Generational Crossroads

From: jerry sommerville

Bcc:

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Raytheon Tracking Pod Youtube Video
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Date: Saturday, October 22, 2022 at 07:04 AM PDT

Hi Everyone,

Raytheon appealed to the rank and file to cultivate critical systems engineering skills by influencing college curricula.

See attachment for comparison of typical STEM education to Systems Engineering training. Active links are available in this attachment. See this email thread for more context.

Meanwhile, here are some articles to share with students about Raytheon's role in the recent Top Gun Movie.
A starring moment for the F/A-18

A starring moment for the F/A-18

It's an awesome multirole aircraft, one former pilot said.

[Raytheon Wins $325 Million to Repair US Navy ATFLIR Pods]

Raytheon Wins $325 Million to Repair US Navy ATFLIR Pods

Raytheon Space and Airborne Systems, McKinney, Texas, is awarded $325,000,000 for a firm-fixed-price contract fo...

I am spreading this information to educators/adminstrators that are responsible for curricula , to influencers, to aspiring entrepreneurs, to aspiring engineers etc.

Please consider adding radio science, model-based engineering (MBE), and coding to your curricula. Please check your existing training methods against the systems engineering training standards (EIA-632) described below and please make the necessary adjustments.

Please See [Beacon Engineering Consortium] and [Solar Solutions] for ideas.

Solar Solutions -

Providing unique, energy-efficient products for renewable energy.

Hi Professors and Administrators,

I want you to see a summary of the skills needed for Synthetic Aperture Radar (SAR) so that you can explain it to professors and students.
There are light beam pulses (microwaves) that are pointed at the ground out of the side of an airplane. The plane receives backscatter reflections of these light beam pulses. SAR uses this information to form a map of the territory being scanned. See this link for theory of SAR

Theory of Synthetic Aperture Radar

The skill set requires some analytical geometry, physics of light, physics of motion, synchronized timing of electronic signals, signal processing, image processing. etc.

We can use many features of laserpositioningsystem.com project as a precursor for SAR training because it uses a laser distance meter to point at the landscape to form a map of the local geometry. Again, skills in analytical geometry, physics of light, signal processing, coding are needed to map local geometry. This is what can be done in a Networked Improvement Community (NIC) with some engineers of the trade.

I have other example of NIC for controlling robots from a graphical User Interface (GUI). An extension of these skills is used in developing a system that follows your eyes like mentioned below.

