ENGINEERING FOR OUTCOME

REQUIREMENTS: DRIVING ACCURATE AND VIABLE VALUE

Dave Miller
VP IT
Customer Access Solutions
“There is no way to significantly improve software quality or productivity without first addressing the quality of the requirements.”

Richard Bender
Growth in Code

Christian Hagen, A.T. Keaney, Steven Hurt, Jeff Sorenson, Effective Approaches for Delivering Affordable Military Software, CrossTalk 2013
Delivering new functional value

Automotive

90% of automobile innovation is based on electronic systems, with 80% of this innovation based on embedded software.

Aerospace & Defense

Today’s F35 Lightning II has a 588% increase in lines of code, 10 million vs. 1.7 million over the F-22 Raptor, released in 2003.

Growing specification complexity
Smarter products and systems

Smarter automobiles

Smarter health care

Smarter devices

Smarter hybrid vehicles

Smarter energy

Smarter defense systems

Higher levels of requirements sophistication
Defense Systems of Systems
... Context for Complexity
Modern Warrior
Dressed for Success

Does it come in PURPLE?
Shifting user experience

Worldwide

4.3 billion Digital Natives 67%

2.1 billion Digital Migrants 33%

Defense Manpower Research
Age Demographics

Baby Boomers: 1946 - 1979

Millennials: 1980 - 2014

Gen X: 1965 - 1980

Gen Z: 1995 - 2014

Digital Natives: more demanding with greater expectations

Digital Migrants

11.23.2013

Worldwide 2.1 billion Digital Migrants 33%
4.3 billion Digital Natives 67%
Gen Z
Always Connected
play connected
Failure – what is the cost?

- **Therac-25 X-ray**
  - 1985-1987
  - Massive overdoses by Therac-25
  - Resultant deaths & serious injuries

- **Patriot Missile Failure**
  - 1991 Gulf War
  - Loss of 28 lives

- **Knight Capital**
  - August 1, 2013
  - Erroneous trading errors
  - $457.7 million loss

- **AT&T Long Distance Failure**
  - 1990
  - 9 Hour Outage
Requirements are still our greatest challenge

The 2012 Software Quality Report by Capers Jones details:

- **Number one and two defect origins:**
  1. Requirements
  2. Requirements creep

- **Requirements defects ranked number one in effort to fix**

---

**Total Defects**
- 70%

**Late Discovery**
- 80%

**In SDLC:**
- 1

**Waste of development**
- 39%

**SDLC consumption**
- 46%

1. SEI 'Four Pillars for Improving the Quality of Safety-Critical Software-Reliant Systems'
2. IAG Consulting 2009 Business Analysis Benchmark
NASA found 84% of requirements issues are lack of clarity and completeness.

“Of all of our inventions for mass communication, pictures still speak the most universally understood language.”

-Walt Disney
Most requirements confirmation techniques validate “words”

- Requirements Reviews
- Requirements Inspection
- Test-Case Driven Inspection
- Check-List Inspection
- Testing-Based Requirements Validation
- Requirements Prototyping
- Model-Based Requirements Validation
Manage clarity and reduced time to market with model-based approach

We build models to understand - providing a systematic and precise approach to requirements definition

- Abstract system view – essential to manage complexity and clarity
- Representation of system under development

Techniques
- Data-Flow Modeling
- Entity-Relationship Modeling
- State-Transition Modeling
- Object Modeling
- Stimulus/Response Modeling
- Process Modeling
Shifting from manual to model-based approach benefits quality and cost

- Visual – improved communication and maintainability
- Early error and risk identification/resolution
  - Provides formal specification of actual intent of functionality
  - Close and timely collaboration with stakeholders and users
  - Accelerated development
- Higher coverage, more effective testing, and greater confidence
By 2019, the growing use of business process modeling and other visualization techniques in iterative elaboration of project requirements will help boost accuracy of solution delivery by at least 35%.

1.) Gartner: Use Business Process Modeling to Visualize and Bring Clarity to Requirements Analysis
02 September 2014  G00258435
Model-based approach challenges us to rethink traditional V&V

Current build-then-test practice for software reliant systems has become increasingly unaffordable.

1. SEI ‘Four Pillars for Improving the Quality of Safety-Critical Software-Reliant Systems
“The hardest part of the software task is arriving at a complete and consistent specification, and much of the essence of building a program is in fact the debugging of the specification.”

Frederick P. Brooks

DRIVING ACCURATE AND VIABLE VALUE

“No part of the delivery process is as critical, nor as difficult - because requirements map the human world to the technological world.”

Jim Highsmith
Continuing the journey left

Science of Testing:

- Academic, industry, and government researchers must continue to structure into rules the knowledge base needed to capture what meets business value and to deliver that value through a deterministic software development process.