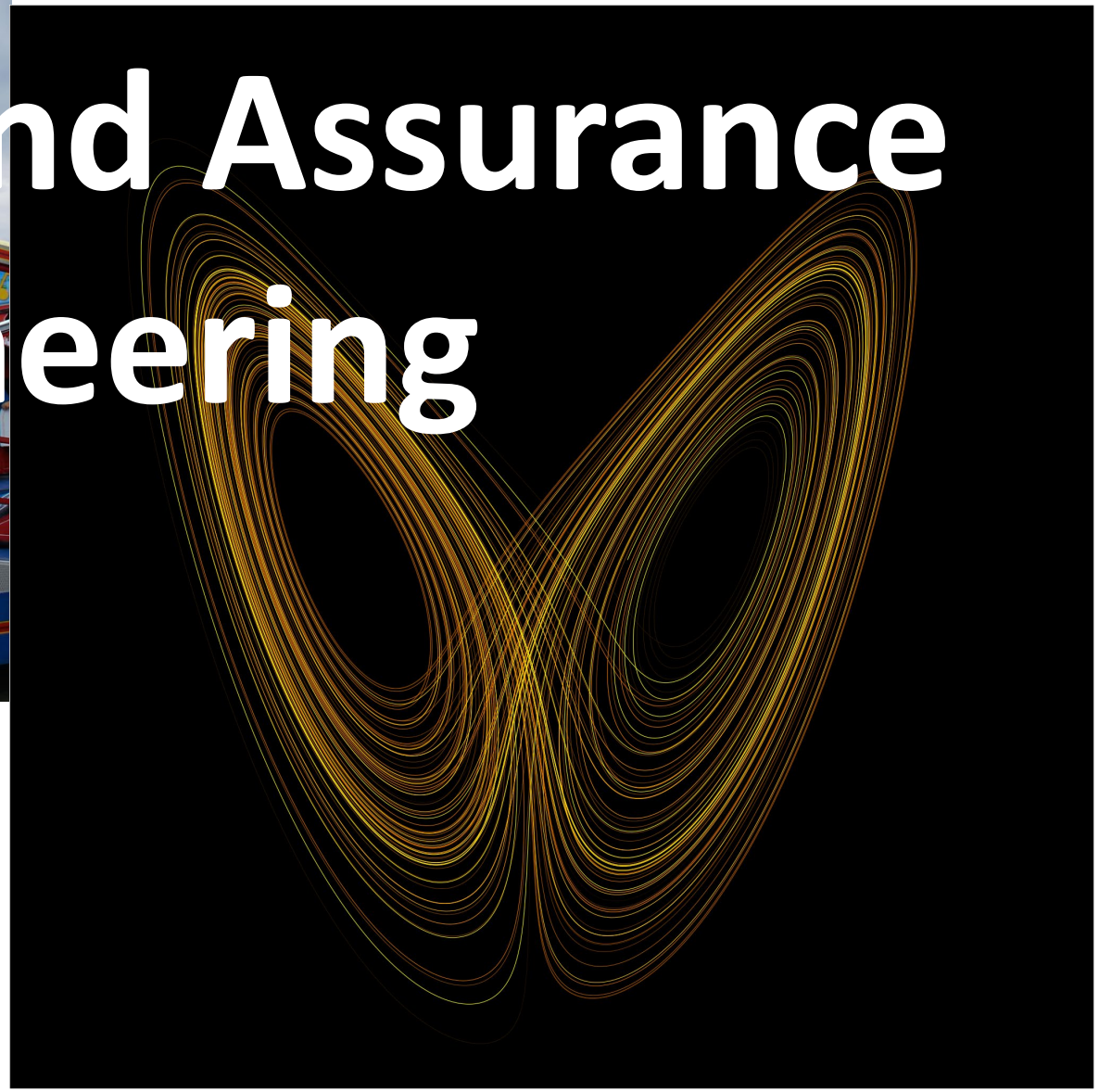
Modeling and Assurance Engineering



Ronnie Knight
Quality Engineering SME
Bastion Technologies

Presentation to Society of Reliability Engineers
1-2 November 2023

Modeling Marshall

BASTION TECHNOLOGIES

Who Is This guy? Who Let A QE In?