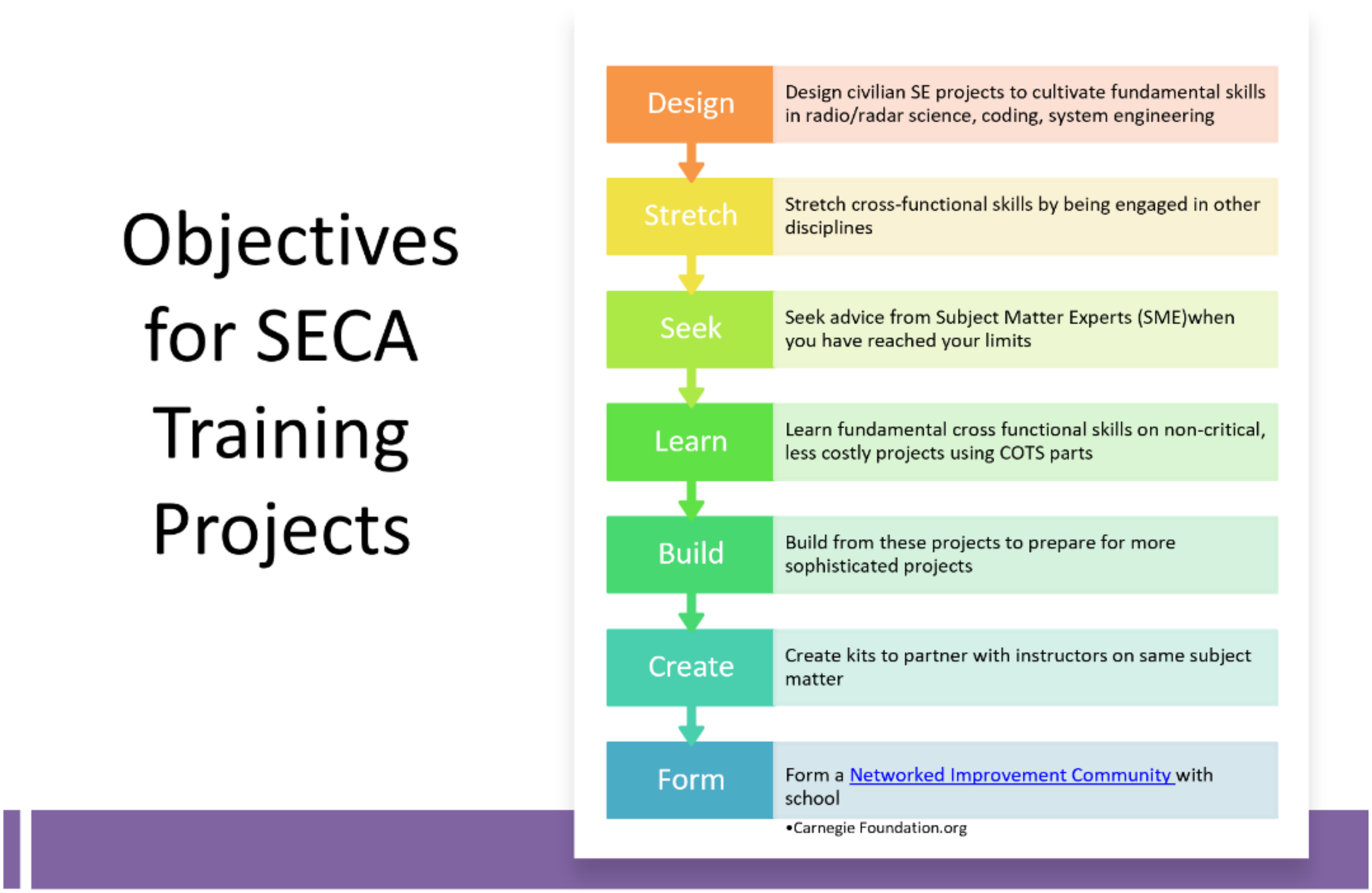
Please share with this professors that will join our discussion.

Please Contact me to have discussion on Systems Engineering Cultivation

I compare typical STEM training to Systems Engineering training below in a chart. We should discuss the contrasts.

Discussion excerpts:

