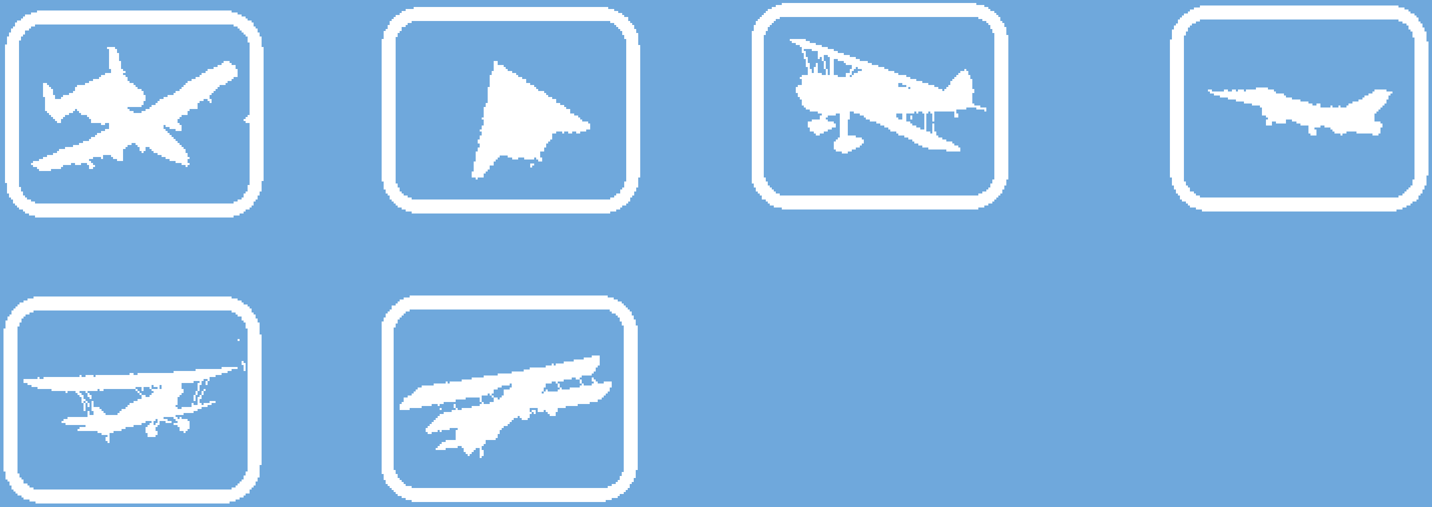


Systems Engineering

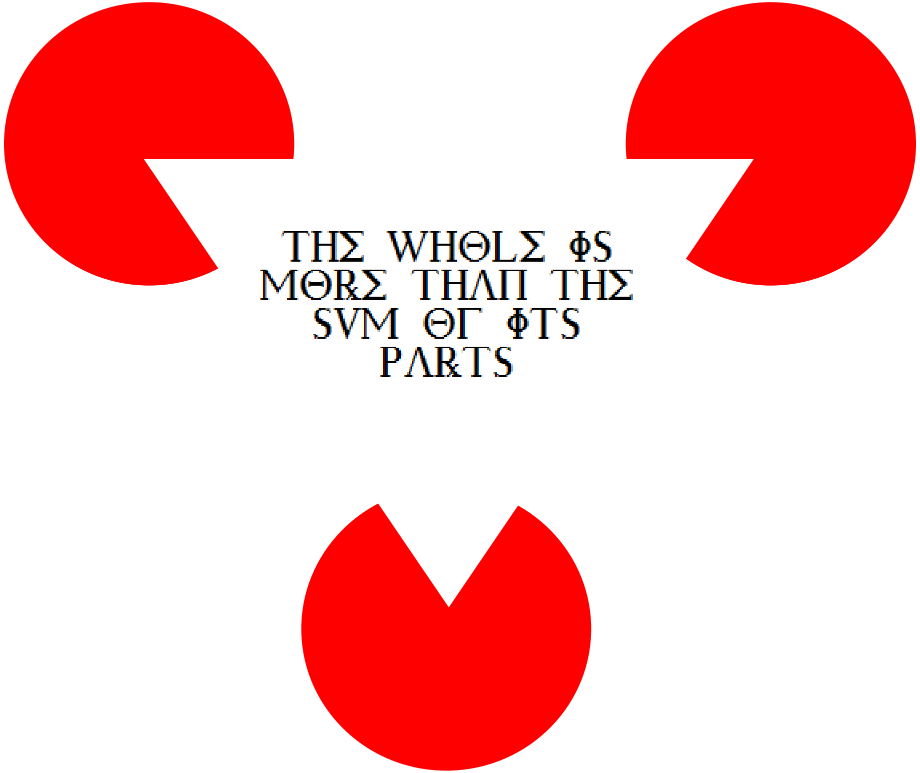
Requires a Paradigm Shift

YOGANANDA JEPPU

SYSTEMS ENGINEERING

A peep into history

SYSTEMS ENGINEERING IS NOT NEW!