-Quality Engineering SME
-Several years in precision tooling
-QE (and QA) work on JWST mirrors
-External Tank QE for 15 SST Missions
-QE on SLS Core Stage
-QE in SLS SEI
-Initiated Quality Working Group
-And Cross Discipline Working Group
-Asked to implement MBMA
-Directorate Support:
Julie Bilbrey
-Built guitars several years
-Known to pick a song or two . . .

NEWS STAFF/B

Ronnie Knight inspects a segment of NASA's James Webb Space Telescope at Axsy
Technologies in Cullman. It is one of 18 mirrored segments that are made of Beryll
will become the primary mirrors on the telescope.

Cullman company work
on space telescope mirr

By KENT FAULK
News staff writer

A Cullman company takes another step this week on a project to help astronomers get a better grip on what happened near the dawn of time.

Axsys Technologies Precision Machined Prod-

up the process it will use to finely
ror segments.

Axsys is in various stages of pro
18 flight segments, the last of whi
for shipment to Tinsley in Januar
thing is going well. Overall the
schedule," Acreman said.

In the news . . .

. . . on the stage

Modeling Marshall: Conquering Complexity in SMA

BASTION TECHNOLOGIES

Agenda Highlights and One Ground Rule

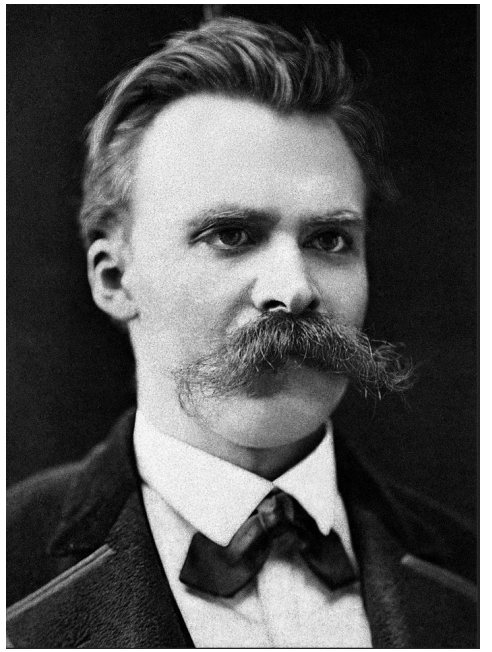
The Highlights:

Cave Art

Zombies

The Ground Rule:

Hecklers Welcome!



"Man's maturity – consists in having found again the seriousness one had as a child, at play." Nietzsche, Beyond Good and Evil, aphorism 94

MBMA: A Quick History

Question: Is MBSE just a "buzzword"?

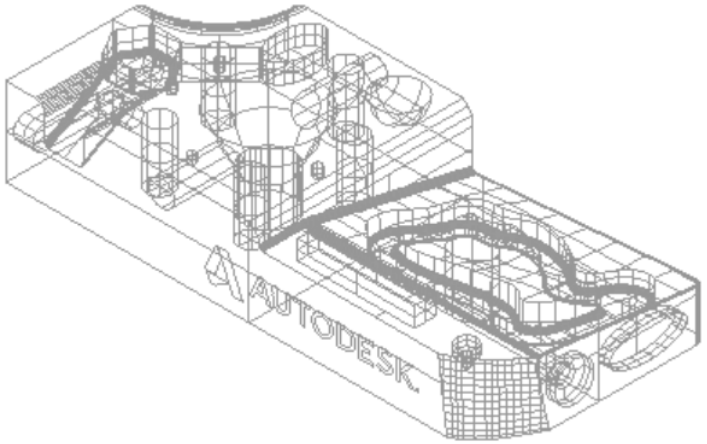
Short history of modeling in Engineering practice:

80s CAD/CAM and EE models (MBE) - Mechanical and Electrical

90s SW models – (SDLC) Logical

00s SE SysML (MBSE) - Complexity (STPA)