See attachment for Systems Engineering Cultivation Topic and Links

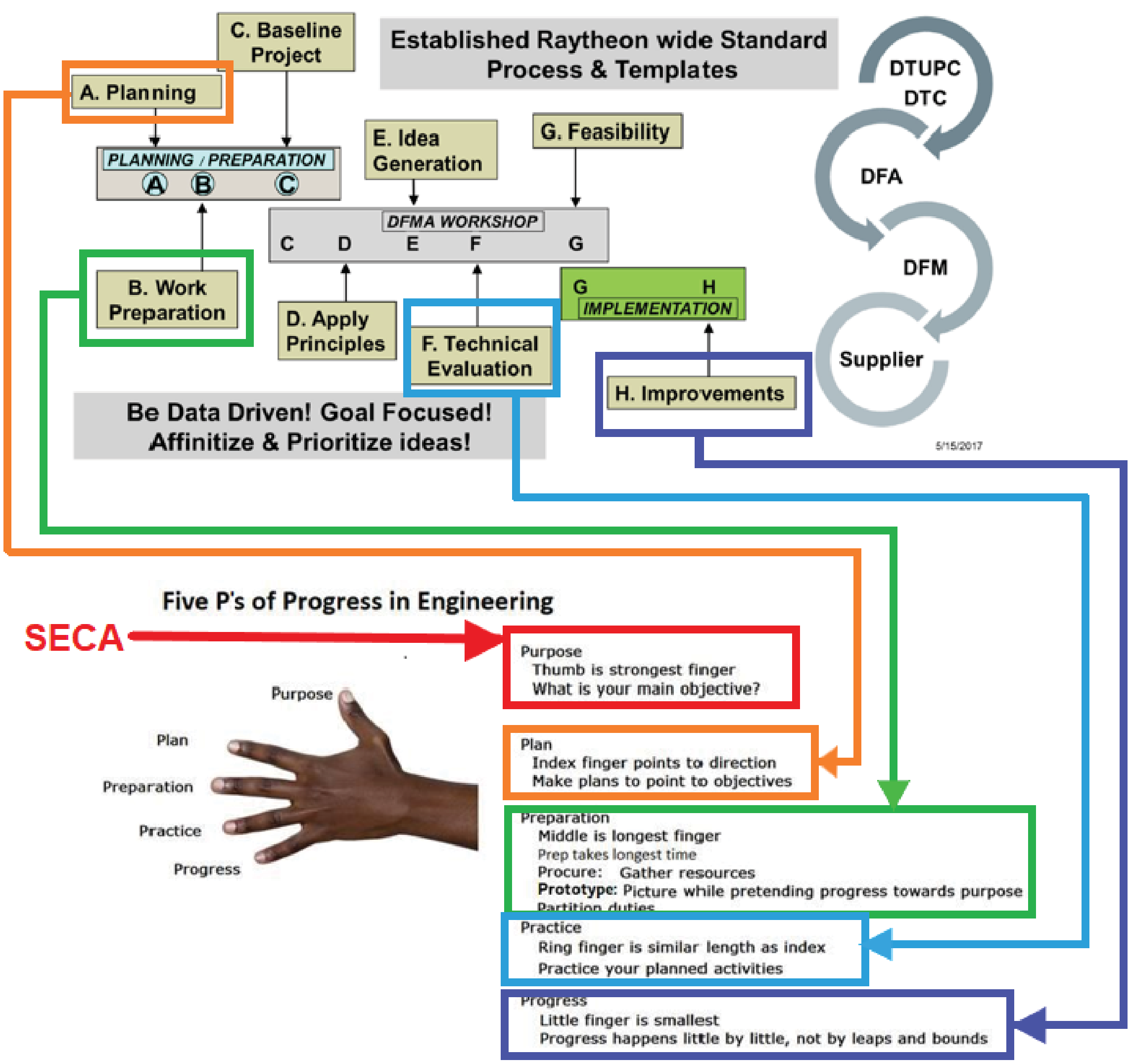


Typical STEM education stops short of using this important skill set.

I modified the Training Methods comparison chart to show synthesis in the flow of project development. The orange color means it is part of the planning phase of project development. I also added links to show how synthesis is used in real-time robot control and how it was used in a NASA antenna project.

I added a link suggesting improved training for those with limited technical backgrounds: "Lab b4 Lecture"

The benefits of a common enterprise processes and tools is that it creates a repeatable workflow that improves over time. Having defined roles and responsibilities improves the handoffs amongst DFMA leads and participants, and improves accountability to goals. We have witnessed a dramatic improvement in the collaboration on cross-organizational/business DFMA events.