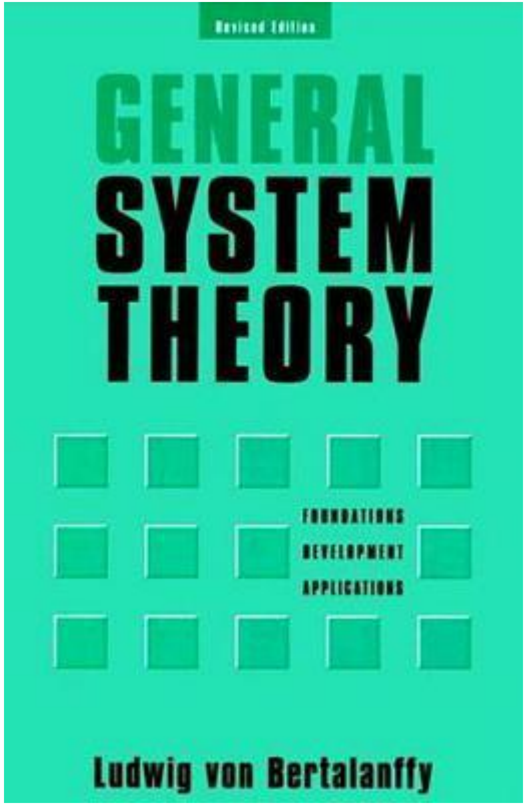


THΣ WHΘLΣ ΦS MΘRΣ THΛΠ THΣ SVM ΘΓ ΦTS PΛRTS

Aristotle – Metaphysica 330 BC

PONT DU GARD IN FRANCE (19 BC)

THE TERM SYSTEMS ENGINEERING CAN BE TRACED TO BELL TELEPHONE LABORATORIES



“today's systems may embed themselves in history” - Ludwig von Bertalanffy

- First attempt to teach systems engineering as we know it today came in 1950 at MIT by Mr. Gilman, Director of Systems Engineering at Bell.

SYSTEMS ENGINEERING PROJECTS OF YORE

- SAGE - Semi Automatic Ground Environment air-defense system was defined and managed by MIT (1951 –1980)

SYSTEMS HAVE BECOME COMPLICATED OVER THE YEARS

The earlier Northrop XB-35 of the 1940s had mechanical controls. The B-2 of today has fly-by-wire controls a combination of mechanical electronics and software.

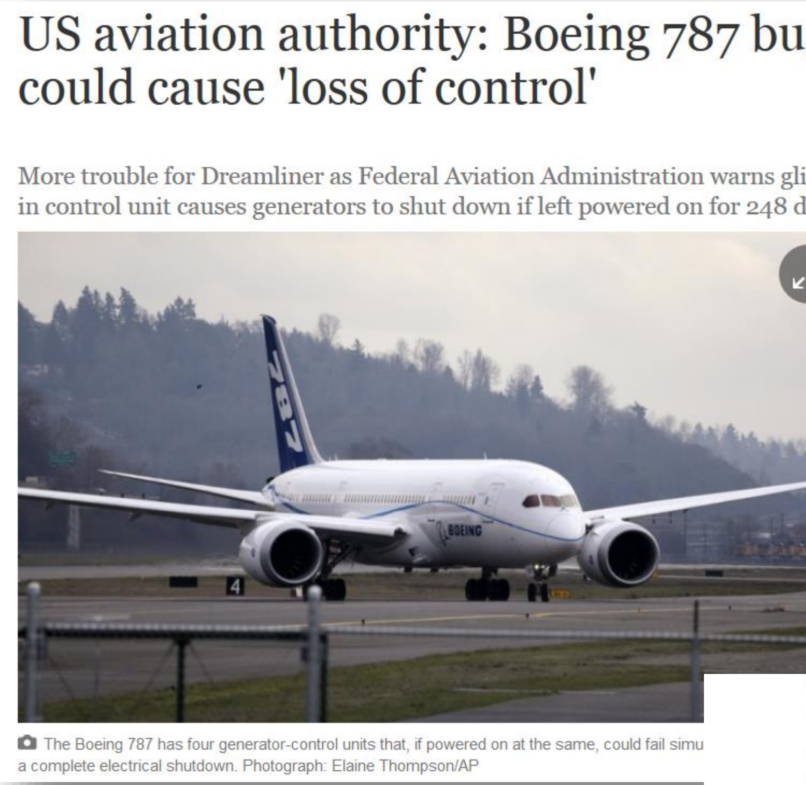
FAILURES HAVE HAPPENED

Systems Engineering has failed us for some time now

AS THE SYSTEMS HAVE BECOME COMPLICATED ACCIDENTS HAVE INCREASED

- The first error in 1962

FAA DIRECTIVE TO RESTART BOEING 787 ENGINES TO AVOID OVERFLOW ERROR

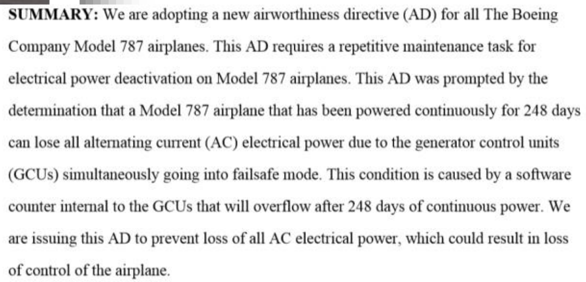


US aviation authority: Boeing 787 bug could cause 'loss of control'

More trouble for Dreamliner as Federal Aviation Administration warns glitch in control unit causes generators to shut down if left powered on for 248 days