10s Safety/MA (MBMA) - Risk Control



MBMA: Development Stemming from 40 Years of Engineering Practice

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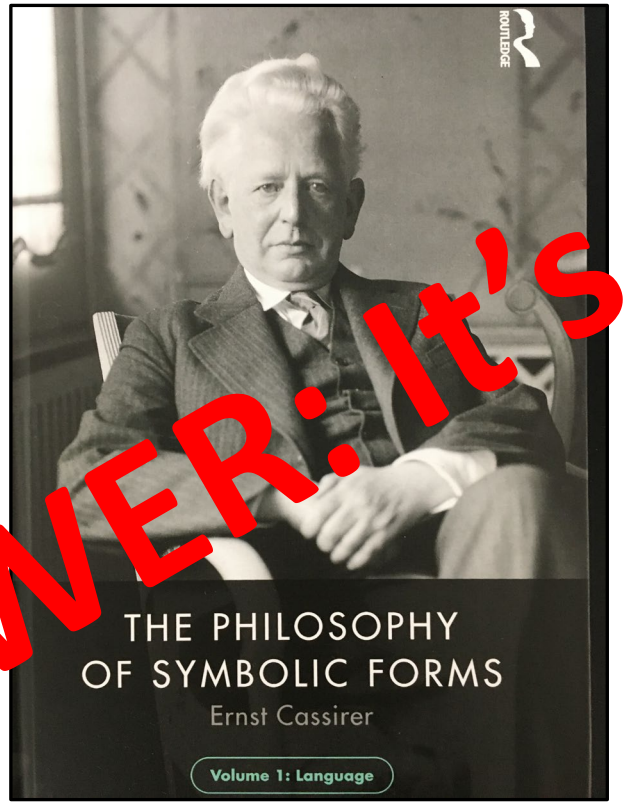
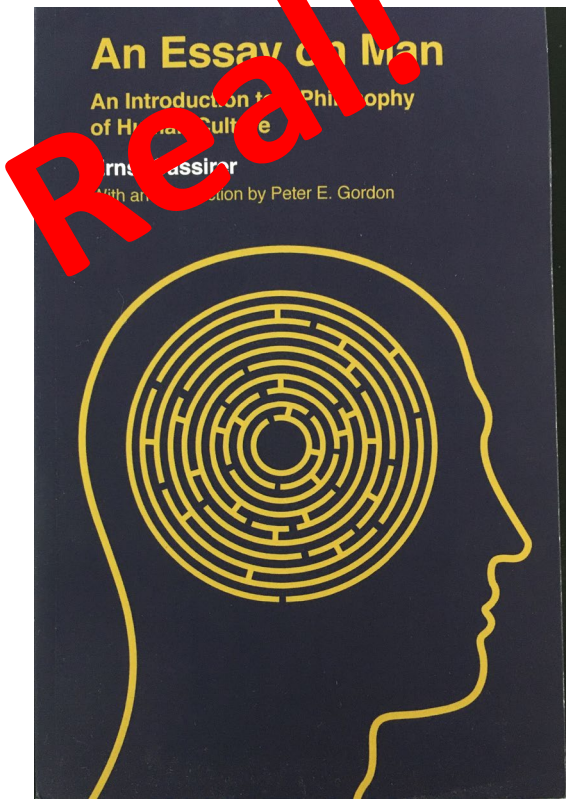
THE QUESTION OF THE DAY:
Modeling: Is It Just A "Buzzword" Or Is It Real?





ANSWER: It's Real!

A model is an abstraction of reality into a symbolic system.

It is, in a sense, the most real of all *Human* tools, activities.

"The facts of science always imply a theoretical, which means a symbolic, element." Cassirer

