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Systems Thinking

Bridging the Educational Red Zone Between System Engineering and Program Management Education

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Today's Presentation

- **Presentation Abstract**
- **Introduction**
- **Global Challenges**
- **Causal Analysis – PM and Engineering Education**
- **Changing the RED Zone to the GREEN Zone**
- **Summary**

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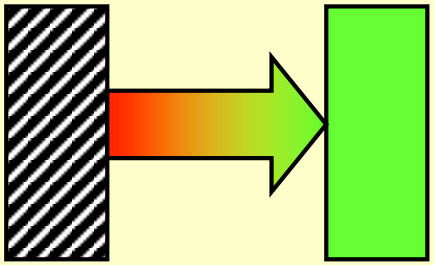
Presentation Abstract



- **Analysis of poor contract and program execution and performance are often traceable to a lack of system development knowledge by Program managers and Engineers.**
- **Yet, both disciplines will confidently tell you they are highly experienced. If so, then WHY we programs repeat the same mistakes over and over?**
- **This presentation:**
  - **Introduces and explores the "RED Zone" that exists in Program Management and Engineering Education**
  - **Proposes a solution of INTERDISCIPLINARY formal education to convert the "RED Zone" into the "GREEN Zone"**

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Introduction

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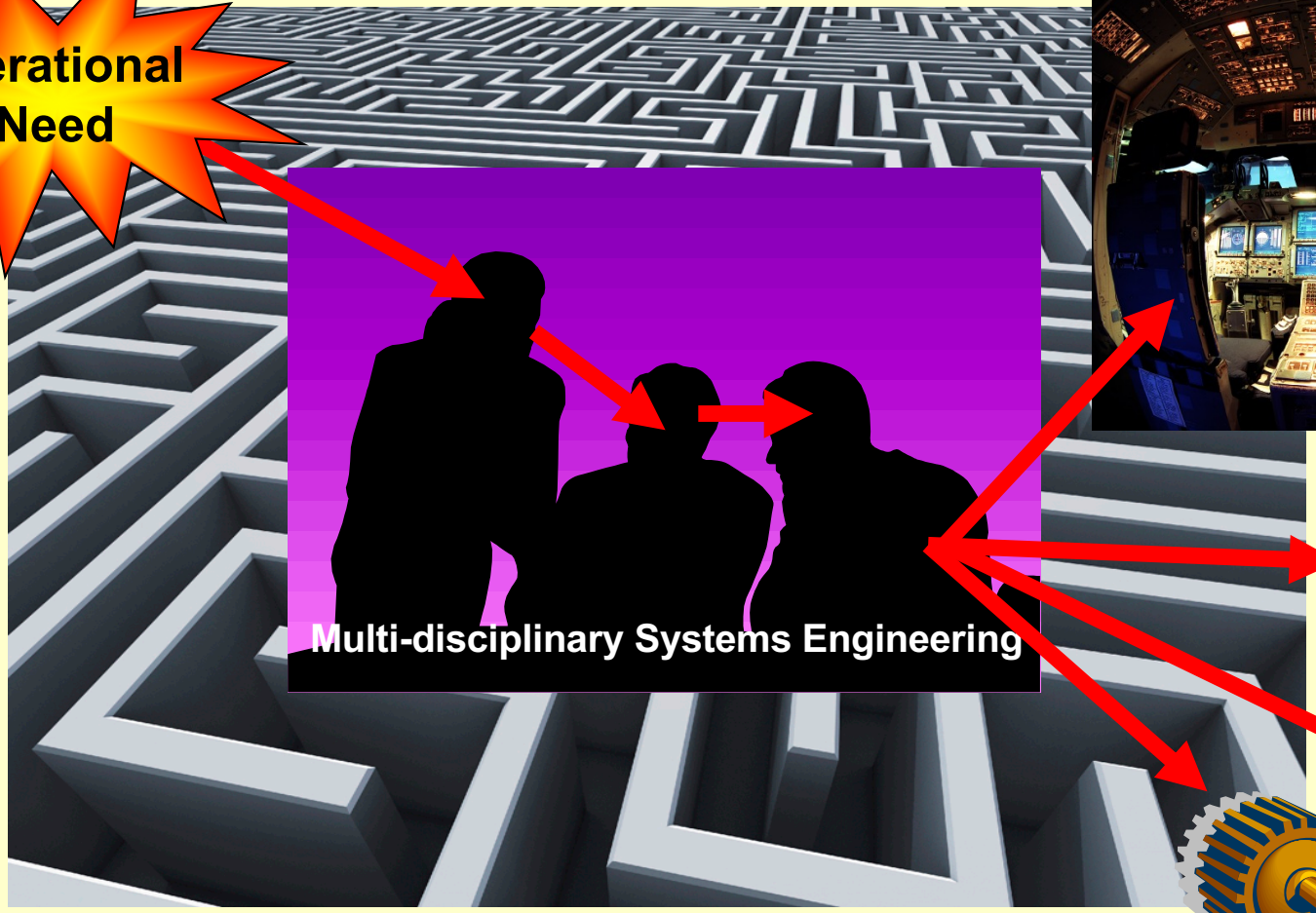
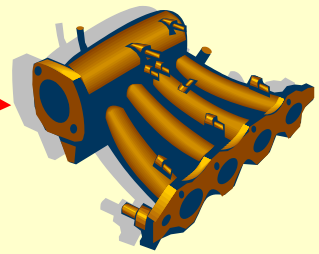
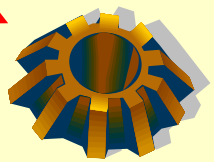
Perceptions of Ourselves

Operational Need







How can the U.S. "tool" our workforce for development of competitive systems, products, or services in a global marketplace?

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System Development Challenges

Despite systems becoming increasingly more complex to manage, organizations still have performance problems developing and delivering simple systems, products, and services.

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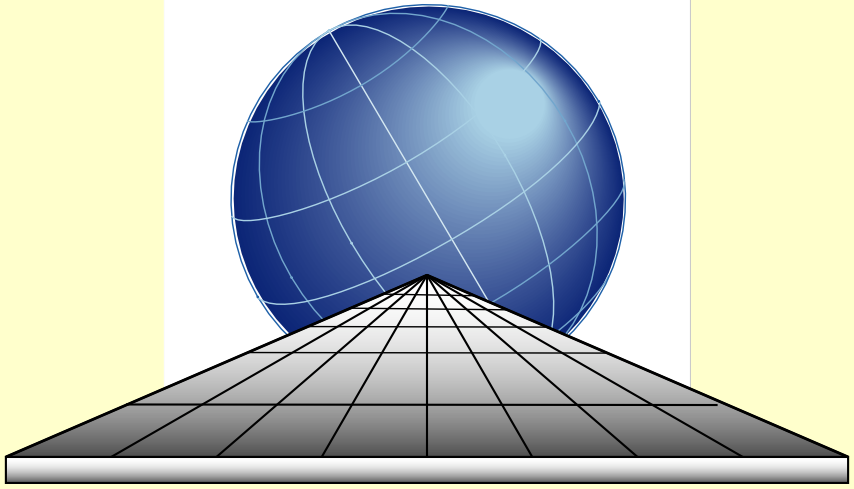
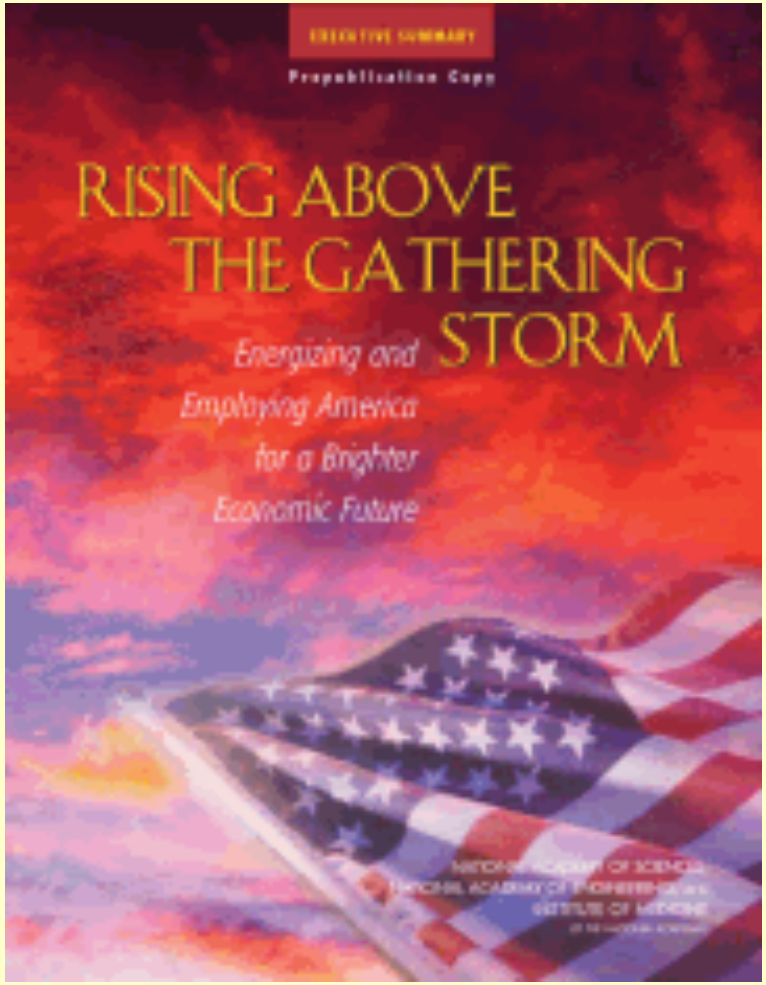