The Boeing 787 has four generator-control units that, if powered on at the same, could fail simu
a complete electrical shutdown. Photograph: Elaine Thompson/AP

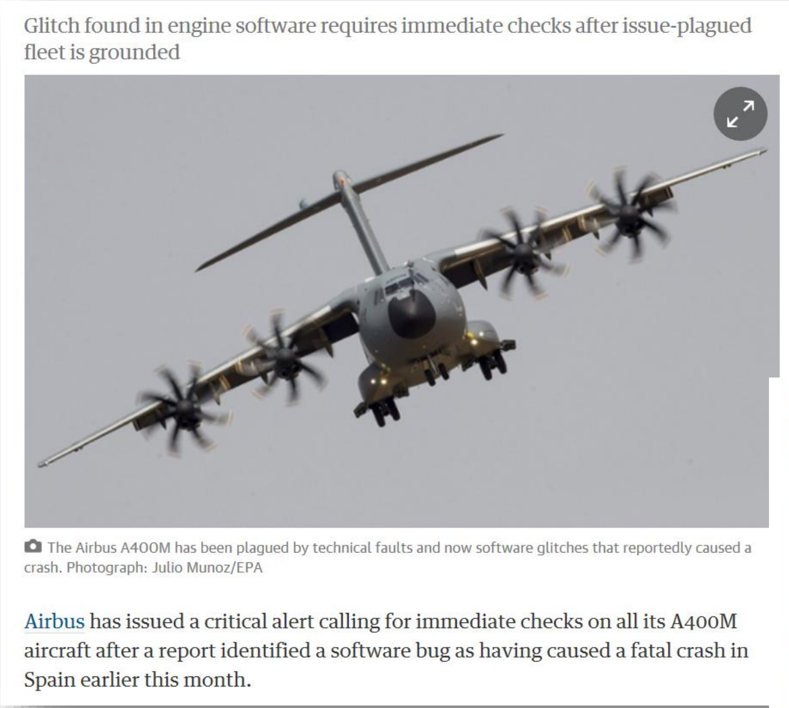
2015



SUMMARY: We are adopting a new airworthiness directive (AD) for all The Boeing Company Model 787 airplanes. This AD requires a repetitive maintenance task for electrical power deactivation on Model 787 airplanes. This AD was prompted by the determination that a Model 787 airplane that has been powered continuously for 248 days can lose all alternating current (AC) electrical power due to the generator control units (GCUs) simultaneously going into failsafe mode. This condition is caused by a software counter internal to the GCUs that will overflow after 248 days of continuous power. We are issuing this AD to prevent loss of all AC electrical power, which could result in loss of control of the airplane.

AIRBUS A400M CRASHES DUE TO ENGINE FAILURE

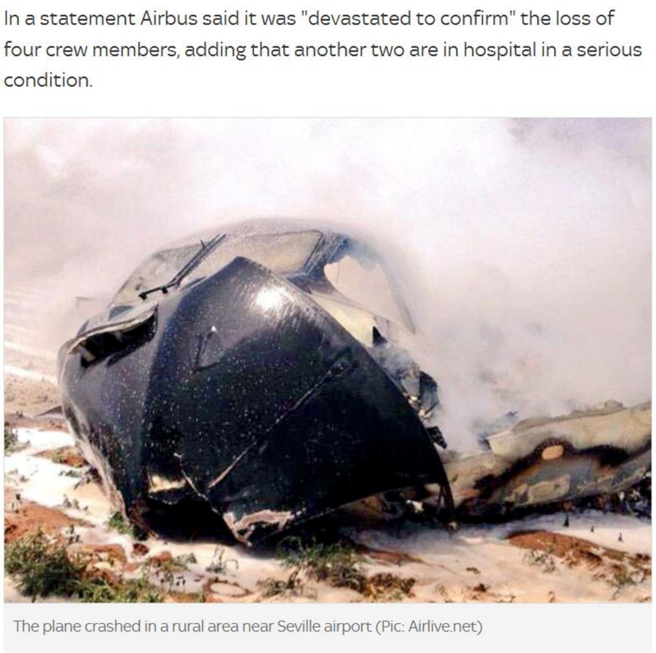
2015



Glitch found in engine software requires immediate checks after issue-plagued fleet is grounded

The Airbus A400M has been plagued by technical faults and now software glitches that reportedly caused a crash. Photograph: Julio Munoz/EPA

Airbus has issued a critical alert calling for immediate checks on all its A400M aircraft after a report identified a software bug as having caused a fatal crash in Spain earlier this month.

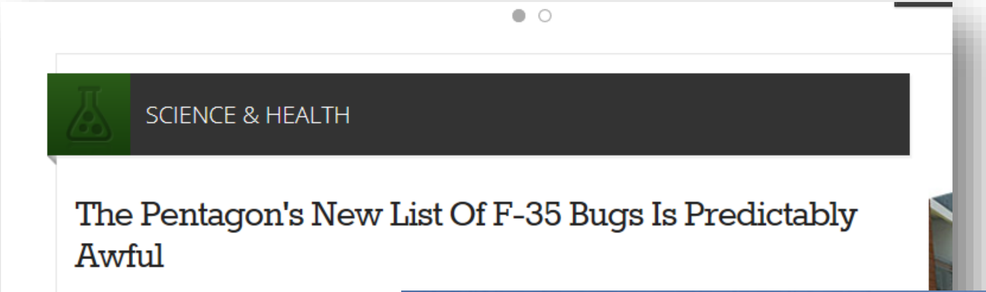


In a statement Airbus said it was "devastated to confirm" the loss of four crew members, adding that another two are in hospital in a serious condition.

