

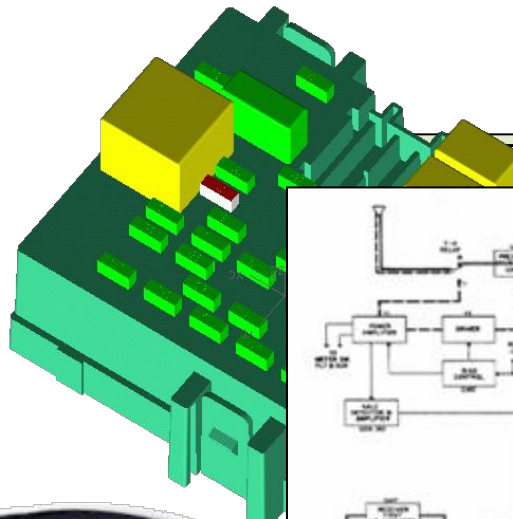
Realize LIVE

Advice from the front-lines: Systems Engineering your MBSE implementation

Moving from “Spec-Design-Build” to “Integrate-THEN-Build” development

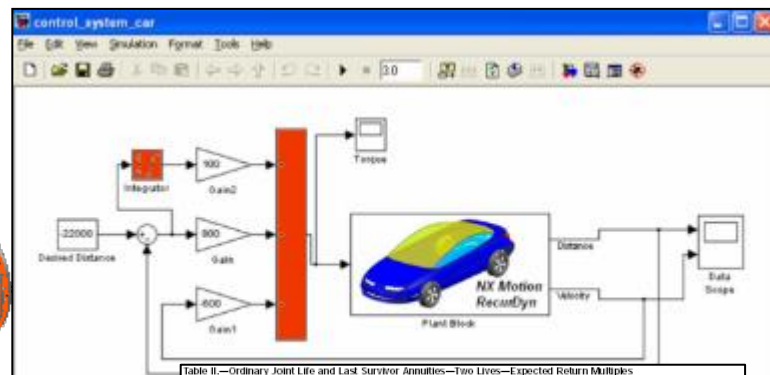
INCOSE Integrated MBSE Vision

What does the integrated digital thread look like...

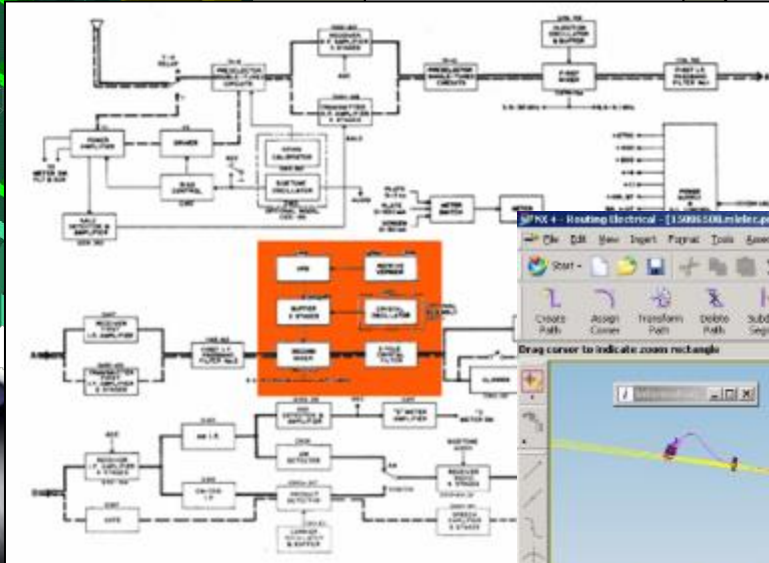


Rating:

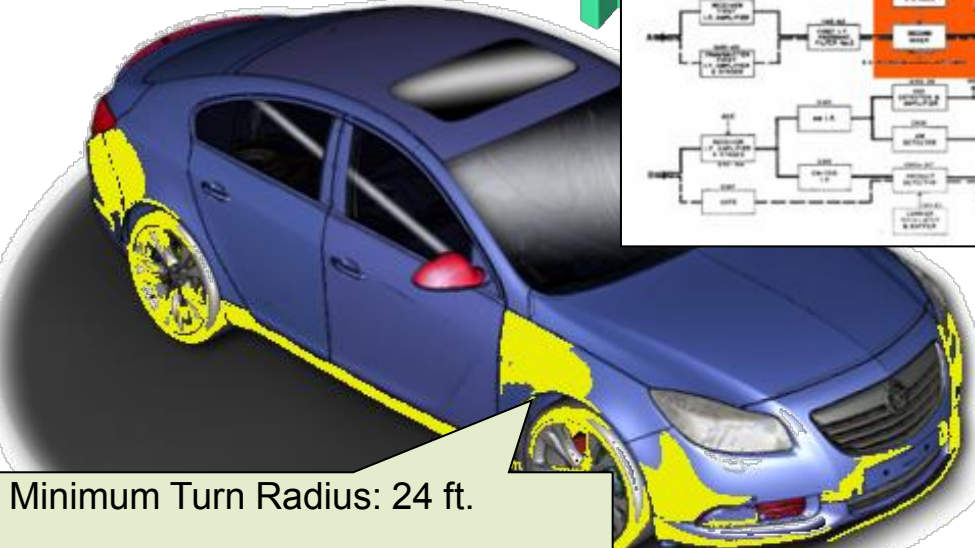
Hydraulic Fluid: SAE 1340 not-compliant



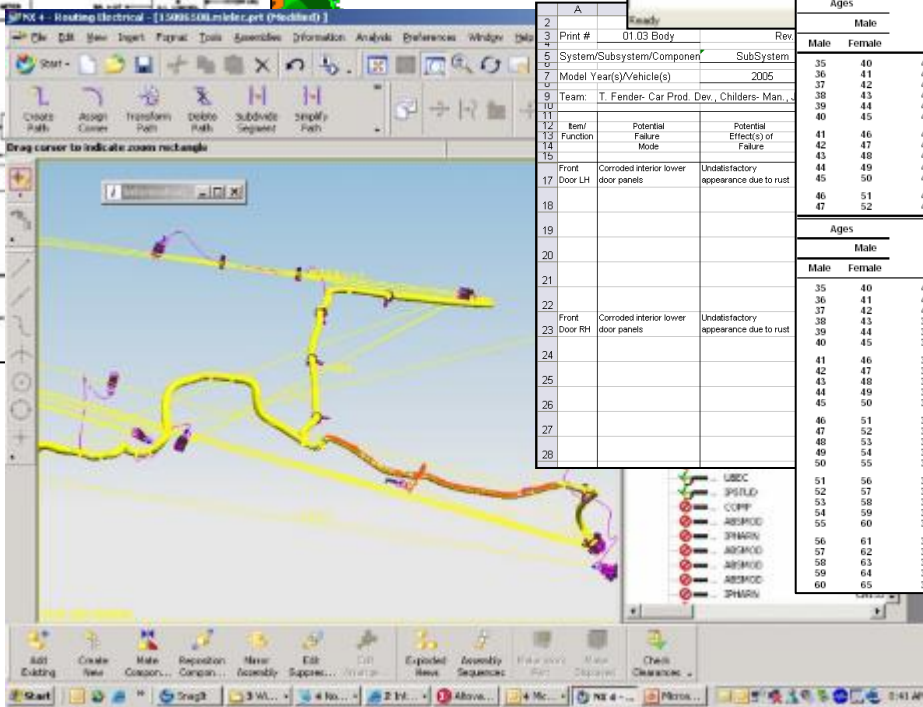
control_system_car



SPN 4 - Routing Electrical - [150005001.mdx] (Modified)



Minimum Turn Radius: 24 ft.
Automatic Dry Pavement Braking Distance at 60 MPH : ~~140~~ ft. 90 ft