Global Challenges

Where we are as a culture …

… Where do we need to be

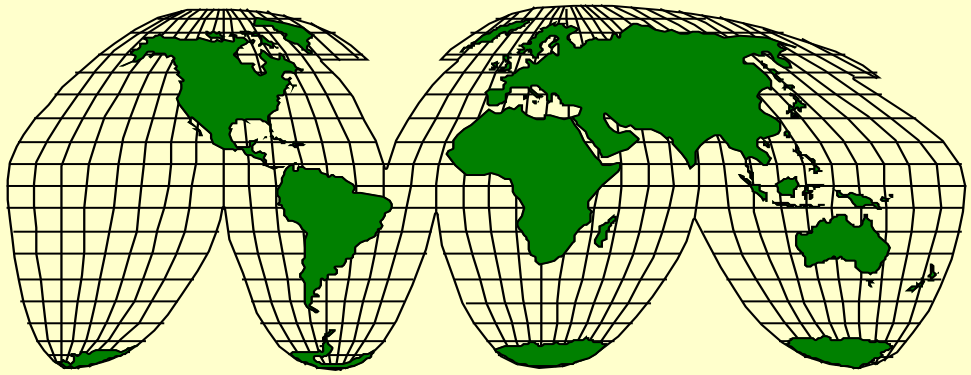
Rising Above the Gathering Storm Report



http://books.nap.edu/catalog.php?record_id=11463

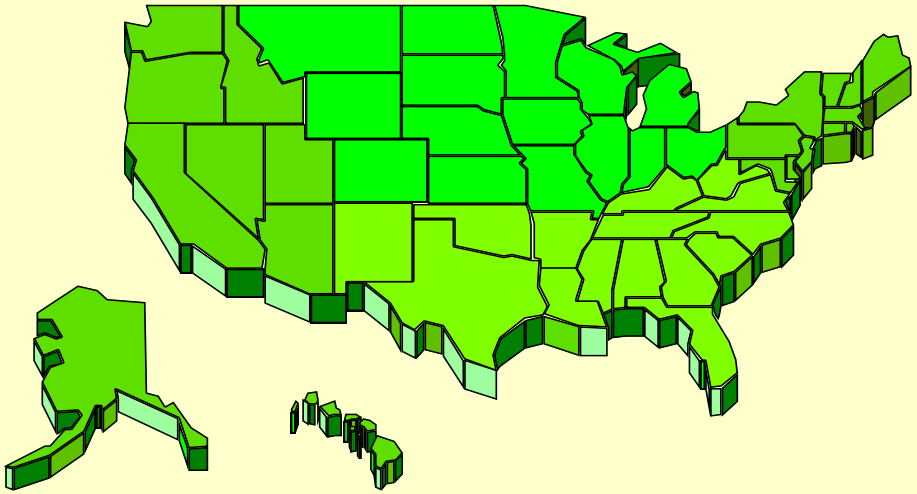
- **Published by the National Academy of Sciences Committee on Science, Engineering, and Public Policy (COSEPUP)**
- **A very sobering look at the challenges facing the US workforce in Education and Training relative to other countries.**
- **Illustrates WHY we must continuously improve workforce practices.**

Reality Check - Global Challenges



- **The U.S. is facing MAJOR EXTERNAL challenges from global commercial and military system, product, or service dependence and competition.**
  - Fierce global competition
  - Outsourcing work to foreign companies for system, product, & service development and maintenance
  - Continuing erosion of our manufacturing base
  - Increasing energy consumption and dependence on foreign oil
  - Defense component suppliers off-shore
  - Et al

Reality Check - National Challenges



- **The U.S. faces INTERNAL challenges**
  - Quality of K – 12 education and training
  - Shortages of professionals entering the workforce
  - Better, faster, and cheaper mindsets that achieve staff reductions without apparent regard to level of service or community impact
  - Value-based personal and professional discipline issues

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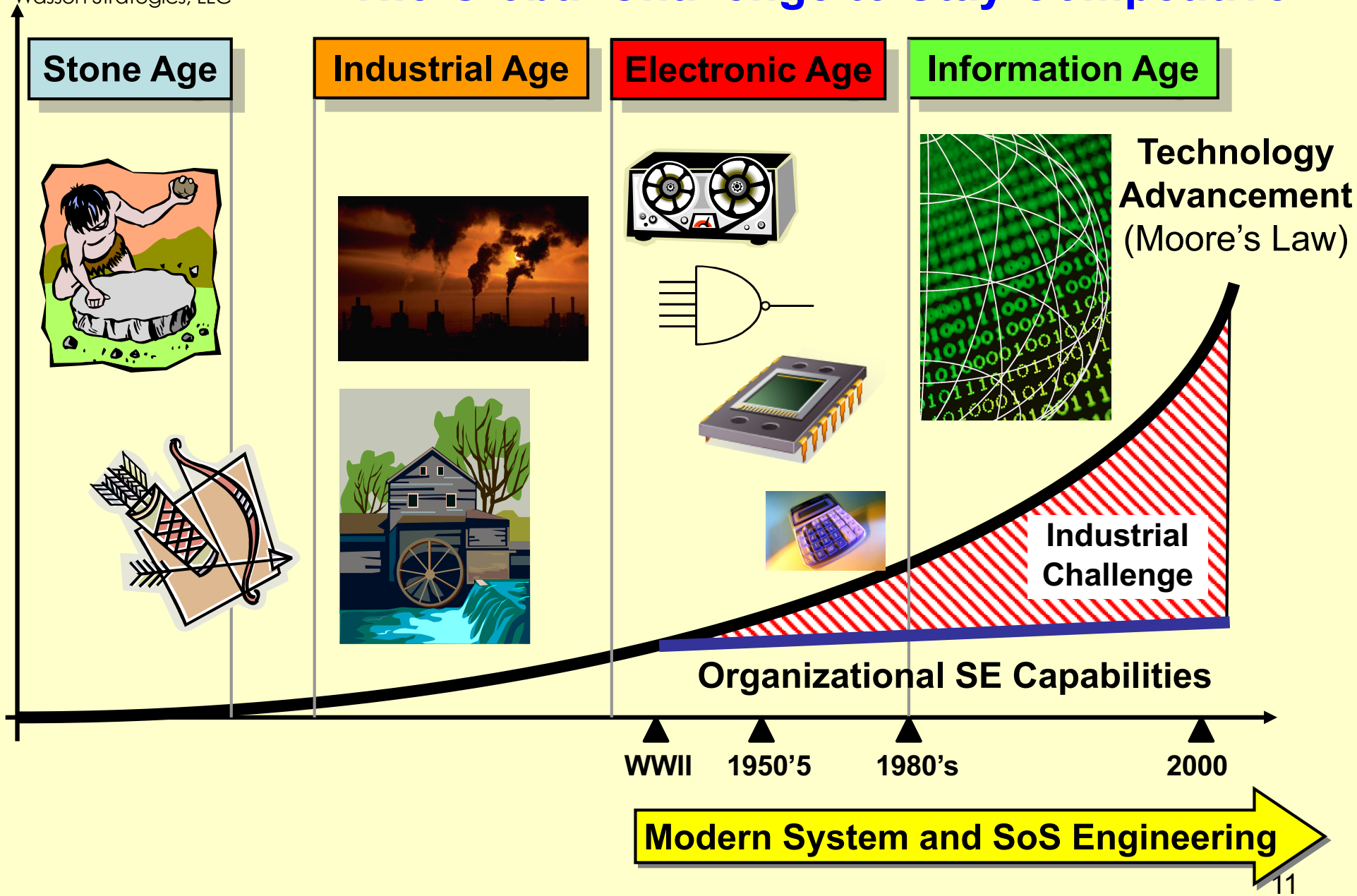
The Global Challenge to Stay Competitive



PM & Engineering Knowledge and Attitudes

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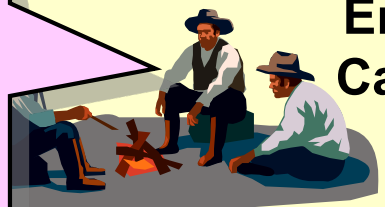
Program Mgt. Camp

Not interested in the Engineering … Just give us a product to deliver on time and within budget

?