Comparing Systems Engineering Training to STEM Training

Comparing SECA* to STEM Training Methods

	PURPOSE	PLAN	PREPARATION	PRACTICE	PROGRESS
SECA*	Solves Societal Issues (National Science Foundation, NSF) Examples: Real-time Robot control Renewable Energy	• DFMA • COTS preferred o Low cost o Time to market o Quality • Specification development • Methodology well defined o Milestones/Tasks o GANTT charts/ o Balance cost, schedule, quality o Revolving Action Item list (RAIL) • Design Trade Study of options • Design Synthesis: Computer Model o JPL Synthesis Example o Real - time robot Synthesis Example	• Round table, o Cross functional skills development o SME o Kaizen • Lab B4 Lecture prototype kits • Full spectrum of Mfg methods • Use of pre-existing similar solutions (bottom up)	Verify solution meets societal need (NSF)	• Meet needs of society • Encourages economic development • Supports teachers with SME, Kits • Builds infrastructure for next project • Teamwork/Networking skills. • Preparation for larger systems engineering role/entrepreneurship
STEM	Competitions to encourage skills Examples: FIRST Robotics Competitions DARPA Robotics Challenge	• Competition goals and rules • Limited to Competition Scope • Siloed backgrounds • Methodology not well defined • Schedule driven decisions • Action Items • No synthesis using computer models	• Gifted Student Isolation • Limited experience base on volunteers • Use of tools offered by sponsors • Makerspace o Solid models o 3D printer o Focus on custom design (top-down) o Lego structures	Test to competition goals and rules	• Limited reuse of results • Teamwork/ Networking skills • Experience in use of various development tools offered by sponsors •

It has been nearly a year since I started working at Raytheon. I am working on both optical pods and synthetic aperture radar (SAR) systems. The optical pods are what was featured on the F/A-18 Super Hornet in the latest Top Gun movie. In the movie, a pilot uses his eyes to find a target with night vision goggles. An underwing pod tracks where his eyes are pointed. to mark a target's location. The weapons system delivers a munition to that location. The GUI controlled motor in blog below is similar.

There are three reasons I am contacting you about some generational crossroads occurring at Raytheon:

1Raytheon management, tasked the rank and file to cultivate skills critical to Raytheon by influencing college curricula.

2. As a consequence, I developed a PPT that outlines a plan to cultivate the radio sciences, model-based engineering, and coding skills

a. PPT is entitled " Cultivating Systems Engineering Skills for the Future.PPT"

b. I developed a blog to describe engineering and entrepreneurship: Laser Positioning System | Measurement in 3 dimensions for real-time and repetitive robot control

Laser Positioning System | Measurement in 3 dimensions for real-time and...

c. I reference the blog to provide tangible examples of engineering and entrepreneurship

d. I defined a "Lab before Lecture Approach" where professionals develop kits to assist instructors to introu ce technology to the classroom with a goal to guide students to the industry.

e. The blog demonstrates technology without compromising company classified information

f. I am suggesting the formation of a Networked Improvement Community (NIC) as training grounds for cultivating Systems engineers at Raytheon

3. I shared this PPT with some peers here in Raytheon who have similar convictions.

I would like to set up a video conference to discuss the 3 points above.

Best,

Jerry

System Synthesis Using Computer Models.pdf
537.5kB

System Synthesis Using Computer Models

From:

To:

Date: Saturday, June 11, 2022 at 11:43 AM PDT

Amen! You are preaching to the choir.

Subject: System Synthesis Using Computer Models

Hi Everyone,

I added **synthesis** using a computer model to the comparison of STEM vs SECA. This adds bit more clarity between the two approaches.

Educators, engineers, and entrepreneurs should understand the inter-relationships of disciplines to develop skills for the future.

Feel free to add your comments.

Subject:
System Synthesis Using Computer Models

Our assignment is to cultivate critical skills needed for Raytheon's future by influencing college curriculums. I am highlighting some critical skills needed for Raytheon's future and I am suggesting some ways to achieve them. I compare the skills developed in a typical STEM education vs. an improved proposed approach using Systems Engineering for Civilian Applications (SECA).

Synthesis of a preliminary design is done with a computer model. Design trades and performance allocations for subsystem performance is managed using mathematical models. I learned this when developing missile systems. I was responsible for developing and maintaining such models for 14 years at TRW (now Northrup Grumman). The feasibility of a design starts with a representative mathematical model.

