Will The Real Solution Please Stand Up

Leadership Needs for Effective Changes in the Engineering Culture

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SAE 2009 AeroTech Congress & Exhibition

November 10, 2009

TV Chapter of The System Safety

July15, 2013

Technology and Model Changes

- Technology Changes demand adaptation by Engineering Leaders
- Most change in the culture can be good, some change can be bad.
- No change when needed = Stagnation, falling behind competitors
- As technology changes, so should innovation. Organizational models and engineering methods must change to be effective

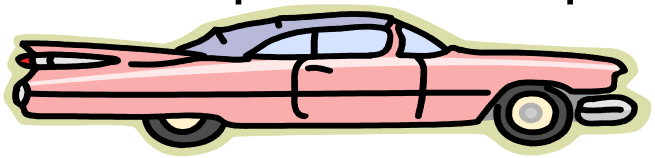
  - Older Federated Systems model based on hardware units – engineering organizational structure based on big units (silos)

  - Legacy Integrated Systems model based on integration – engineering organizational structure based on functional matrix and IPT (many units partitioned)

  - Current model - sensor fused, interoperable, systems-of-systems, software intensive avionics – engineering organizations must be based on multidisciplinary collaboration (meshed and highly horizontally Integrated). Autonomous systems, high automation is growing.

Example of Technology Change

- Would the Automobile (or Aircraft) industry of 2010 develop and build products as they did in 1960s?



  - ***Ask audience to give "more examples" of <u>then</u> and <u>now</u> for automobiles.***
    - ***Cost and Value ($3K vs. $30K)***
    - ***Style Selections (big V8 sedans vs. smaller cars, SUV)***
    - ***Standard Technologies (Carburetors vs. EFI, Computers)***
    - ***Options (AM radio vs. GPS, Video)***
    - ***Fuel Economy (12 mpg @ .35 gal vs. 24 mpg @ $3.50.***
    - ***Required Safety Features (few vs. many)***
    - ***Crash Protection (little vs. crumple zones and airbags)***
    - ***Warranties, Reliability(1 yr 12K mi vs. 5 yrs 50/100K)***

One Example: Aircraft Technology

- Then (1960s) Commercial or Military
  - Flight Controls: analog, units, pitch, roll and yaw amplifiers with fixed gains; mechanical bell cranks, metal stranded cable wires, pulleys, PC pumps, hydraulic lines and fluid actuators, O rings, washers, nuts, bolts and safety wire.

- Now (Early 21st Century)
  - Typical Flight Controls: digital, modular, triple/quad redundant digital computers, stability augmentation software - level A, DO-178B qualified, software controlled, partitioned CSCI, BIT, continuously monitored, fly-by- wire, multiple autopilot modes, electrical powered electro-static hydraulic actuators, fewer parts.

What type safety analysis/assessment is applicacle for each era of technology?

Military Aircraft Affordability Comparison (Safety - Loss Perspective)

- Then (1950-1960s) – Legacy military tactical (fighter & attack) aircraft developed in many models, single mission, inexpensive, effective, large in numbers produced, but viewed as expendable:

  - **Example: Outstanding single place F-8 Crusader earned Collier trophy and was built for fighter mission "effectiveness" (19:3 kill ratio in SE Asia). A truly great value at <$2M (however safety record was poor ~ 40% lost in non-combat)**

- Now (1980s -2010+) - Modern military multi-role aircraft are fewer in models, very expensive, extremely effective, fewer in number, survivable, and are NOT viewed as expendable.

  - **At $50M – $150M apiece, what loss numbers or percentages are acceptable in this modern age?**

We Must Constantly Change

- How are we going to structure and manage highly integrated, complex, and multiple partner (collaborative) programs, now, in 5 years, 10 years?

The Real Solution

- The "Real Solution" is Exceptional Leadership
  - Strategic Vision and Tactical Implementation
  - Absolute Commitment to Explicit Goals
  - Focus on the Integrity of the Product Line
  - Engaged at All Levels
  - Listens to Customers and Stakeholders
  - Inclusive of Required Domains and People
  - Expectations of Effectiveness
  - Commitment to Duty, Excellence & Professionalism
  - Holds Employees Accountable for Performance
  - Allocates Value Stream Work Products

Leadership Attributes and Actions (1)

- Be engaged
- Have A Clear and Realistic Vision
- Maintain Constancy of Purpose (Deming)
- Listen to Customers and Meet their Needs
- Ensure Substance and Reality
- Focus on Ultimate Objectives
- Establish Clear Goals, Critical Path
- Collaborate and Share Knowledge for Success
- Focus on Essentials with Value
- Eliminate Ineffective and Wasteful Activity
- Be Inclusive and accept inputs
- Do What is right (know precisely what this means)

Leadership Attributes and Actions (2)