Not interested in bureaucratic PM, processes, SE, etc. … If my university had thought this was important … would have taught us.

Engr. Camp



Primary Domain Elements

- Customer Relations
- Contract Compliance
- SOW
- Work Breakdown Structure (WBS)
- Deliverables
- Program Organization
- Budget
- Schedule / Cost Risk Status
- Risk Management
- Data Management
- Program Reviews

Engineering Domain Elements

- System Requirements / Traceability
- Technical Planning
- Architecture Development
- Detailed Design
- Interface Definition & Control
- Modeling & Simulation
- Tech. Performance Measurement
- Procure, Fab. Coding, Assy, & Test
- System Integration & Test
- Configuration Management (CM)
- Verification & Validation (V&V)

Recipe for Poor Program Performance or Failure and/or Poor System/Product Performance or Potential Failure

Responsibility but no interest

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Systems Thinking – Bridging the Educational Red Zone

Need for System Development Education & Training

Program Management Camp

Systems Engineering

Engineering Camp

Primary Domain Elements

- Customer Relations
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- Work Breakdown Structure (WBS)
- Deliverables
- Program Organization
- Risk Management
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Primary Domain Elements

- System Requirements / Traceability
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- Modeling & Simulation
- System Integration & Test
- Configuration Management (CM)
- Verification & Validation (V&V)

Who orchestrates the System Integration of the Program?

PM Domain Competency (Typical)

In System Engineering 1 - 3 out of 10

Engineering Domain Competency (Typical)

In System Engineering 3 - 5 out of 10

In Disciplinary Engineering 8 – 10 out of 10

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The PM - Engineering RED ZONE

Business Education Paradigm

Engineering Education Paradigm

Project Management Education & Training

Red Zone

Engineering Education & Training

You stay out of our turf … we will stay out of yours !!!

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Executive & PM "Knob Twiddler" Dashboard

Desired Performance Outcomes

PM Dashboard

Plans **Staffing** **Morale**

Processes **Tools** **Technology**

Issues

Insanity is doing the same thing over and over, and expecting a different result [Dr. Albert Einstein]

Dealing with Unknowns - Here Be Dragons

Source: Paper - Dr. Arthur A. Moorish, Director Tactical Technology Office (TTO)
Here Be Dragons, http://www.darpa.mil/darpatech2005/presentations/tto/morrish.pdf

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Locating the Organization's Process Dragons

Plans & Performance Discussions

PM

Flow Down

Ftn'l Mgr.

Ftn'l Mgr.

Contract

SOW

SPEC

WBS

Et al

Staffing and Training

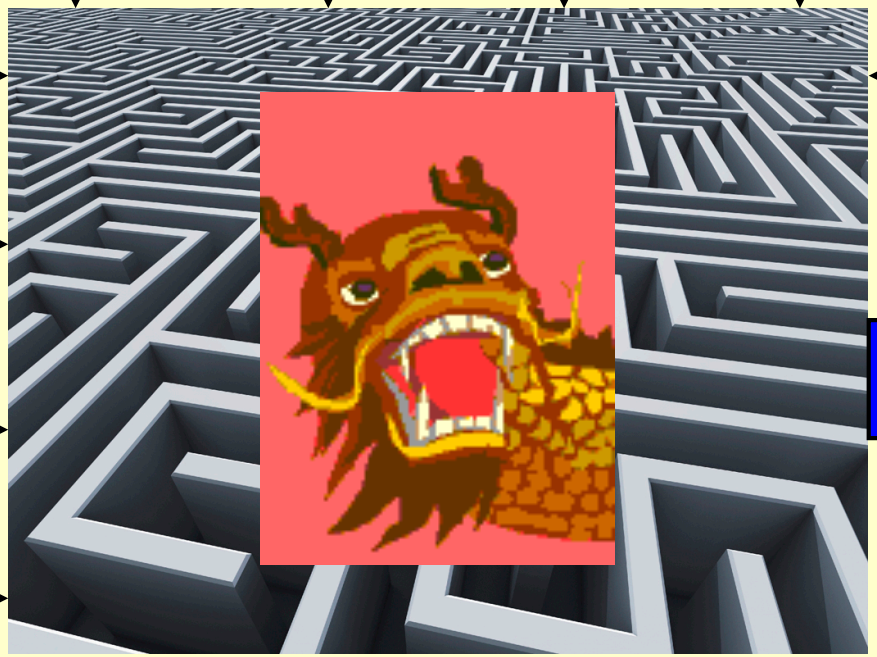
Staffing and Training

IPT A

IPT B

IPT C

IPT D



Deliverable Outcomes

- Systems
- Products
- Services
- By-Products

Here Be Dragons!!!

Examples of the Program "Dragons"

- **The web of key program and technical documents are not linkable and consistent with each other:**
  - Contract Statement of Work (CSOW)
  - Contract Work Breakdown Structure (CWBS)
  - Organizational Breakdown Structure (OBS)
  - System Architecture (Product Structure)
  - Specification Tree and Documentation Trees
  - Master Program Schedule (MPS)
  - Earned Value Plan (IMP) and Tasks (IMS)
  - Resource Loading

- **Program Organizational Breakdown Structure (OBS) is:**
  - Structured around personalities rather than competency qualifications
  - Lacks a product or services oriented team focus rather than functional

- **SOW and Specification Scopes Violated**
  - System Performance Specification (SPS) requirements documented as tasks in the CSOW.
  - CSOW tasks stated as requirements in the System Performance Specification (SPS).

An Ounce of Knowledge ... Amateurish Implementations …WHY ??

Why Dragons Live in Programs (1 of 2)

Reason #1 – Incomplete PM Education and Training

- **PMs are often KNIGHTED but UNTRAINED …**

  … in understanding the product structures and behavioral interactions of the system, product, or service being developed.

- **It is perceived to be "MANAGERIAL" by upper management and personnel when …**

  – … PMs "delegate" program tasks to Engineering Leads whose system development experience is "experiential" – e.g., the "school of hard knocks" … e.g., no formal training.

  – Besides … when the program gets into trouble, the PM can always replace the Engineering Lead!!

Every system is PERFECTLY designed to produce the results your are observing. [Anonymous]

Example #1 – PM Understanding of Systems

Project Management | **Red Zone** | **Engineering**

Project Memo

(By virtue of the power I possess), I am announcing the elimination of program technical reviews and peer reviews. We need to cut costs and this will allow more time to focus on "engineering the system."

Signed, I M N Charge

Engineer #1 …Wonder if I M N Charge is aware that elimination of reviews means that system integration and test will go high risk and will result in rework, slipped schedules, and budgets overruns!

Engineer #2 …I M N charge did this on the last program that failed and still got a PROMOTION!!

Why Dragons Live in Programs (2 of 2)

Reason #2 – Incomplete Engr. Education & Training

- **Engineers will often tell you …**
  - … they didn't spend 4 years getting a degree to have to do budgets and schedules … it's not the FUN stuff!
- **When confronted with responding to Program Management budgeting, scheduling, EV, and other tasking …**
  - … engineers complain "He / she (PM) really doesn't know what they want … so give them something …
  - … if it's not what they want, they will send it back to rework! We have more pressing matters to address!"

Every system is PERFECTLY designed to produce the results your are observing. [Anonymous]

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Example #2 –Engineering Training Deficiencies

Project Management | **Red Zone** | **Engineering**

Project Task Memo

To: Engineering

Based on our proposed technical design solution, please provide a detailed schedule of Engineering tasks including networked dependencies to John Doe, XYZ Program Planner, by COB on September 15th.