The plane crashed in a rural area near Seville airport (Pic: Airlive.net)

Four crew dead!!

F-35 LIST OF BUGS PUBLISHED IN REPORT



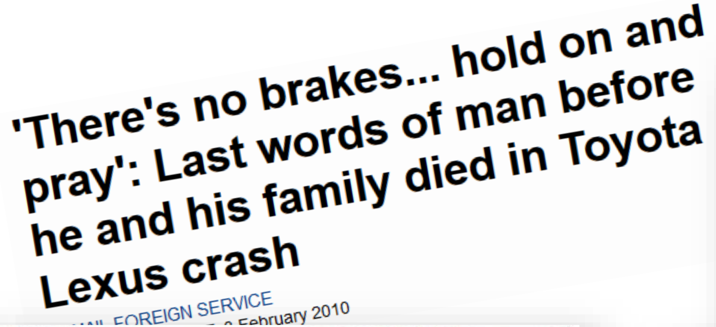
SCIENCE & HEALTH

The Pentagon's New List Of F-35 Bugs Is Predictably Awful

MICHAEL NUNEZ 4 FEBRUARY 2016 11:00

2016

THERE HAVE BEEN FAILURES IN OTHER FIELDS TOO



'There's no brakes... hold on and pray': Last words of man before he and his family died in Toyota Lexus crash