Here are some quotes from **Systems Engineering** Specifications:

(Mil Std 499A Para 10.2.4)

Synthesis. " Sufficient preliminary design shall be accomplished

to confirm and assure completeness of the performance and design requirements

allocated for detail design. The performance, configuration, and

arrangement of a chosen system and its elements and the technique for their

test, support, and operation shall be portrayed in a suitable form such as

a set of schematic diagrams, physical **and mathematical models, computer**

simulations, layouts, detailed drawings, and similar engineering graphics.

These portrayals shall illustrate intra-and inter-system item interfaces,

permit traceability between the elements at various levels of system

detail and provide means for complete and comprehensive change control…."

(EIA-632)

Requirement 5—Technical Effort Definition

The developer **shall** define a technical effort that is in accordance with the process implementation strategy.

The developer **should** plan and do the appropriate tasks to complete this requirement. Tasks to consider include the following:

a) Identify project requirements to include: agreement requirements; other stakeholder requirements; and enterprise, project, and associated process constraints.

b) Establish an information database that will allow capture of project data and be able to securely retain and make information available, as required.

c) Determine the risk management strategy to identify technical risks to the appropriate level and properly avert those risks that could adversely affect the project

d) Define product metrics by which the quality of the products will be evaluated and process metrics by which the efficiency and effectiveness of the technical effort will be measured.

e) Establish cost objectives (e.g., ownership, acquisition, operating, support, and disposal) to be used in tradeoff analyses.

f) Identify technical performance measures that will be used to determine the success of the system, or portion thereof, and that will receive management focus and be tracked using Technical Performance Measurement (TPM) procedures.

Process models used for:

a) analysis of problem (analysis of requirements and analysis of functions) (e.g., Quality Function Deployment, behavior, and time);

b) solution definition (synthesis) (e.g., for design);

c) validation and verification;

d) systems analysis (e.g., for tradeoff analyses, risk analyses, and effectiveness analyses);

e) control (e.g., interfaces, data, configurations, schedules, costs, product performance, reviews, and assessments).

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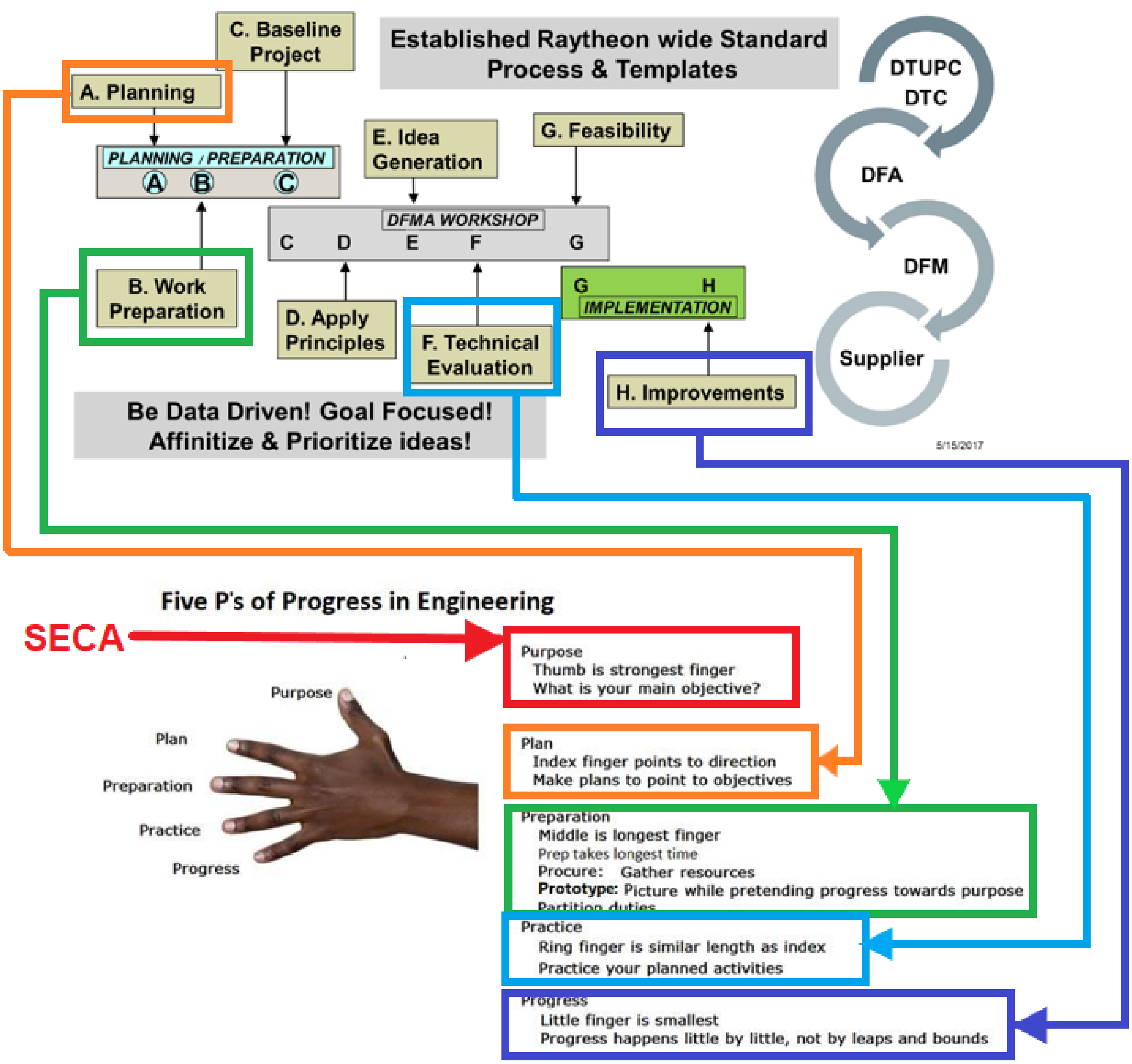