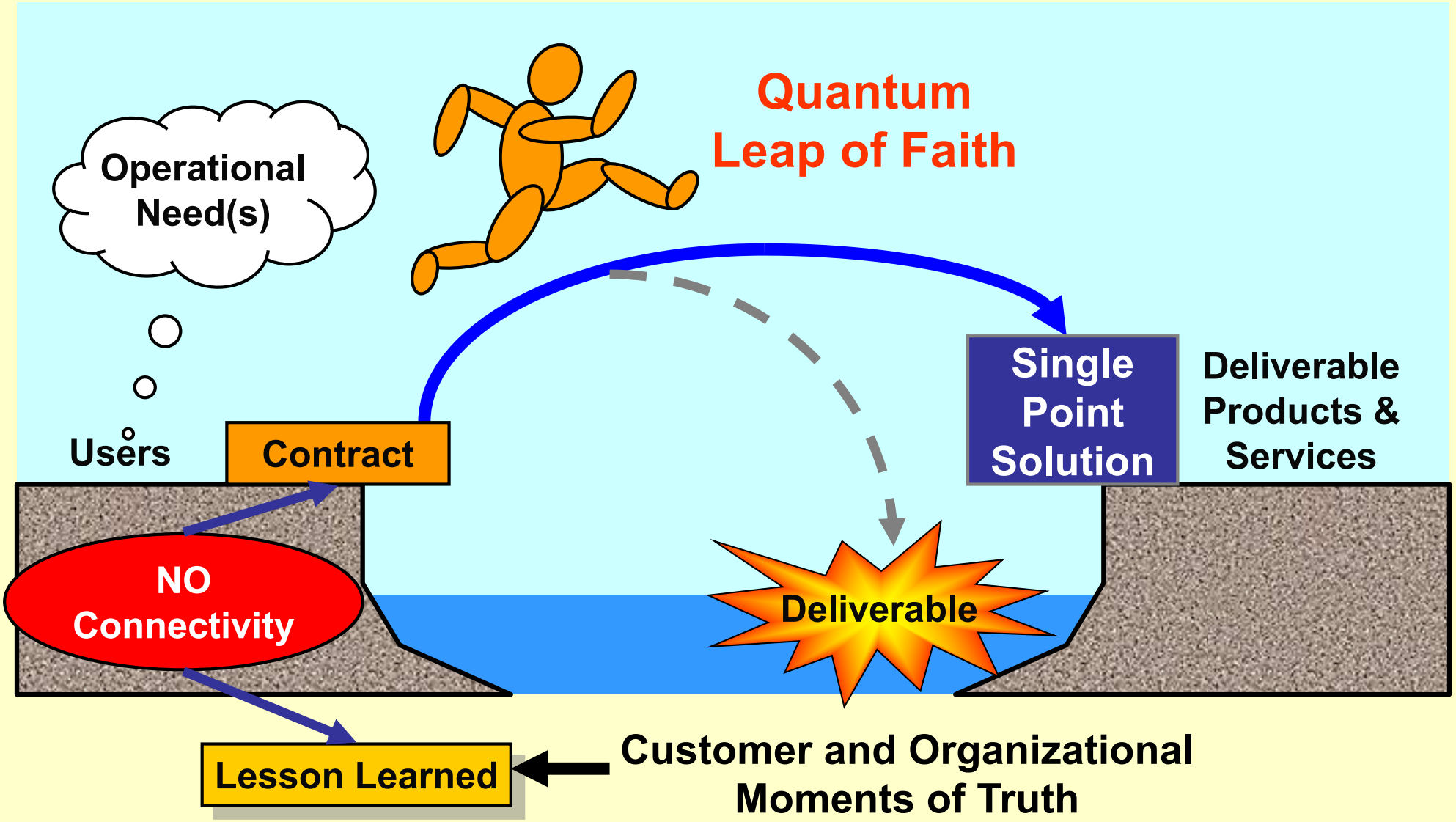
Thank you for your timely support!
Signed …. Mary _____, PM

Mary:
Per your request, detailed Engineering schedule provided below … No critical paths.

Task 1 - Define Requirements
Task 2 - Design System
Task 3 - Order Parts
Task 4 – FAIT* Components
Task 5 - Integrate System
Task 6 - System Acceptance
Task 7 - Deliver System

* FAIT – Fabricate, Assemble, Integrate, & Test Components

Fallacy of the Better, Faster, Cheaper Shortcuts

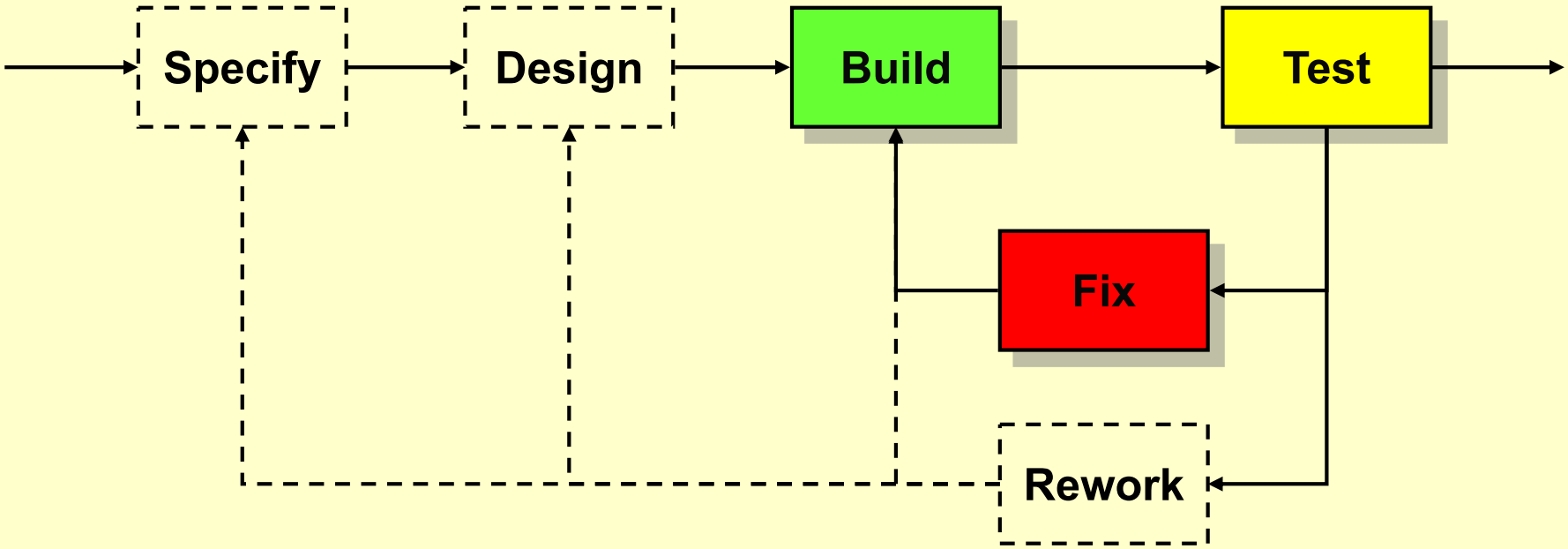


Every system is PERFECTLY designed to produce the results you are seeing.

The Build, Test, Fix Paradigm

Our iterative process evolves system design

…. … until we get it RIGHT!! … (sometime in the future)



Every system is PERFECTLY designed to produce the results you are seeing.