FOREIGN SERVICE

February 2010

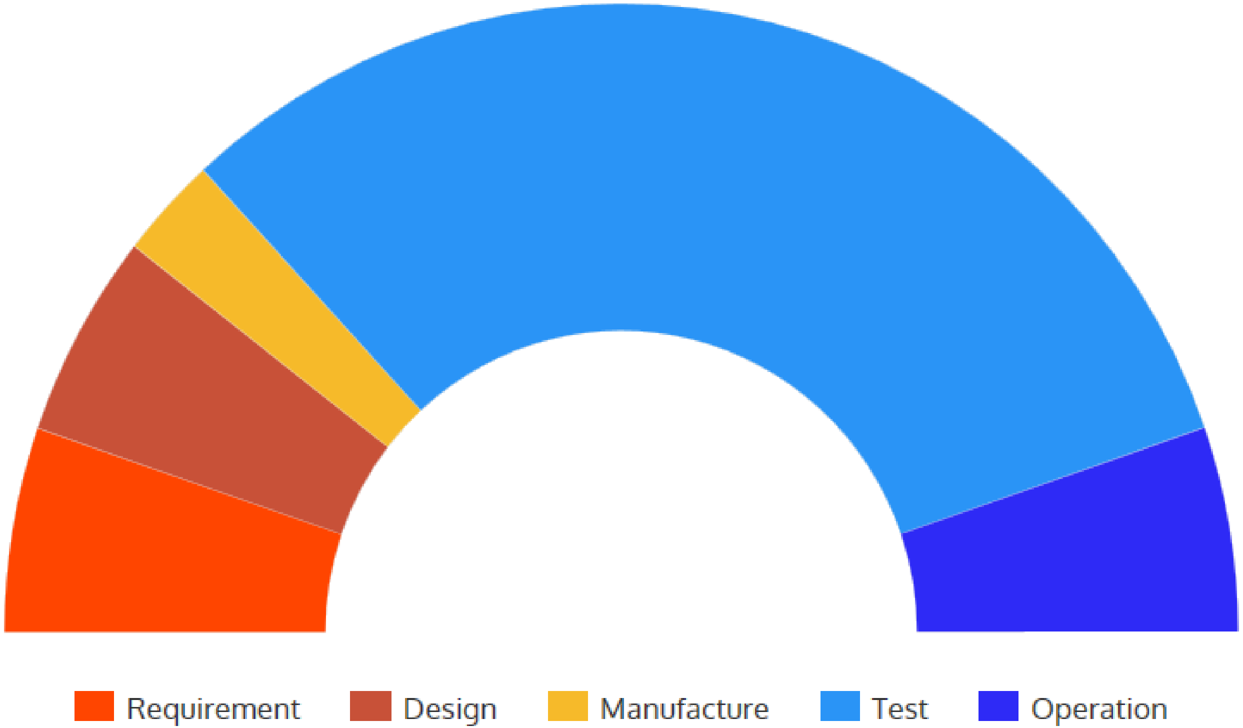
WE REQUIRE SOMETHING

Different

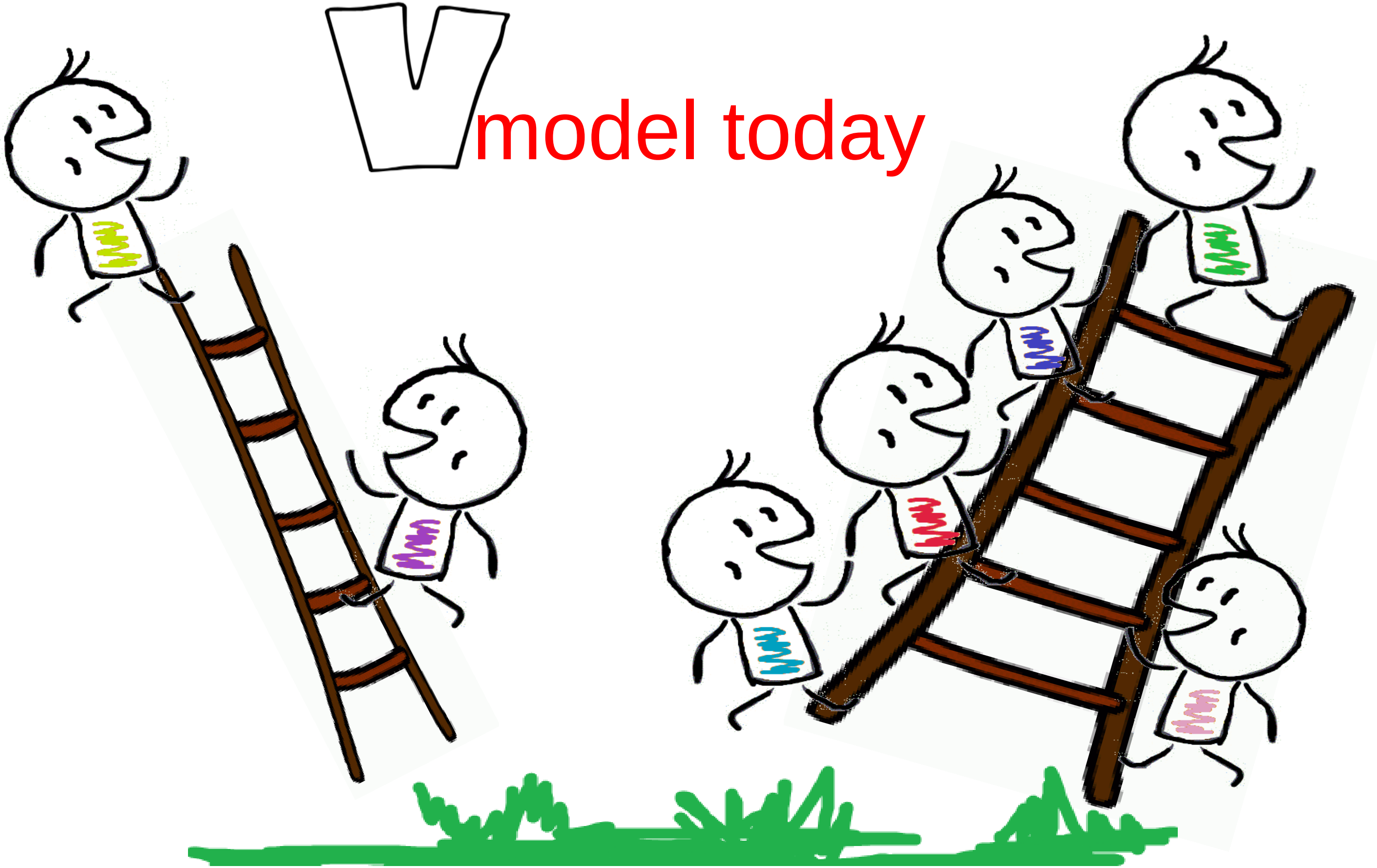
"The world as we have created it is a process of our thinking. It cannot be changed without changing our thinking

-Albert Einstein"