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Subject: Roadmap Charts for SECA vs STEM Training Methods

I spent this weekend developing some “road maps” to compare current STEM education vs proposed SECA(Systems Engineering for Civilian Applications) Training Method.

Back in 2019, I used the attached Raytheon publication to express the need for the industry voice in Colleges to some local college administrators . I will forward you this dialog sometime later.

Meanwhile, please let me know if these charts are understandable.

I thought some more about our conversation. You are right. I do have something that I can leverage for a 40 min discussion. I can use the "road map approach" that was presented yesterday in the lunch and learn.

Lunch and Learn Title: Using Systems Engineering in Civilian Applications (SECA)

Purpose: Cultivating the next generation of leaders in systems engineering

Approach:

1. Use Five P's of Progress phases in a "**road map"** to contrast typical STEM education/Makerspace (top down/3D printed/ custom made) with SECA/DFMA approach (bottom up/use of pre-existing/standard parts).
2. Offer tangible example how industry can inform/train students of skills needed for the future
    a. Introduction of Networked Improvement Community (NIC) from Carnegie Foundation
    b. Use SECA approach in schools to train Junior engineers at Raytheon as volunteer leaders in pedestrian projects

1. Use renewable energy project to demonstrate tangible benefits of SECA vs STEM/Makerspace approach in education
    a. COTS solutions (low cost, readily available, proven design) vs custom design/reinvention of wheel
        i. Convert DC drill to electricity generator
        ii. Use it to teach concepts in electricity production/conservation of energy/ renewable energy
    b. DFMA (learning from SMEs in manufacturing vs. trial and error with 3D printer)
    c. Lab before Lecture (development of prototype kits, support from advocates brings credibility to instructors)
    d. cross functional skills (round table, engage entire class as participants, rather than "gifted" student isolation)
    e. networking,
    f. GANTT chart, delegation of duties,
    g. Progress: Building infrastructure from piece parts of a project
        i. Make electricity generator available for other training/problem solving activities.
    h. Other projects examples: Software/virtual reality, electrical, real-time robotics