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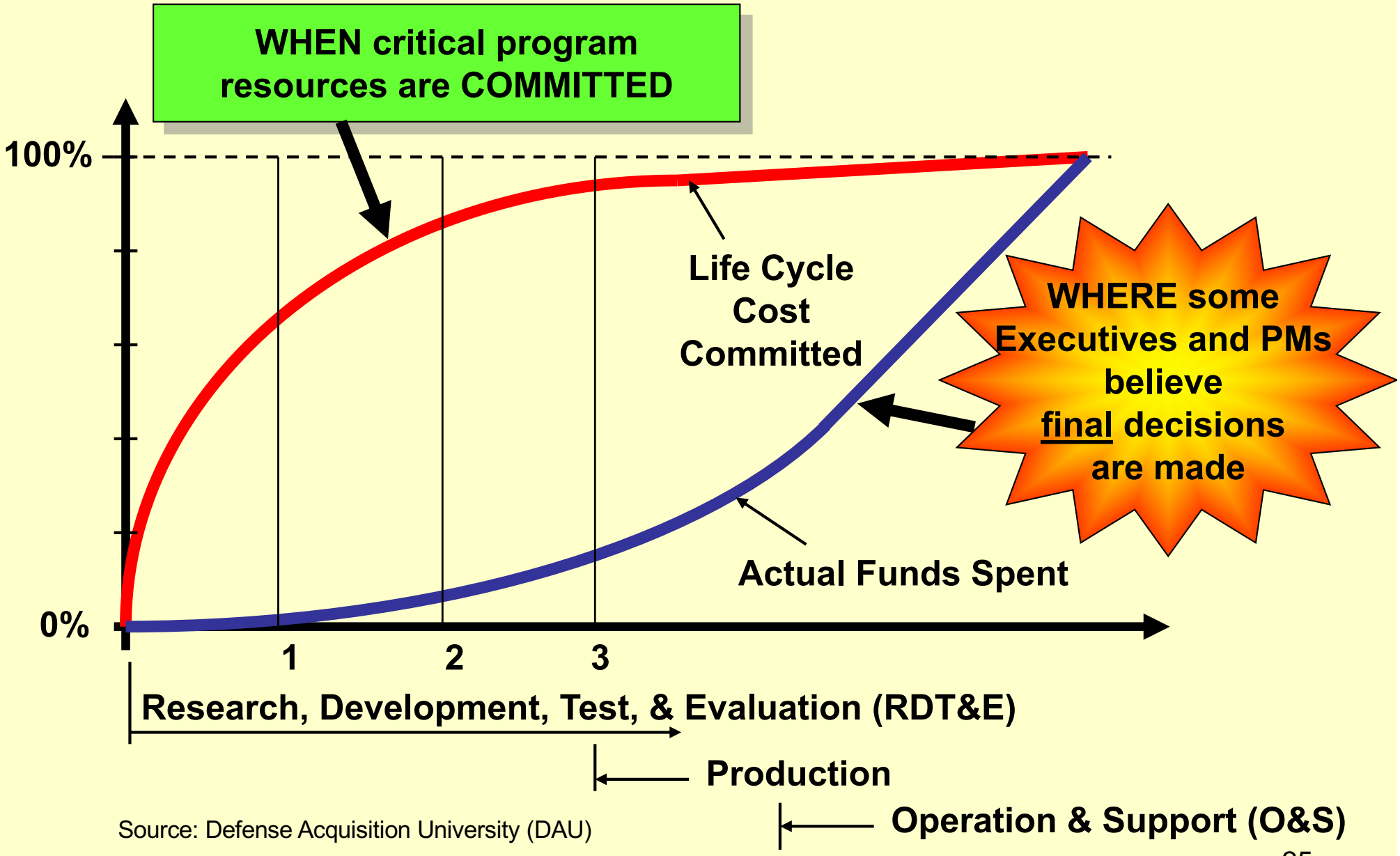
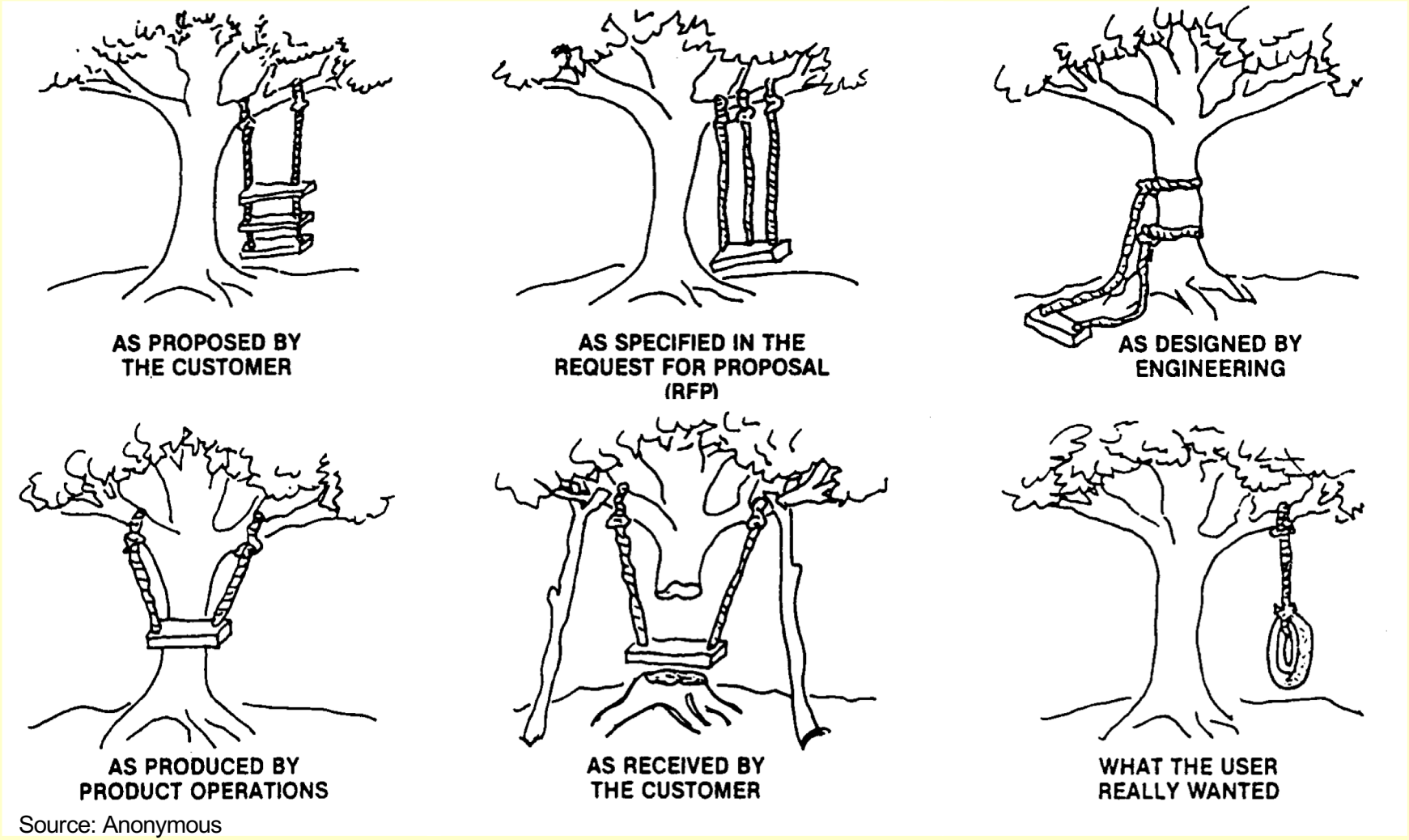
Lack of Understanding of Cost Commitments



Source: Defense Acquisition University (DAU)

Is There Any Wonder Why This Occurs?



Source: Anonymous

All of these factors … and we wonder why the Guidance for Success fails us!!!

If the U.S. Is Going to Remain Competitive …

THE lesson learned was we didn't learn our lessons [Anonymous]

Every system is PERFECTLY designed to produce the results your are seeing. [Anonymous]

Insanity is doing the same thing over and over, and expecting a different result [Dr. Albert Einstein]

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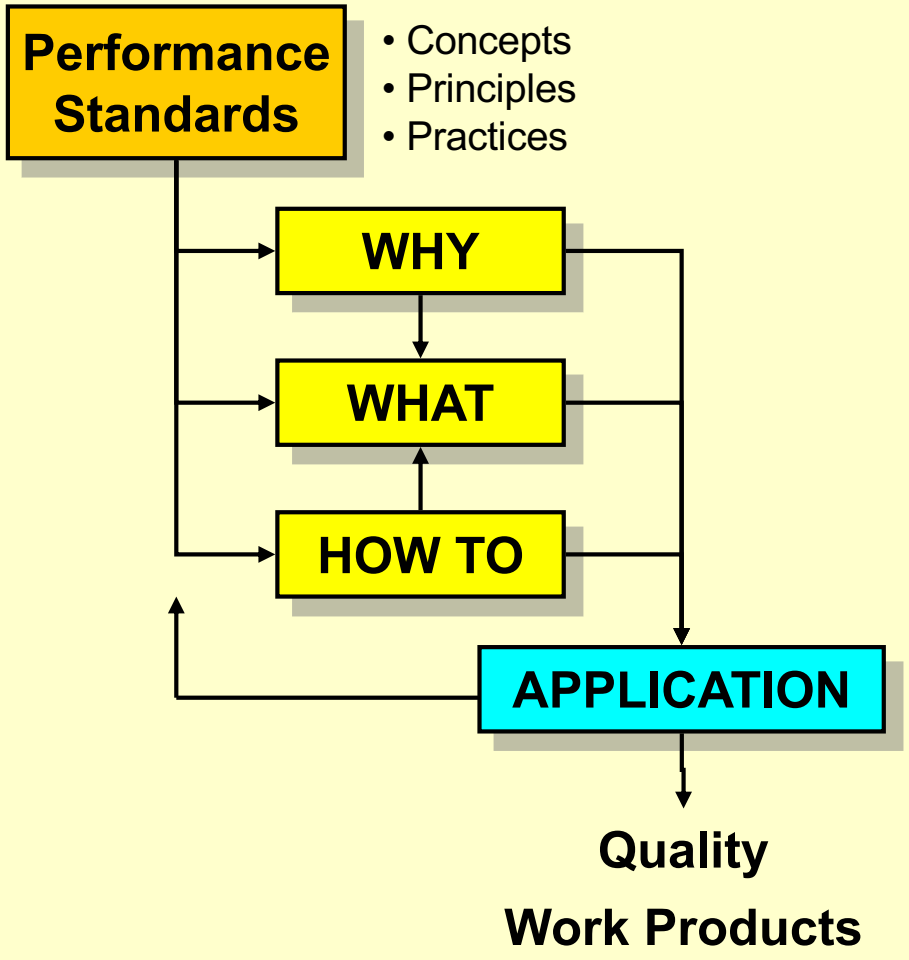
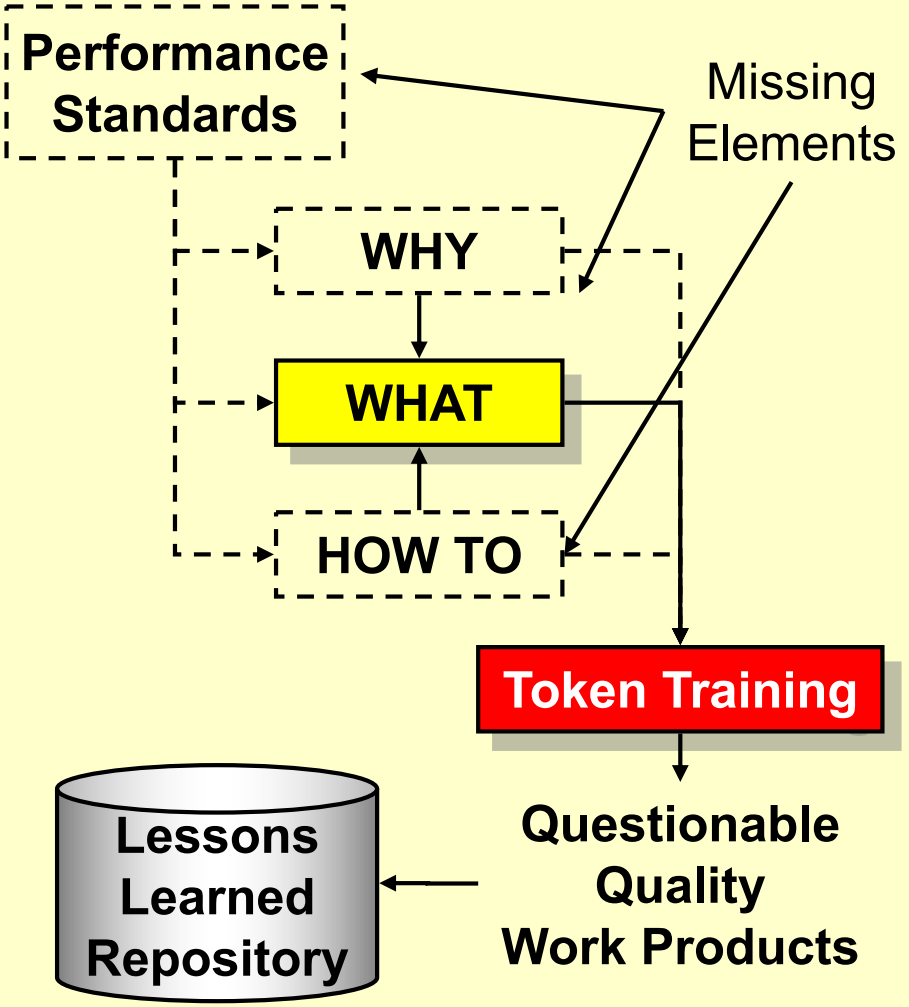
Understand the Human Education Process