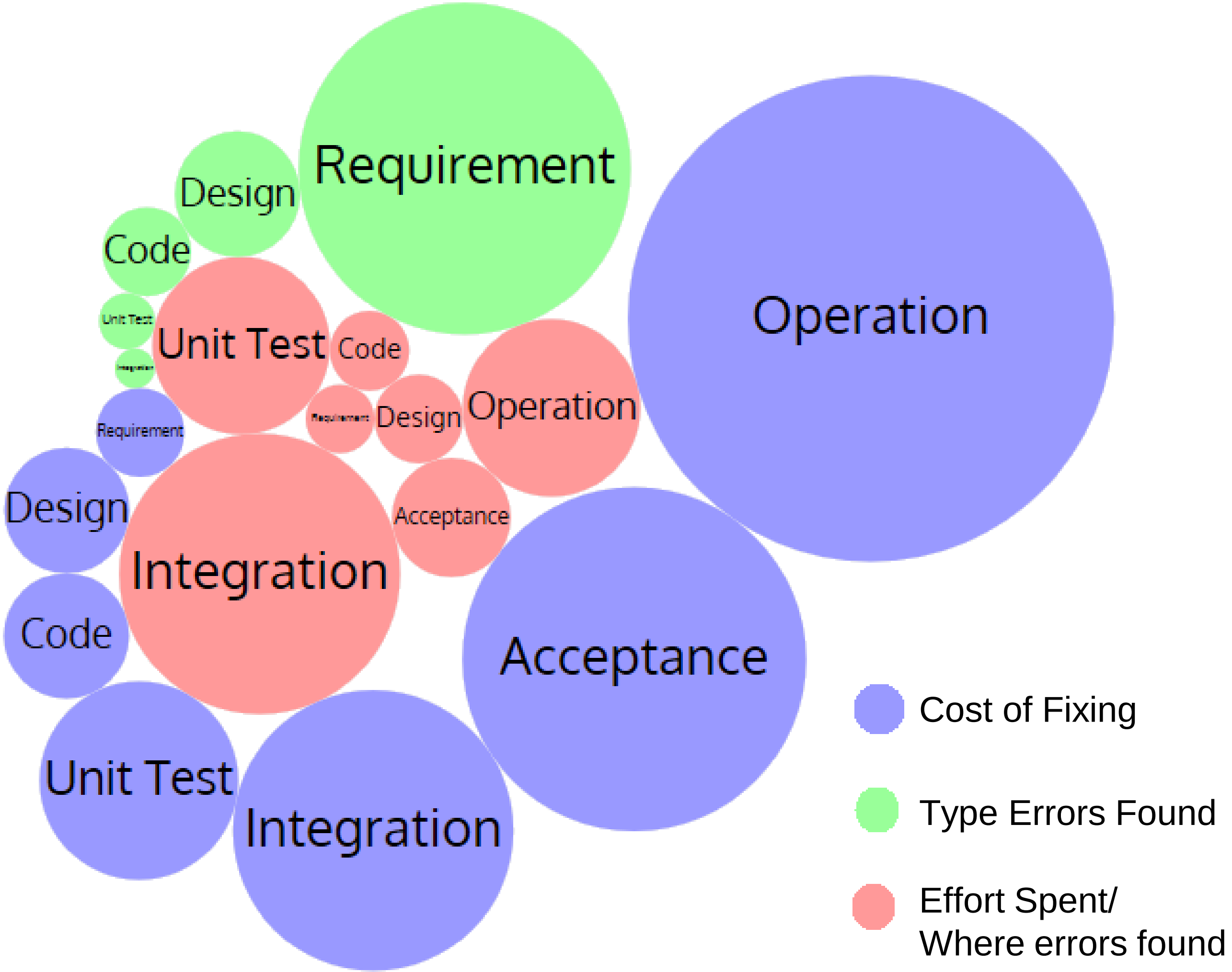
EFFORT DISTRIBUTION IN SYSTEM DEVELOPMENT



