Interfaces Variables

Natification Maga Command Mogs

Request Maga

Save to Database Download Reset

PnP Space Software Group

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xTEDS Developer

claml version**1.0* encoding**utf-8* l>
(xTVDS selfas*hare)



Atmel Flip

PnP Web Suite: xTEDS Developer, ASIM Wizard, SDM **App Wizard**

ace Software Group

SDM App Wizard

Create an ASM Tester App Create an SSM App Pramework

Dreveloads Feruna File Manager Jason



Selected Student Projects





Temperature Sensor



Propulsion System Simulator



Propulsion Valve Controller



CCD Camera



Tracking Solar Array Drive



Infrared Communication Link



3-Axis Accelerometer



Laser Transceiver



Reaction Wheel Driver



Thermoelectric Cooler





Reports & Presentations

















- □ Jim Lyke of the Air Force Research Laboratory
- □ Craig Kief and Brian Zufelt of COSMIAC
- □ Mark Shaw of Data Designs
- □ Jacob Christensen at the Utah State University
- □ All of our students for their energy and efforts
- The American Society for Engineering Education's Science and Engineering Apprenticeship Program





- SPA constructs offer a compelling path to speed experimental spacecraft development while reducing cost
- Because it designed to be accessible to a wide range of users, SPA is also well-suited for use with students
- SPA is an excellent vehicle for exposing high school students to a host of concepts and technologies associated with spacecraft and electronics
- Mentors and students each benefit from valuable insights that arise during the mentorship process



NSF ATE Grant \$700,000: Developing the Digital

Technologist for the New Millennium

• NSF has one program dedicated to technician and community college support called the Advanced Technological Education Program.

- The major goals of COSMIAC's ATE Project include:
 - Development of an online core curriculum (including laboratory material).
 - Establishment of FPGA laboratories at four community colleges.
 - A series of educational workshops for 90 academic instructors to facilitate the process as well as providing on-site support.

• Increased use of HDL design techniques into degree and certificate programs at partner colleges

- Results so far:
 - Forty-six community college instructors
 - Seven professors from four-year colleges and universities



Active COSMIAC Academic Partners

This is a subset of our current partners





University





NEW MEXICO STATE UNIVERSITY





Community College Technical Overview

• Community Colleges are a method by which many individuals are completing their first two years of a technical program – especially if they are paying for it themselves

- Background
 - In the technical arena, community colleges usually teach one or a combination of two tracks in their two year programs:
 - Electronics or Electrical Engineering Technology (generally not Calculus based)
 - Electronics or Electrical Engineering (generally Calculus based)

• Schools that are producing Technology individuals are struggling to keep programs alive. Schools that are producing Engineering track individuals are have massive growth



Community College Technical Observations

• Craig's opinion – We are seeing a decline in demand for the technicians of the past and a greater desire for a new breed of technician with higher technical skills that can often be used to do work formerly accomplished by engineers

• Could there be a technician that creates VHDL test benches or runs tests against modules for the design team?



Workforce Preparation and Opportunities – Preparing for Rapid and Complex Technology Changes

Tim Gallagher Lockheed Martin Space Systems Company



- What the educators need to do
 - Emphasize these types of classes:
 - System architecture development (SysML)
 - SoC, embedded processors, and multi-core concepts
 - System integration and system focused testing
 - Test development, prototyping, debug (labs)
 - Functional and high-level verification (SystemVerilog)
 - DSP and model-based development (MATLAB/Simulink)
 - High-level software languages (C/C++) and low-level hardware languages (VHDL/Verilog)
 - Space environment issues and mitigation methods



- What the employees need to do
 - Develop good communication skills
 - You will be reading (and writing) design specifications
 - You will be presenting to management, VPs, and customers
 - Develop good math/problem solving skills
 - You will need to logically think through difficult problems
 - Develop a good attitude!
 - Enthusiastic, energetic, attentive, pro-active
 - You will be working in a group environment
 - You need to take care of your own career
 - o You need to enjoy what you are doing!



- What the employers need to do
 - Work with educators on current/future agenda
 - Support activities where engineers are developed such as University studies, NSF CHREC
 - Provide summer internships to forge relationships
 - Provide additional education opportunities
 - Provide training and mentoring opportunities
 - Provide the ability to move around to develop full potential of employee
 - Provide career path, leadership opportunities, and rewards for good performance





Questions? Comments?