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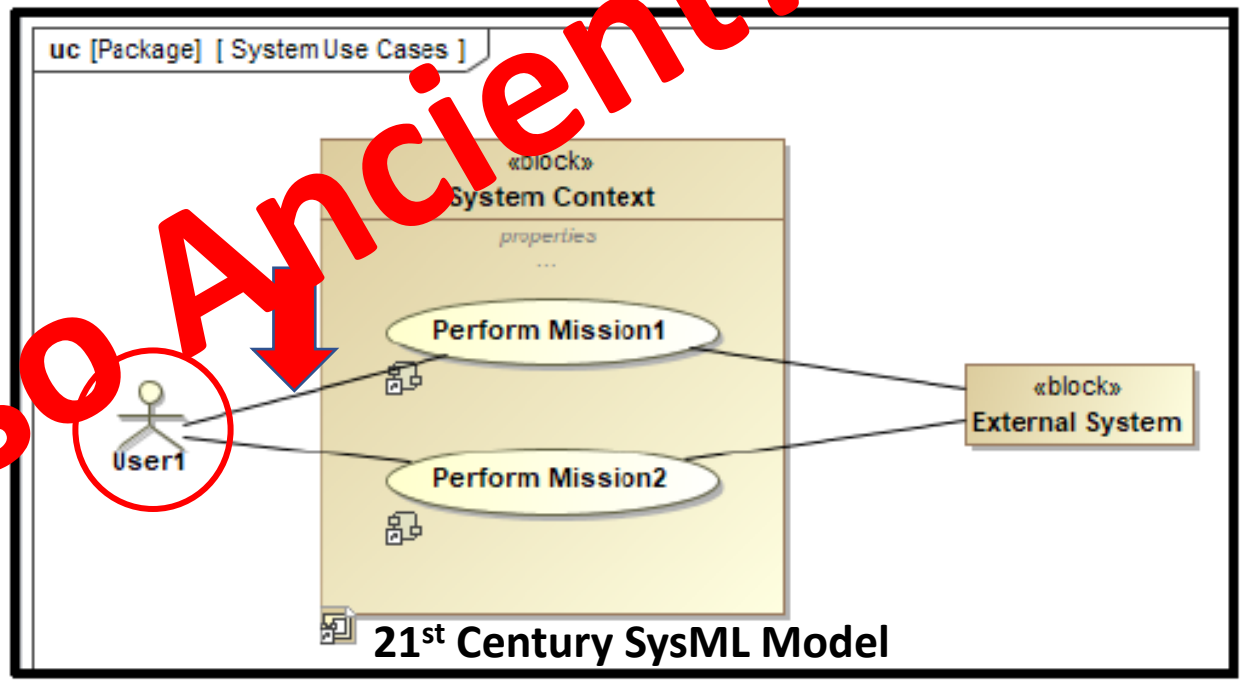
BASTION TECHNOLOGIES

Modeling: Similarities Ancient & Modern



NOTE: It's Also Ancient!

- Actors (Human Agency, Intent)

= Direction of Intent (Abstract "nesting" in SysML)