Drag corner to indicate zoom rectangle

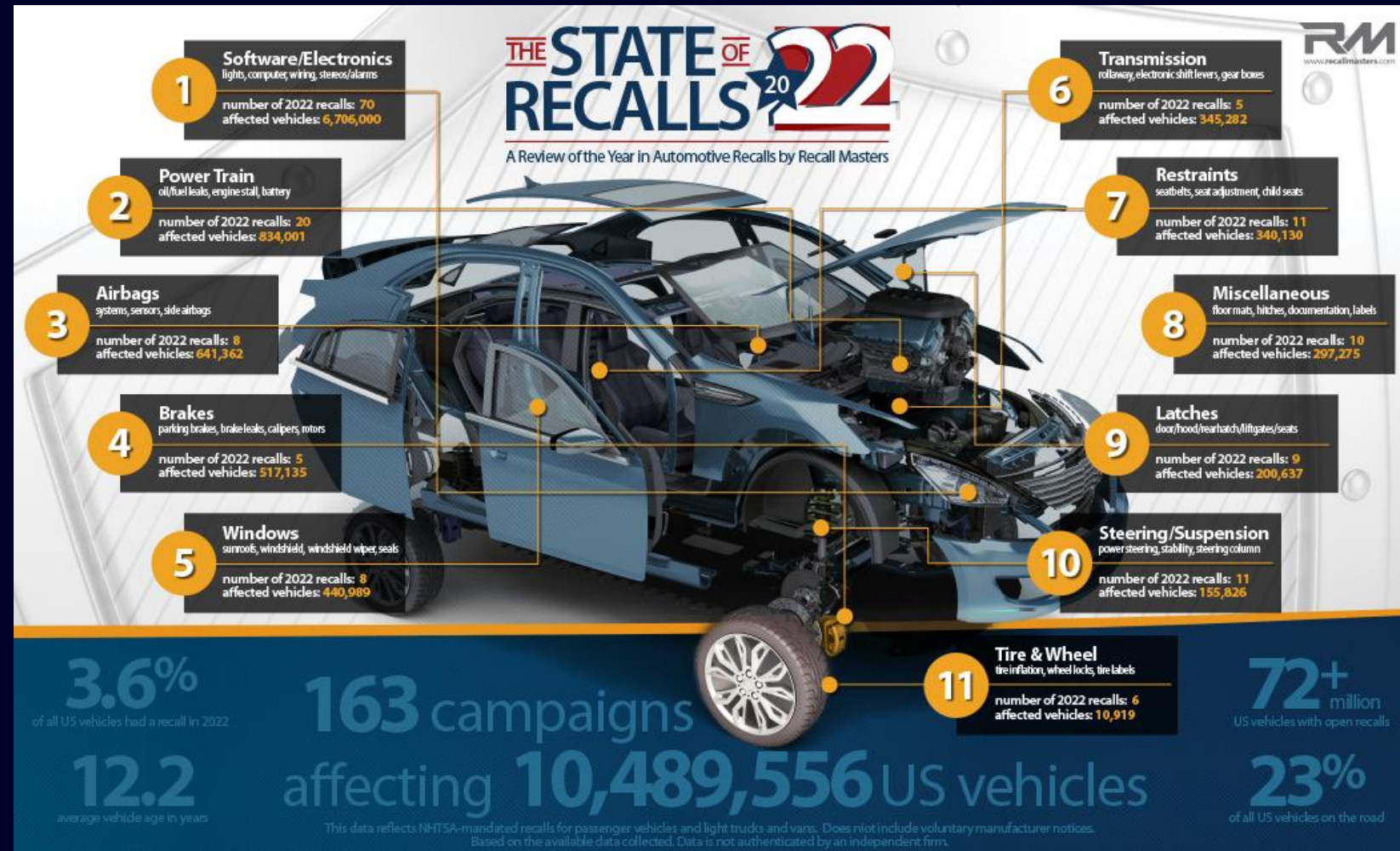
Ages		35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Male	Female	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
35	40	46.2	45.7	45.3	44.8	44.4	44.0	43.6	43.3	43.0	42.6	42.3	42.0	41.8	41.6	41.4	41.2	41.0	40.8
36	41	45.7	45.2	44.8	44.3	43.9	43.5	43.1	42.7	42.3	42.0	41.7	41.4	41.1	40.9	40.7	40.5	40.3	40.1
37	42	45.3	44.8	44.3	43.8	43.4	42.9	42.5	42.1	41.8	41.4	41.1	40.7	40.4	40.2	40.0	39.8	39.6	39.4
38	43	44.8	44.3	43.8	43.3	42.9	42.4	42.0	41.6	41.2	40.8	40.5	40.1	39.8	39.6	39.4	39.2	39.0	38.8
39	44	44.4	43.9	43.4	42.9	42.4	41.9	41.5	41.0	40.6	40.2	39.9	39.5	39.2	39.0	38.8	38.6	38.4	38.2
40	45	44.0	43.5	42.9	42.4	41.9	41.4	41.0	40.5	40.1	39.7	39.3	38.9	38.6	38.4	38.2	38.0	37.8	37.6
41	46	43.6	43.1	42.5	42.0	41.5	41.0	40.5	40.0	39.6	39.2	38.8	38.4	38.0	37.8	37.6	37.4	37.2	37.0
42	47	43.3	42.7	42.1	41.6	41.0	40.5	40.0	39.6	39.1	38.7	38.2	37.8	37.5	37.3	37.1	36.9	36.7	36.5
43	48	43.0	42.3	41.8	41.2	40.6	40.1	39.6	39.1	38.6	38.2	37.7	37.2	36.8	36.4	36.3	36.1	35.9	35.7
44	49	42.6	42.0	41.4	40.8	40.2	39.7	39.2	38.7	38.2	37.7	37.2	36.8	36.4	36.3	36.1	35.9	35.7	35.5
45	50	42.3	41.7	41.1	40.5	39.9	39.3	38.8	38.2	37.7	37.2	36.8	36.3	35.9	35.8	35.6	35.4	35.2	35.0
46	51	42.0	41.4	40.7	40.1	39.5	38.9	38.4	37.8	37.3	36.8	36.3	35.9	35.4	35.3	35.1	34.9	34.7	34.5
47	52	41.8	41.1	40.4	39.8	39.2	38.6	38.0	37.5	36.9	36.4	35.9	35.4	35.0	34.9	34.7	34.5	34.3	34.1