Basic Education Instructional Process



Typical Work Place

Check the Box Approaches



The State of PM & Engineering Education

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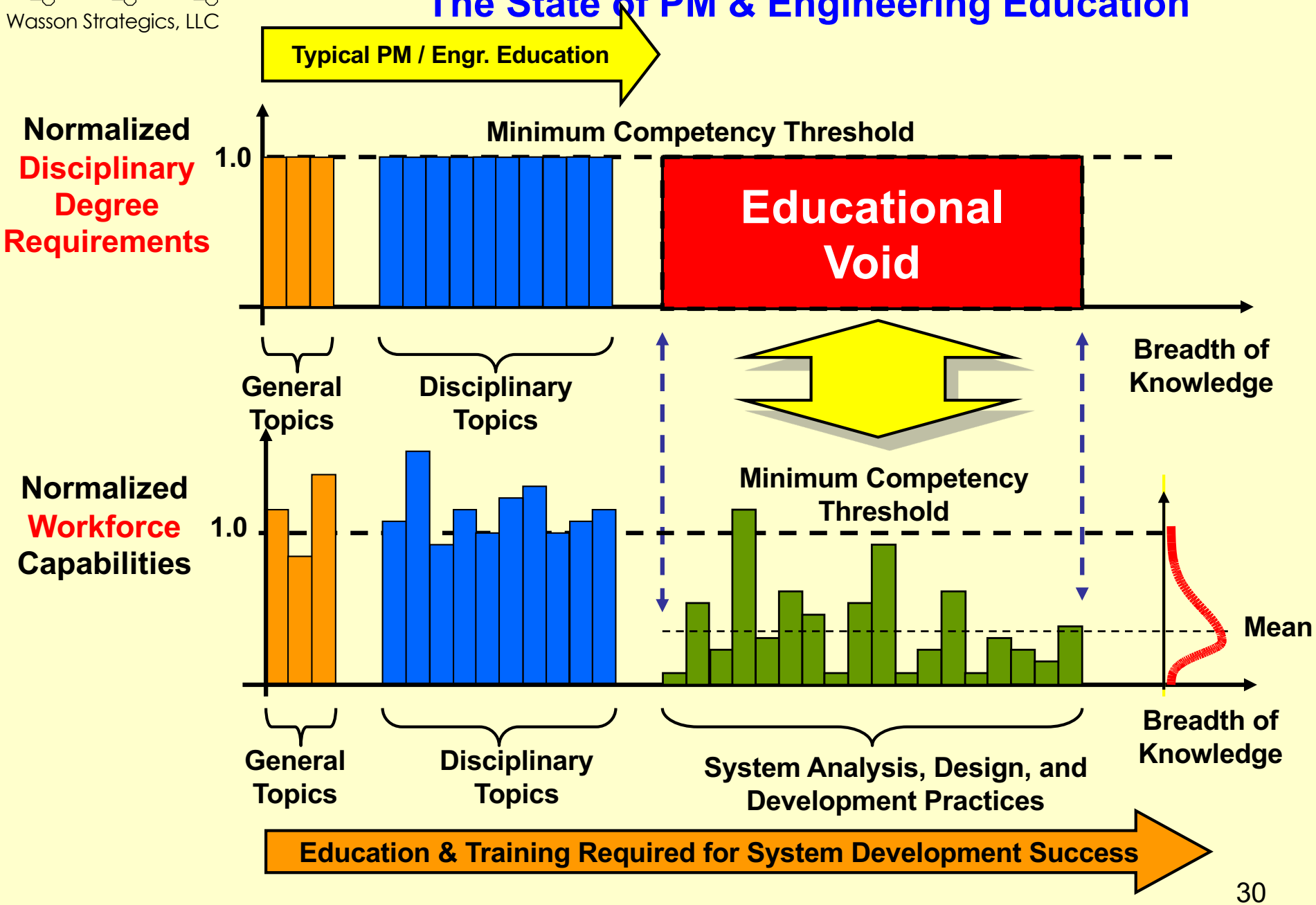