BASTION TECHNOLOGIES

Where Modeling Can Take Us

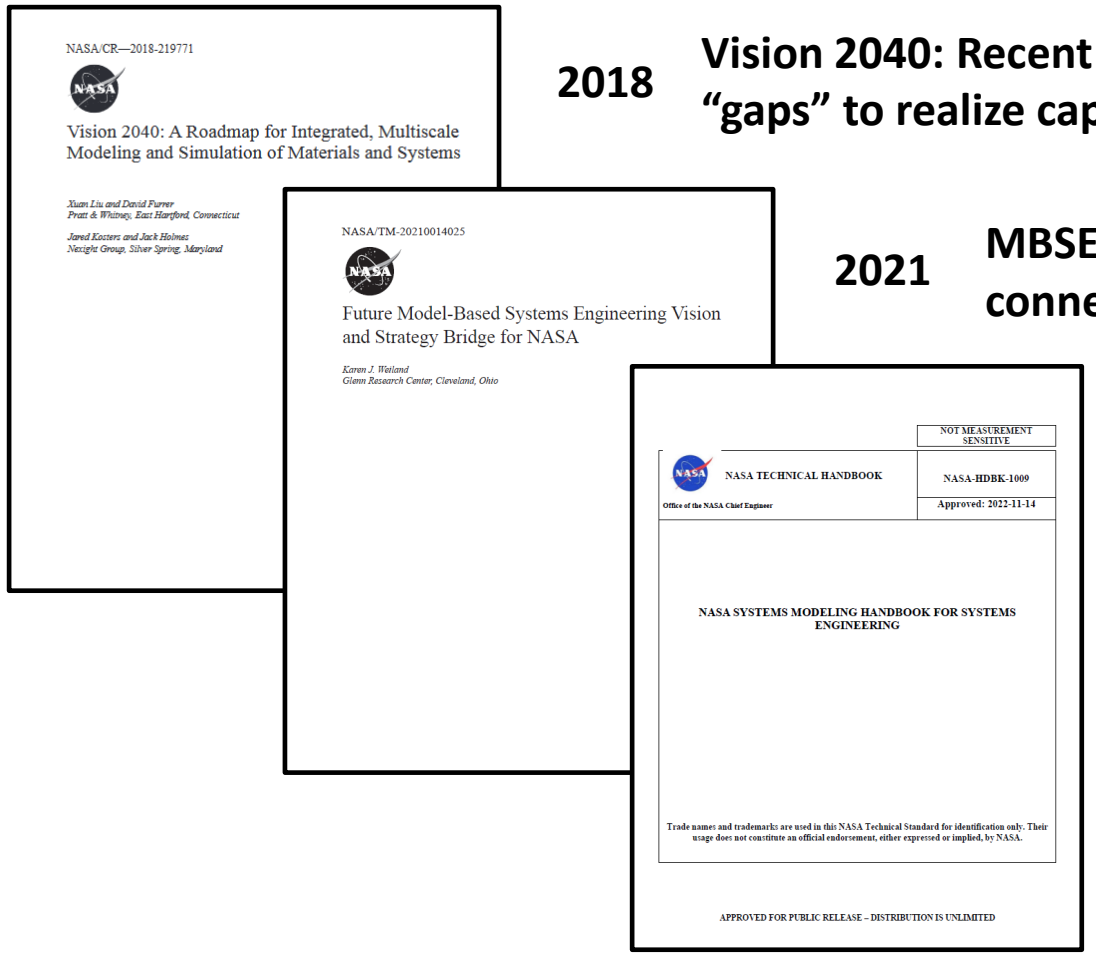
Dr. Scott Parazynski

‘“Unknown unknowns” are the concerning thing’
Dr. Scott Parazynski at 2023 MSFC Safety Day

SMA Knowledge of the Risks of Failure Space Entry

INCOSE Definitions
Data = facts with no context
Information = facts with context
Knowledge = patterns distilled from information
Wisdom = knowledge combined with experience

What Will It Take To Get Us There?



2018 **Vision 2040: Recent emphasis by NASA Administrators on filling tech "gaps" to realize capability goals for the next generation of engineers.**

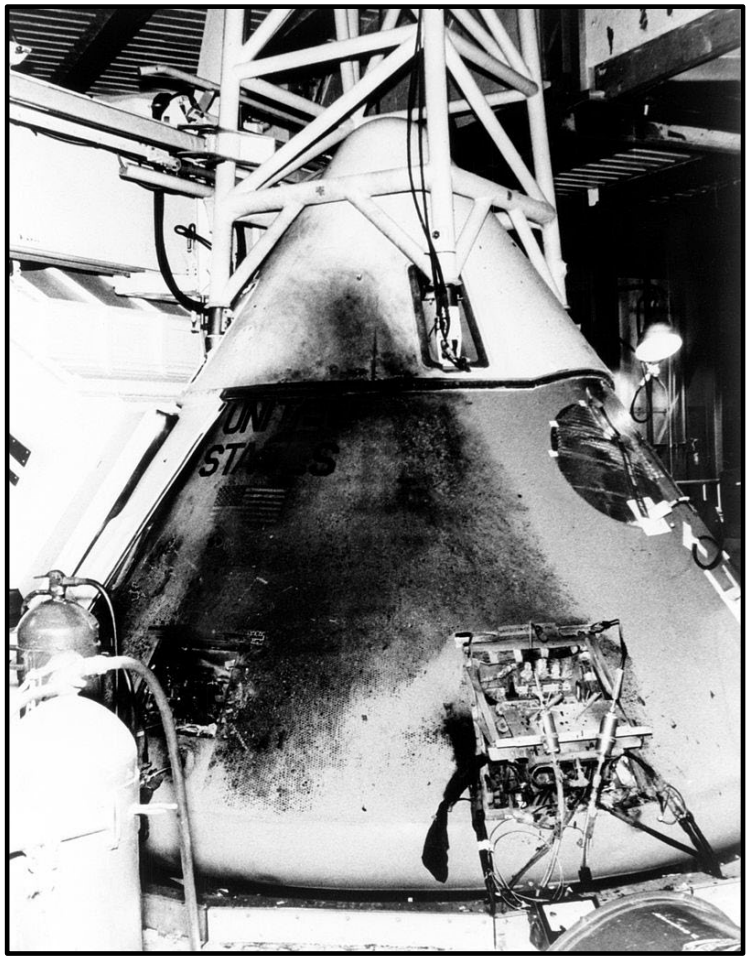
2021 **MBSE Vision For NASA: A nearer-term goal (2029) of connecting engineering domain "silos" via systems models.**

2022 **First Agency "guidance" document offered to system modelers in November 2022.**

So, what's the answer?
Leadership with vision (any level)
and . . .
"Perflexilience"
(persistent flexibility and resilience)

BASTION TECHNOLOGIES

What Is The Common Cause Of These Failures?



Modeling Marshall: Conquering Complexity in SMA

BASTION TECHNOLOGIES

“Dog Work” and Other Affairs of Plain Living

Dr. Steve Cornford has often remarked that the system model can do the “dog work” for us.

