Systems Engineering and Innovation

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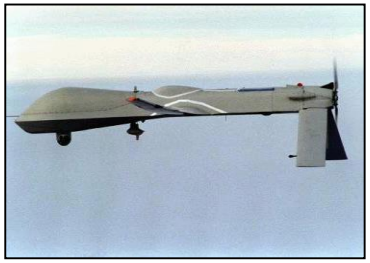
Engineering Within DoD

Systems Engineers creatively apply scientific principles across a broad portfolio of weapons, sensors, command and control, logistics, and business systems:

- To design, develop, construct and operate complex systems
- To forecast their behavior under specific operating conditions
- To deliver their intended function while addressing economic efficiency, environmental stewardship and safety of life and property

- ***US Department of Defense is the World's Largest Engineering Organization***
- ***Over 108,000 Uniformed and Civilian Engineers***
- ***Over 39,000 in the Engineering (ENG) Acquisition Workforce***





Systems Engineering Research Center

1. Stevens Institute of Technology
2. University of Southern California
3. Air Force Institute of Technology
4. Auburn University
5. Carnegie Mellon University
6. Georgetown University
7. Georgia Institute of Technology
8. Massachusetts Institute of Technology
9. Missouri University of Science and Technology
10. Naval Postgraduate School
11. North Carolina Agricultural & Technical State University
12. Pennsylvania State University
13. Purdue University
14. Southern Methodist University
15. Texas A&M University
16. Texas Tech University
17. University of Alabama in Huntsville
18. University of California - San Diego
19. University of Maryland
20. University of Massachusetts Amherst
21. University of Virginia
22. Wayne State University

Research Focus Areas:

- Enterprise Systems and Systems of Systems
- Trusted Systems
- Systems Engineering and Systems Management Transformation
- Human Capital Development

NOTABLE PROJECTS

- Tradespace and Affordability Methods, Tools, and Processes
- Security Engineering
- Capstone Marketplace

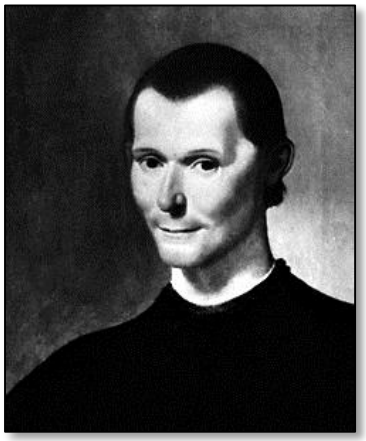
SERC leverages expertise of over 400 researchers across the Nation

Difficulties in Innovation

Niccolò Machiavelli - *The Prince* (1513), Chapter 6

*"And let it be noted that there is no more **delicate** matter to take in hand, nor more **dangerous** to conduct, nor more **doubtful** in its success, than to set up as the leader in the introduction of changes.*

*For he who innovates will have for his **enemies** all those who are well off under the existing order of things, and only **lukewarm supporters** in those who might be better off under the new. "*

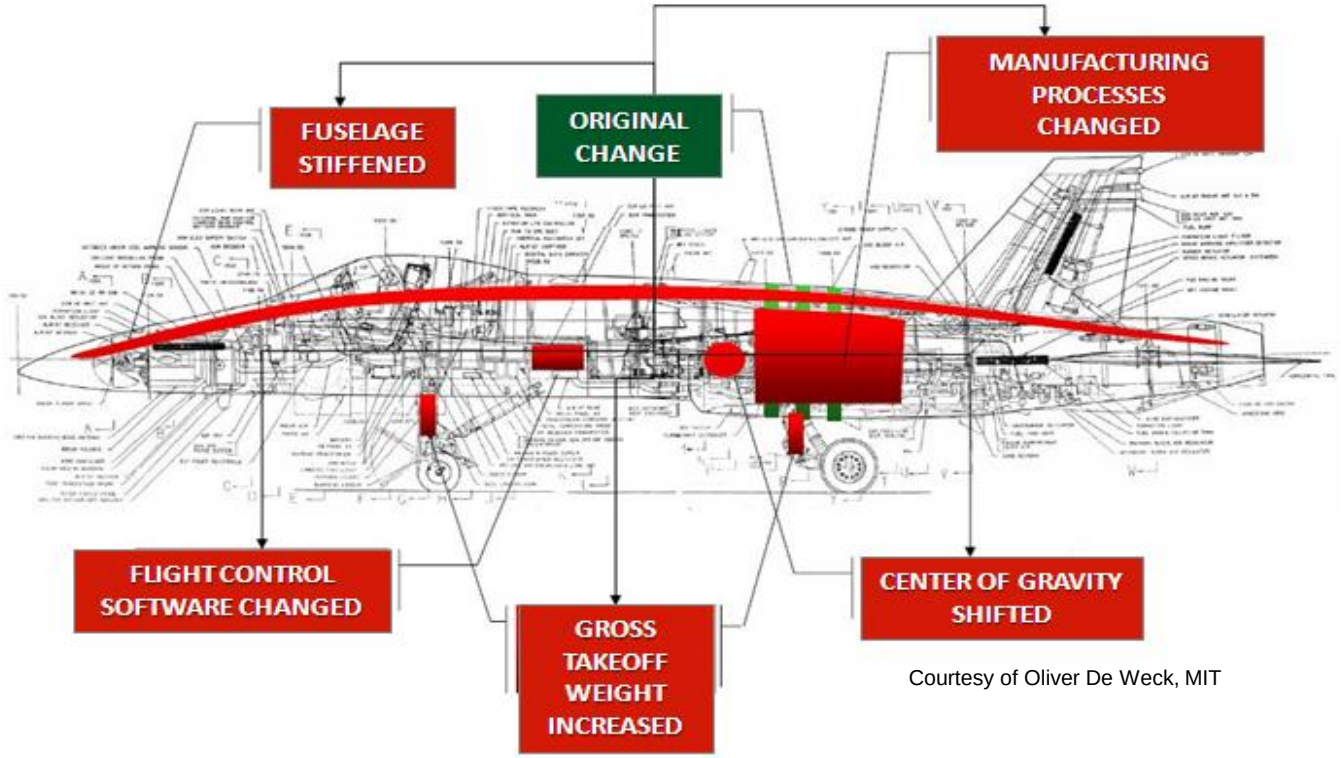


Niccolò Machiavelli (1469-1527)
Detail of an oil painting by Santi di Tito;
in the Palazzo Vecchio, Florence, Italy

N. H. Thomson, translator,
Dover Publications, Inc., New York, 1992, page 13.
Originally published by P. F. Collier & Son, New York, 1910.

Engineering Challenges for Complex Systems

F/A-18 – Adapted from USN to Swiss Versions



Courtesy of Oliver De Weck, MIT

Significant Cost and Schedule Increase to Achieve Required Performance

Small Engineering Changes – Significant Unintended Consequences

Resilient Systems?
Adaptable Systems?

Apache Revolver / Knife / Brass Knuckles

SPECIFICATIONS	
Country of Origin:	France
Date:	1869
Calibre:	7mm (.275in)
Operation:	Revolver
Weight:	.362kg (.8lb)
Overall Length:	105mm (4.3in) folded; 200mm (7.8in) unfolded
Barrel Length:	N/A
Muzzle Velocity:	N/A
Feed/Magazine:	Detachable cylinder
Range:	3m (10ft)

Swiss Army Knife

Specifications
- 85 tools
- 8.75" x 2.75"
- 2 lbs, 11 oz
- $1,300
- Lifetime warranty

Train Transportation

A system that complies with thousands of specifications is not necessarily resilient

We need to be able to manage and design to frequent changes in requirements