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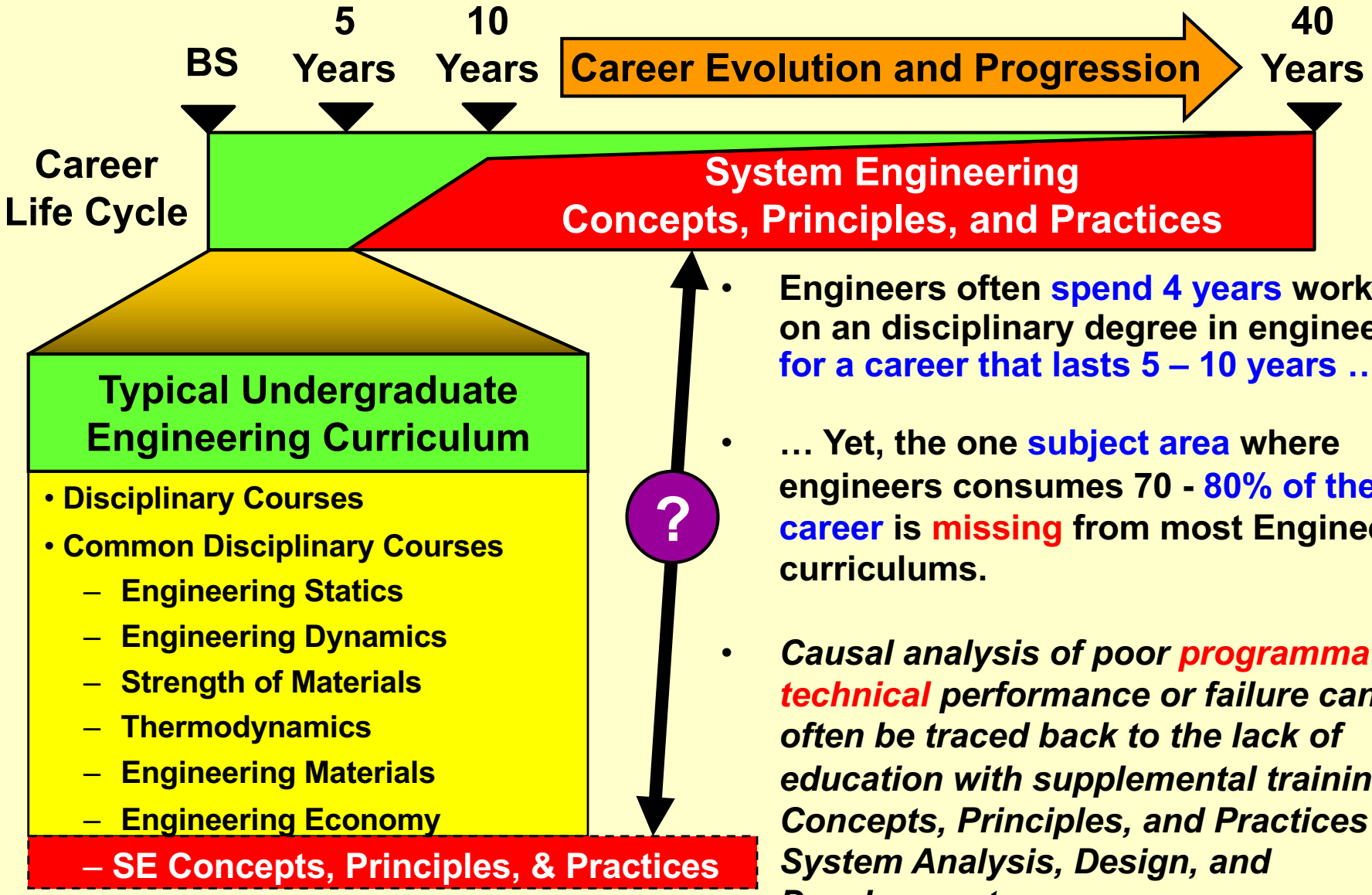
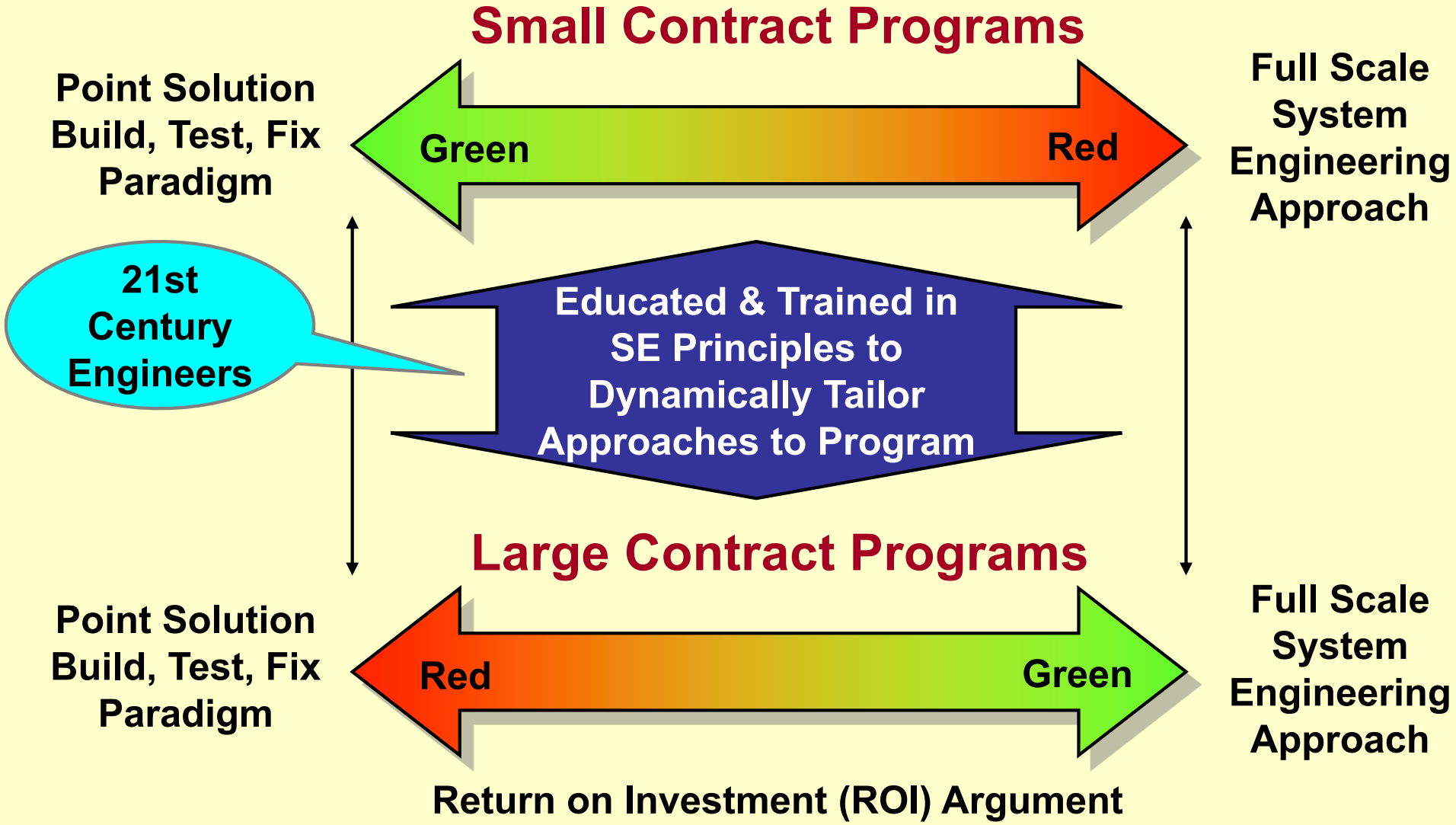
The Gap in Engineering Education



- Engineers often spend 4 years working on an disciplinary degree in engineering for a career that lasts 5 – 10 years …
- … Yet, the one subject area where engineers consumes 70 - 80% of their career is missing from most Engineering curriculums.
- *Causal analysis of poor programmatic or technical performance or failure can often be traced back to the lack of education with supplemental training in Concepts, Principles, and Practices of System Analysis, Design, and Development*

Effective SE Education and Training

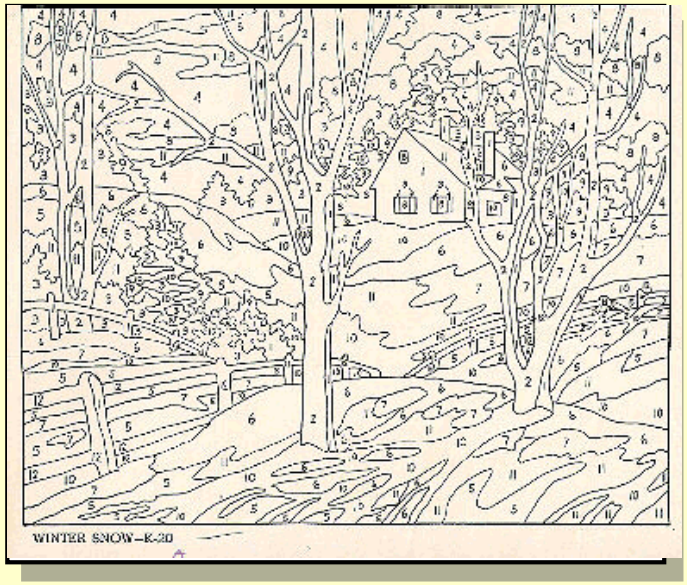


Paint By Number System Development

Standard organizational processes are ABSOLUTELY ESSENTIAL to focusing group activities on producing PREDICTABLE and REPEATABLE systems, products, and services … HOWEVER … without proper SE training … programs have evolved into Paint-By-Number system development believing the end result will be a work of art?

Processes are guiding enablers – the formula or recipe – not the focus!!

Organizational Standard Process (OSP)



Winter Snow. Printed line art. PBN/NMAH.
http://americanhistory.si.edu/paint/Images/Large_Images/IMAGE_HTML/fl06ws.html

Deliverable

***Indian Summer.* Super Craft Master SM-404. Lent by Gregory Brackens.**
http://americanhistory.si.edu/paint/Images/Large_Images/IMAGE_HTML/IndianSummer.html

PMs and Engineers Need to learn STRATEGIC and TACTICAL PROCESS THINKING ... NOT mindless reading of instructions that induce errors!!