“Dog work” defined: the busy work trying to find things (data, requirements, design info, etc.), perform standard analyses (fault trees, FMEAs, FMECAs, Hazard Analyses, etc.) trace things (requirements to verifications), remember things, connect things.

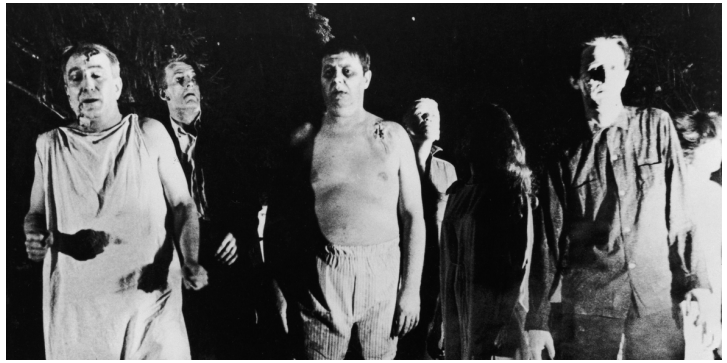
These system model capabilities give engineers more time to think, reason, collaborate and imagine.

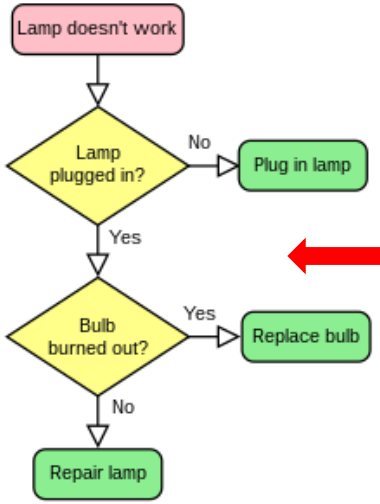
Modeling Marshall: Conquering Complexity in SMA

BASTION TECHNOLOGIES

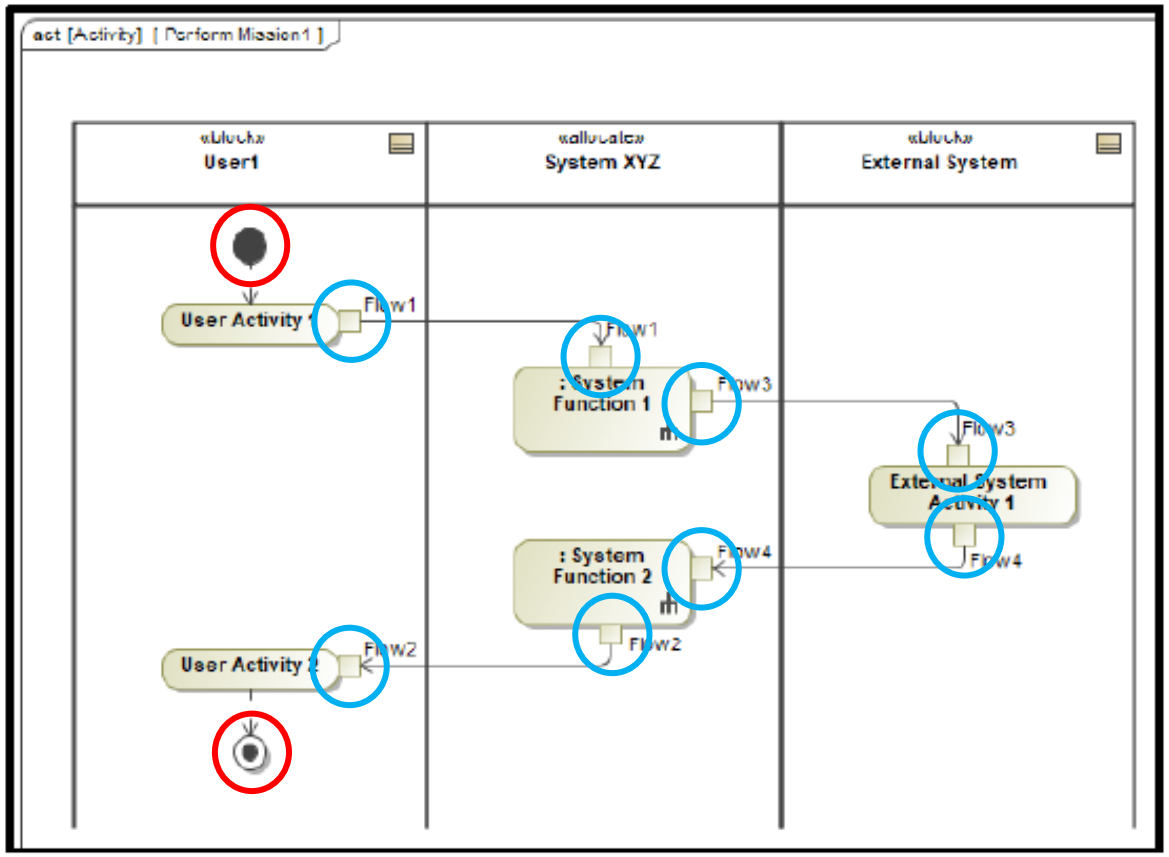
The Power of Models: In Connections/Relationships