- Embrace Mentoring (Knowledge Transfer)
- Share, Share and Share
- Communicate, Communicate and Communicate
- Understand Different Views (It is OK to Debate Tactfully)
- Maintain Dignity and Respect (Don't "badmouth" people)
- Tell it like it is (speak up when there are risk issues)
- Have Dedication and Passion (Tenacity – Don't cave in)
- Persevere and Remain Committed
- Maintain Integrity (Leadership and Technical)
- Meet Requirements / Expectations
- Do All of the above and much more
  - within constraints of contract, cost, schedule & 7 Ps: (performance, people, policies, plans, processes, procedures, practices)

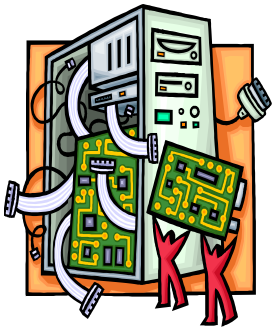
Some Cultural Norms to Embrace

- Support suitable initiatives for improvement (Listen to input)
- Accommodate new ideas - get out of the comfort zone
- Allow innovation outside the box and more critical thinking
- Communicate - share important information
- Tweak, reduce, change or eliminate “outdated” command media *
- Ensure ineffective ways and means are corrected
- Update methods and models to fit the era of technology
- Allow flexibility and acceptable new ways to get things done
- Accept the need to be more inclusive and holistic
- Understand the needs for diverse methods and techniques
- Accept personality differences and management styles
- Measure domain effectiveness and improve (metrics)
- Create a work environment that brings out the best
- Share, Mentor, Train, Transfer Knowledge, Develop Staff

* This includes ensuring holistic and “effective” best practices

Technology Models and Methods

- Eras of High Technology required different engineering approaches and system integrity methods:
  - 1940s – Analog and Vacuum Tube Circuits
  - 1950s – Transistor and Solid State Circuits
  - 1960s – Integrated Circuits, Discrete Devices
  - 1970s – Micro Chips - Digital Computing Devices
  - 1980s – Highly Integrated Modular Systems
  - 1990s – Network, Software Intensive Systems
  - 2000s – Sensor Fusion and Interoperability
  - 2010s – Extensive Software Command and Control



Holistic System Safety Programs

- **Safety- Critical Functionality now require more holistic approaches and formal methods for effective safety programs.**
- **The "blended" approach is recommended for effectiveness:**
  - **Hazard based (identify hazards)**
  - **Risk based (severity, probability, consequence)**
  - **Functional based (safety-critical functions)**
  - **Requirements based (derive safety requirements)**
  - **Criteria based (airworthiness, qualifications)**
  - **Evidence based (objective evidence and absolute proof)**
  - **Formal methods based for UK (safety cases, ALARP, GSN)**

Safety & Integrity Culture

- Cultural Domains should be more Horizontally Integrated with Constancy of Purpose
- Free of Silos – Allowing True Collaboration
    - System Safety
    - Software Safety Aspects
    - Test Safety
    - Human Systems Integration
    - Operational Safety
    - Safety Management Systems

The Engineering Culture Must Be Holistic

- Practicing Innovative and Flexible Technical Leadership with the focus on ensuring Work Product Effectiveness is the Solution:
  - Ensure Horizontal Integration with Constancy of Purpose
  - Don't Rely on One Size Fits All Processes or Solutions
  - Allow better method that may not be in Command Media
  - Seek out Collaborative and Teaming Opportunities
  - Bring Out the Best in Organizations and People
  - Take Action to Ensure A Positive Work Environment
  - Enable All to Contribute to Full Potential
  - Be able to Evaluate Progress, Measure Effectiveness and Change (self correct as needed)

A Few Recommendations

- **Will The Real Solution [“True Leaders”] Please Stand Up and Vow To:**
  - **Be enthusiastic, even during setbacks**
  - **Listen to those closest to the issues**
  - **Be supportive of those who take risks**
  - **Be able to listen to different views without criticism**
  - **Implement policies, plans and practices that work**
  - **Mentor, develop, reward truly engaged engineers**
  - **Empower and trust engineers (but verify)**
  - **Be fair, but firm when needed**
  - **Allow more innovation and effective solutions**
  - **Accept new proven methods and solutions**
  - **Have more face time with Chief Engineers and PMs**
  - **Educate specific engineering disciplines on System Safety**
  - **Make Decisions based on Facts and Objective Evidence**

A Few More Recommendations

- Remove friction and break down silos
- Eliminate barriers that hamper effectiveness
- Never impede efficiency or constrain performance
- Provide honest and sincere appreciation
- Demand High Quality Output that matters
- Prioritize and focus on decisions that matter
- Organize to fit the correct model for technology
- Lead people in the right direction – set example
- Manage assets as if they were your own
- Treat people with the Golden Rule in mind
- Be a good coach and do what is right

Closing Thoughts

Famous Coach Vince Lombardi said,

..."Football is like life – it requires perseverance, self-denial, **hard work**, sacrifice, dedication, respect for authority"

Exceptional Leadership requires the Same!

Any questions?

“Will The Real Solution Please Stand Up”
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