SYSTEM DEVELOPMENT V MODEL – WE SPEND TIME ON THE RIGHT SIDE

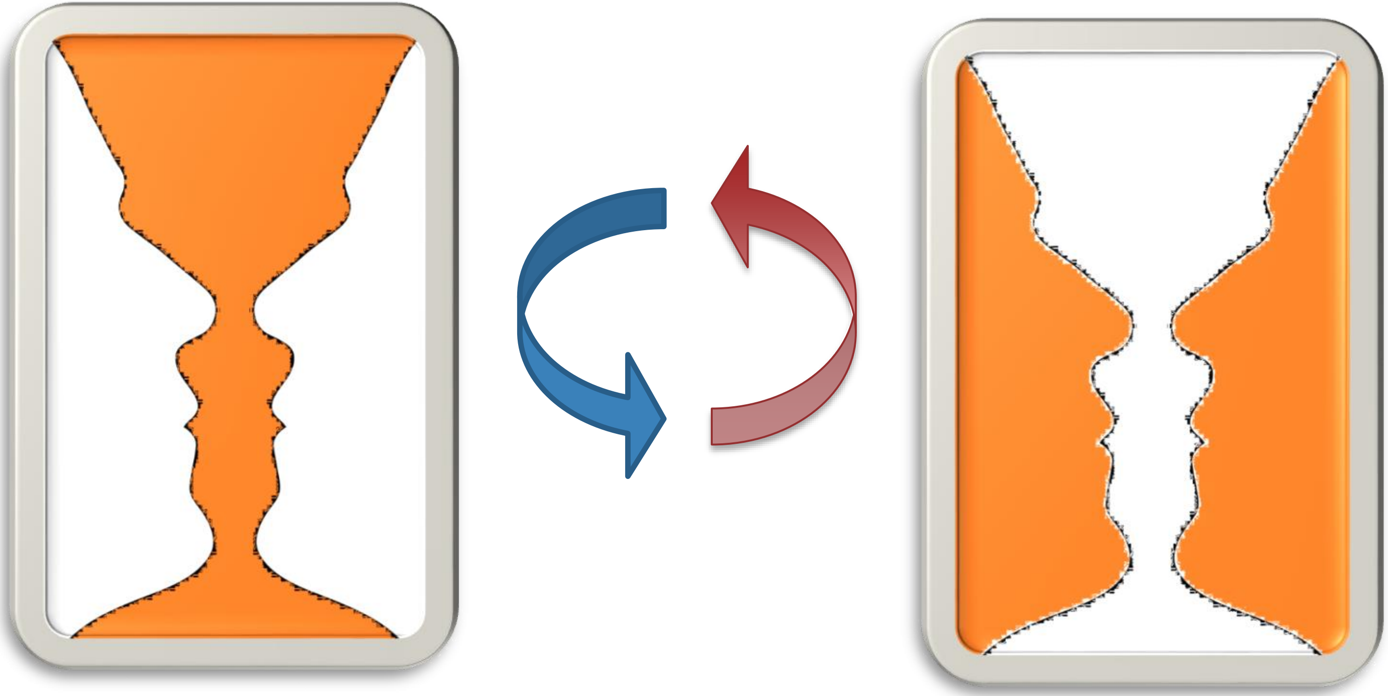


AN INTERESTING METRIC ON THE PROCESS TODAY



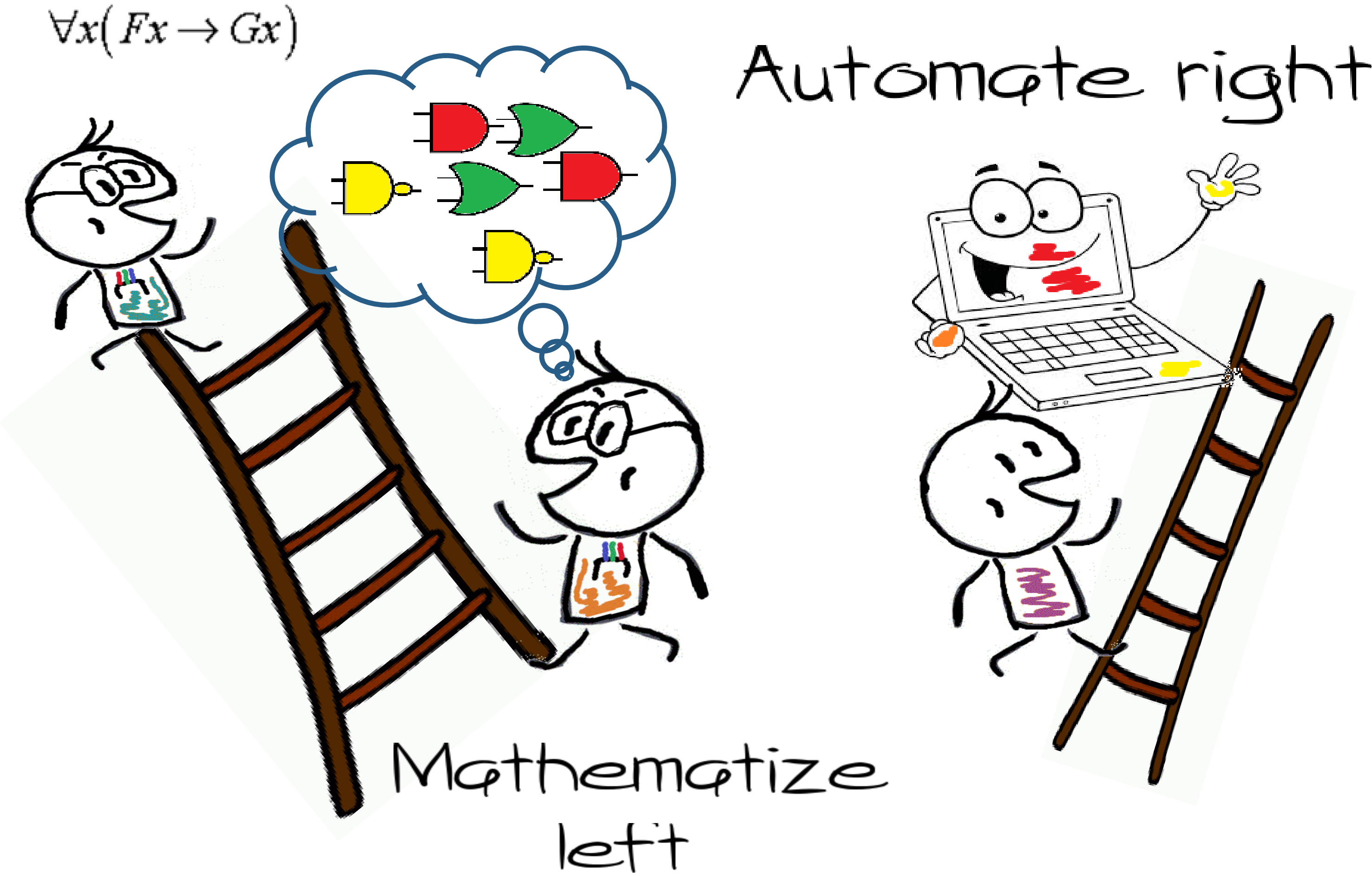
Paradigm Shift

WE REQUIRE A PARADIGM SHIFT !