The Goal: No Zombies!





Flow Charts are useful, but they are algorithms existing in only one dimension.



SysML Activity Diagram from NASA-HDBK-1009

The Power of Models: In Connections/Relationships

Why this question is important, taking requirements for the example:

-How do you account for requirement changes?

-How do you account for requirement deletions?

-What does it take to provide assurance for the requirements set?

#	Id	Name	Text	Refined By	Derived From	Verify Method	Verified By	Satisfied By
1	sys-1	System Requirement	The system shall....	System Function 1(contex			verif-1 Verification Requirement 1	System XYZ
2	subsys-2	Subsystem Requirement 2	The subsystem total mass shall.....	Subsytem Function 3(cont Subsystem Function 4(con	sys-1 System Requirement			/mtotal
3	subsys-1	Subsystem Requirement 1	The subsystem shall....	Subsystem Function 1(con Subsystem Function 2(con	sys-1 System Requirement		verif-3 Verification Requirement 3	Subsystem1
4	comp-4	Component Requirement 4	Component 4 shall....		subsys-2 Subsystem Requirement 2			
5	comp-3	Component Requirement 3	Component 3 total mass shall...		subsys-2 Subsystem Requirement 2			mtotal
6	comp-2	Component Requirement 2	Component 2 shall....	Component Function 2	subsys-1 Subsystem Requirement 1	Test		Component2
7	comp-1	Component Requirement 1	Component 1 shall generate x-Watts power.	Component Function 1	subsys-1 Subsystem Requirement 1	Analysis	verif-2 Verification Requirement 2	power value

Figure 22—System Requirements Table

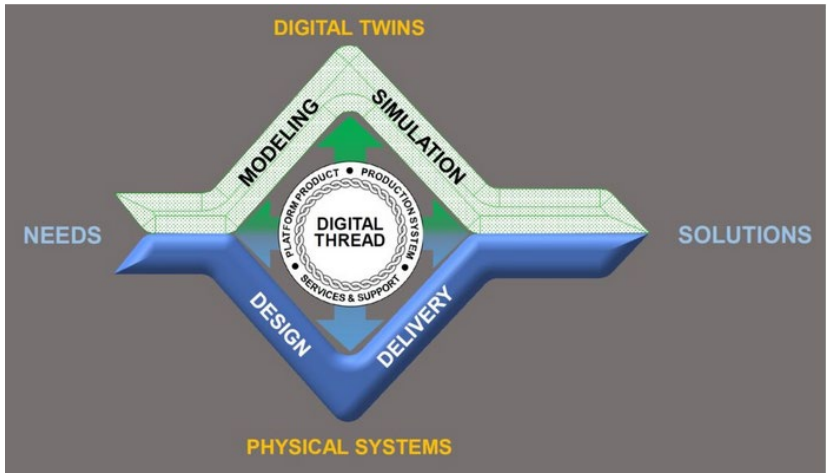
Table from NASA-HDBK-1009

Descriptive To Executable To “Digital Twin”

Descriptive: Aids understanding of a system and its environment. Currently modeling MSFC’s QMS in a descriptive modeling effort.

Executable: A model expressed sufficiently precisely “to be executed by an execution environment.” Friedenthal, et. al. A Practical Guide To System Modeling Language

Digital Twin: Varied definitions; be aware. “Twininess” levels up to real-time commanding.



Boeing “Diamond” vs System Engineering “V”

Assurance Engineers Will Need All, As Well As Methods For Each

Modeling Marshall: Conquering Complexity in SMA

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As Morris Day would say: Fini!

Open Floor for Hecklers!
Quick! Somebody Tell Me a Question!