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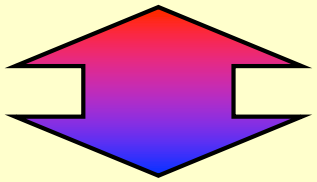
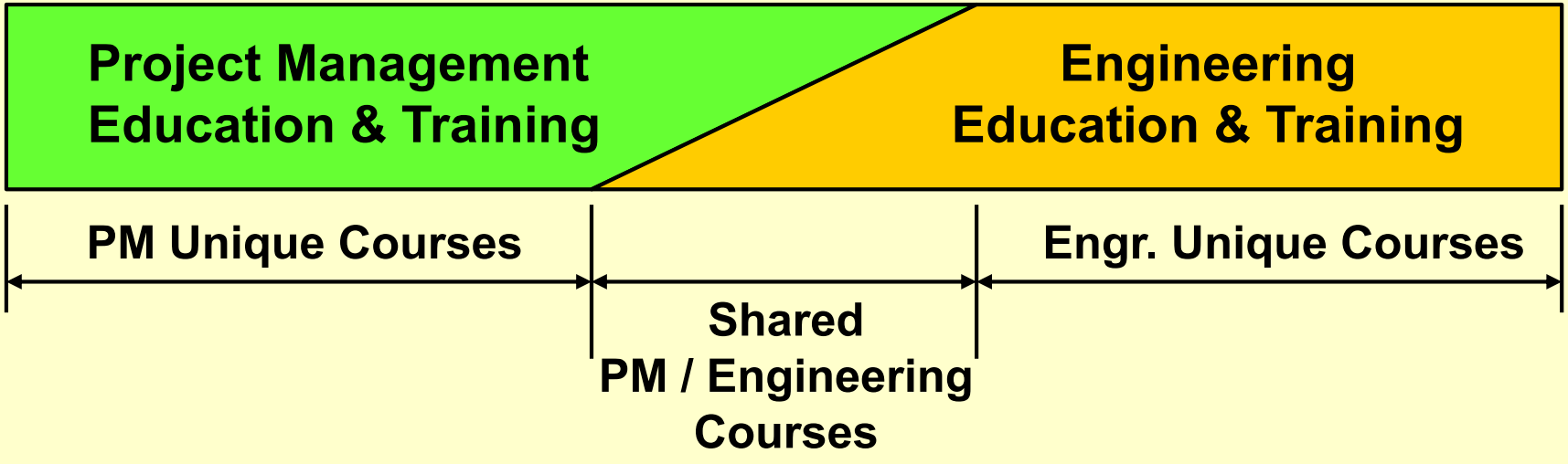
Scoring a Success - Eliminating the Red Zone

CURRENT State



SHOULD BE State



Inter-disciplinary PM and Engineering Education and Training!

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Changing the

RED Zone

to the

GREEN Zone

Competitive Systems - Supply Chain Dependencies

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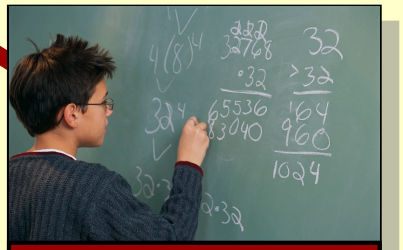
Families

Government & Industry



K-12 Education

Systems, Products, & Services

Higher Education

Young Adults

Education Realities & Responsibilities (1 of 2)

What are the missions of Government, Industry, and Academia in System Analysis, Design, and Development Education and Training?

- **Industry, by default, claims ownership of SE education …**
  - **Administered by disciplinary functional managers who often lack an understanding of SE yet have administrative oversight over SEs**
  - **Is stymied by the lack of quantitative measures of SE effectiveness … i.e., the FEAR that application of SE methods will slow design defaults to BRUTE FORCE Build, Test. Fix disciplinary methods that are acknowledged as INEFFICIENT and BREAKDOWN in complex system development**
  - **Yet … only has token investments in System Analysis, Design, and Development courses**

Education Realities & Responsibilities (2 of 2)

What are the missions of Government, Industry, and Academia in System Analysis, Design, and Development Education and Training?

- **Academia could deploy introductory SE education … but:**
  - **Is already constrained by courses required to maintain accreditation**
  - **Prioritizes schedule time to offer disciplinary courses rationalized as "necessary"**
  - **Often lacks instructors with SEASONED SE practitioner experience**
  - **Industrial and SE (ISE) schools claim ownership of SE … HOWEVER**
    - Courses in processes, statistics, human factors, safety, logistics do not constitute an SE curriculum for full system development life cycle activities

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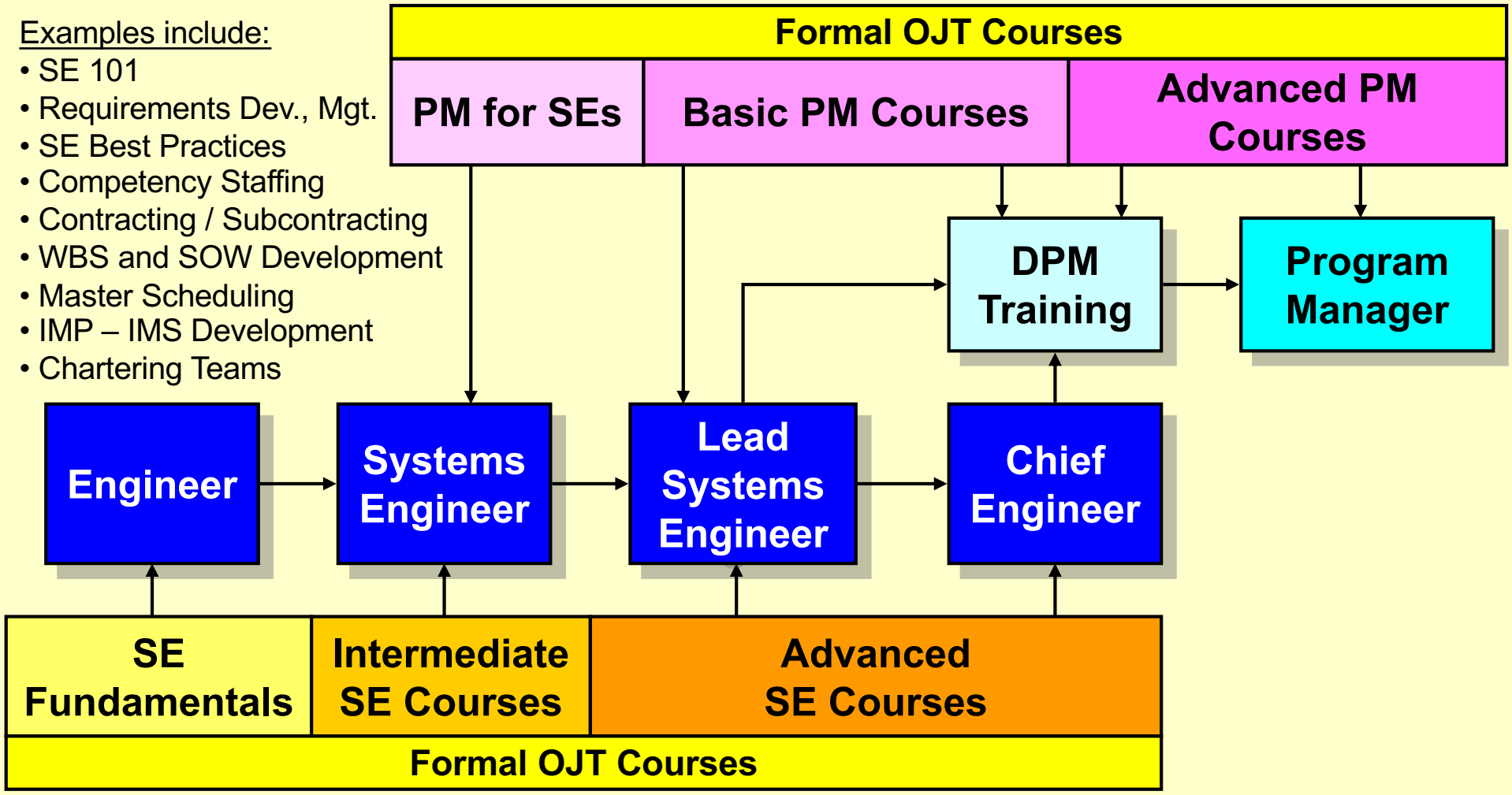
An Example for Solving the "Red Zone"

Examples include:
- SE 101
- Requirements Dev., Mgt.
- SE Best Practices
- Competency Staffing
- Contracting / Subcontracting
- WBS and SOW Development
- Master Scheduling
- IMP – IMS Development
- Chartering Teams



**Conduct ROBUST workshop-based interdisciplinary courses …
NOT general awareness courses as presently provided!!**

"Return to Green" Path to Scoring Success

Project Management Education & Training

Engineering Education & Training

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Summary

Shifting the Current Paradigm …

… Meeting the Global Challenges

The Global Workplace Conundrum

Whereas the US leveraged STRATEGIC and TACTICAL competitive advantages in system development over the past 60+ years …

Risk

Global Diversification …

Opportunity

… Achieving Shared Multi-Disciplinary Team Visions

… everyone around the globe has the same access to best practices via the Internet, books, symposia, and periodicals. Competitive survival can only come from being the BEST via PM & Engineering education, training, and program execution!

John F. Kennedy – A Call for National Focus

On May 25, 1961, President John F. Kennedy appealed to the nation

"...I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth."

Today we have a similar situation driven by GLOBAL COMPETITION and other threats … it's time for a new national focus on overlapping PM and Engineering Education and Training !!

Thank You !!

Thank you for inviting me to present at the 2nd Annual INCOSE Great Lakes Conference.

I extend best wishes for success and encourage each of you to challenge traditions through innovative management of system, product, or services development.

Work to revitalize the U.S. position in delivering systems, products, and services to meet our nation's exploration and technological needs in a highly competitive global environment.

Charles Wasson
September 8th, 2008

Questions & Answers ??