MATHEMATIZE THE LEFT AND AUTOMATE THE RIGHT

– IS THE MANTRA



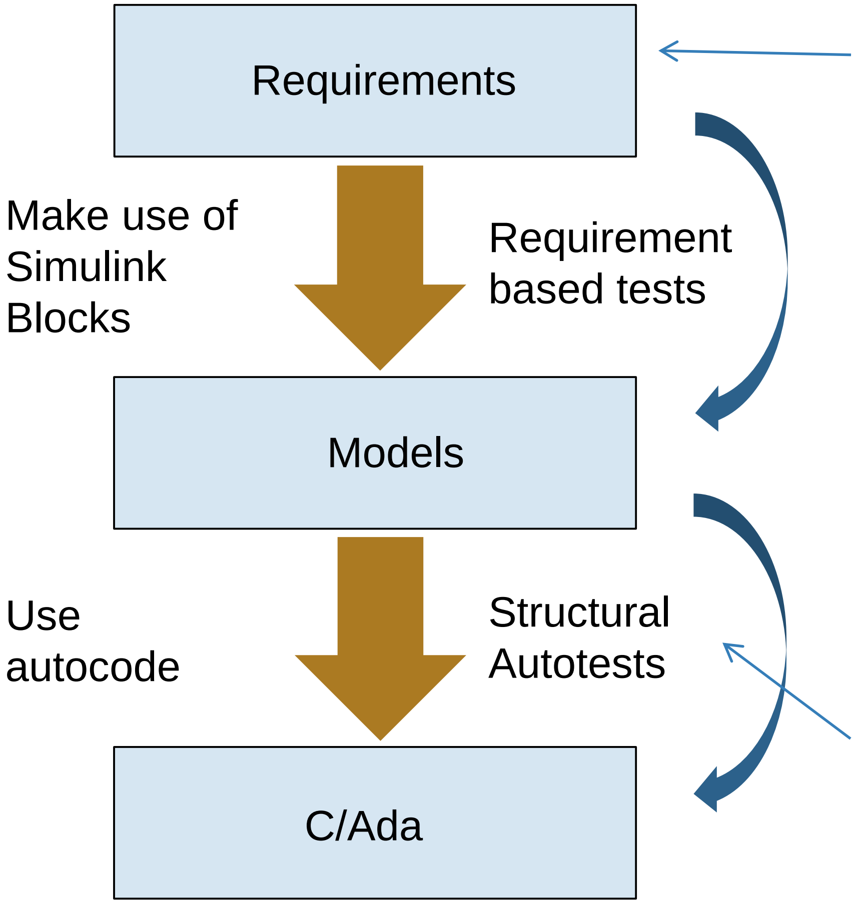
MATHEMATIZE THE LEFT

- Model based representation
- Property based requirements
- Formal proof of correctness of behavior
- Validated control system in the presence of noise, modeling inaccuracy, data ambiguity, faults

AUTOMATE THE RIGHT

- Model based testing
- Generate random test cases
- Generate test cases using Orthogonal arrays
- Generate test cases using formal methods
- Generate test cases from Mutants
- Always measure coverage

THIS IS WHAT WE DO TODAY



Requirements

Make use of Simulink Blocks

Requirement based tests

Models

Use autocode

Structural Autotests

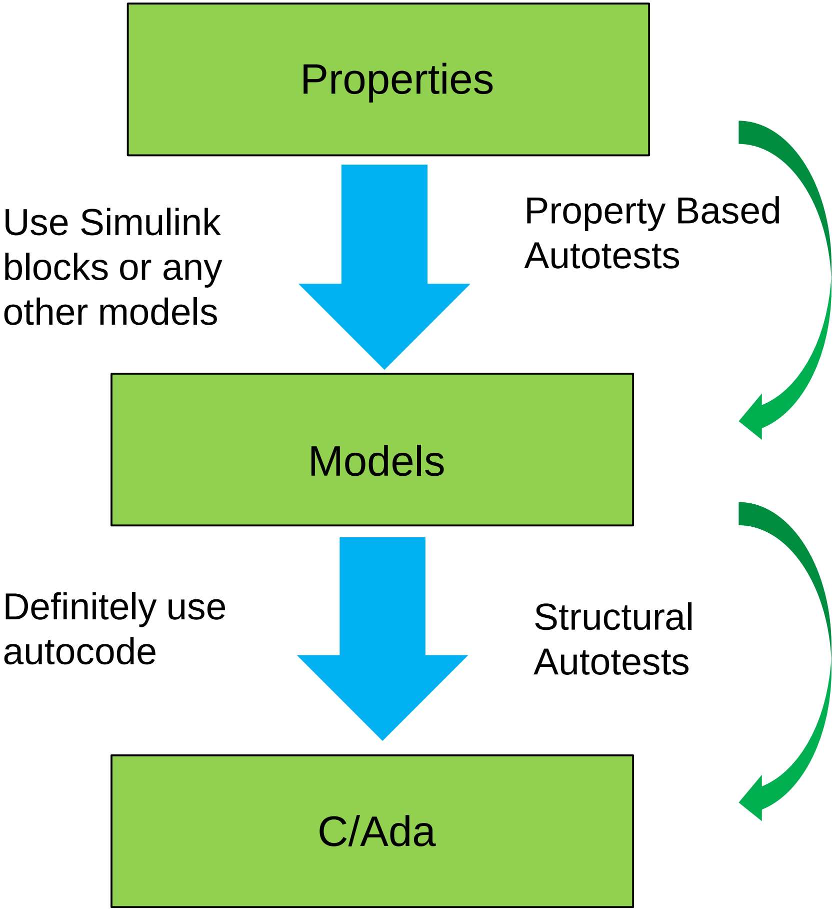
C/Ada

There is a big confusion here on how to write requirements!!

Remember: Models ARE NOT requirements!!

There is a little bit of test case automation here.

THIS IS WHAT WE NEED TO DO NOW



Properties

Use Simulink blocks or any other models

Property Based Autotests

Models

Definitely use autocode

Structural Autotests

C/Ada

Bring in Property Based Requirements

Bring in Property Based Testing

Continue with your automated testing

Thank you

Any questions?

You can find me at

- yvjeppu@gmail.com

Our system is only as good as the test cases we have designed to prove it correct