Ages		48	49	50	51	52	53	54	55	56	57	58	59	60
Male	Female	53	54	55	56	57	58	59	60	61	62	63	64	65
35	40	41.5	41.3	41.0	40.8	40.6	40.4	40.3	40.1	40.0	39.8	39.7	39.6	39.5
36	41	40.8	40.6	40.3	40.1	39.9	39.7	39.5	39.3	39.2	39.0	38.9	38.8	38.6
37	42	40.2	39.9	39.6	39.4	39.2	39.0	38.8	38.6	38.4	38.3	38.1	38.0	37.9
38	43	39.5	39.2	38.9	38.7	38.5	38.3	38.1	37.9	37.7	37.5	37.3	37.2	37.1
39	44	38.9	38.6	38.3	38.0	37.8	37.6	37.3	37.1	36.9	36.8	36.6	36.4	36.3
40	45	38.3	38.0	37.7	37.4	37.1	36.9	36.6	36.4	36.2	36.0	35.9	35.7	35.5
41	46	37.7	37.3	37.0	36.7	36.5	36.2	36.0	35.7	35.5	35.3	35.1	35.0	34.8
42	47	37.1	36.8	36.4	36.1	35.8	35.5	35.2	34.9	34.7	34.4	34.2	34.0	33.8
43	48	36.5	36.2	35.8	35.5	35.2	34.9	34.7	34.4	34.2	33.9	33.7	33.5	33.3
44	49	36.0	35.6	35.3	34.9	34.6	34.3	34.0	33.8	33.5	33.3	33.0	32.8	32.6
45	50	35.5	35.1	34.7	34.4	34.0	33.7	33.4	33.1	32.9	32.6	32.4	32.2	31.9
46	51	35.0	34.6	34.2	33.8	33.5	33.1	32.8	32.5	32.2	32.0	31.7	31.5	31.3
47	52	34.5	34.1	33.7	33.3	32.9	32.6	32.2	31.9	31.6	31.4	31.1	30.9	30.6
48	53	34.0	33.6	33.2	32.8	32.4	32.0	31.7	31.4	31.1	30.8	30.5	30.2	30.0
49	54	33.6	33.1	32.7	32.3	31.9	31.5	31.2	30.8	30.5	30.2	29.9	29.6	29.4
50	55	33.2	32.7	32.3	31.8	31.4	31.0	30.6	30.3	29.9	29.6	29.3	29.0	28.8
51	56	32.8	32.3	31.8	31.4	30.9	30.5	30.1	29.8	29.4	29.1	28.8	28.5	28.2
52	57	32.4	31.9	31.4	30.9	30.5	30.1	29.7	29.3	28.9	28.6	28.2	27.9	27.6
53	58	32.0	31.5	31.0	30.5	30.1	29.6	29.2	28.8	28.4	28.1	27.7	27.4	27.1
54	59	31.7	31.2	30.6	30.1	29.7	29.2	28.8	28.3	27.9	27.6	27.2	26.9	26.5
55	60	31.4	30.8	30.3	29.8	29.3	28.8	28.3	27.9	27.5	27.1	26.7	26.4	26.0
56	61	31.1	30.5	29.9	29.4	28.9	28.4	27.9	27.5	27.1	26.7	26.3	25.9	25.5
57	62	30.8	30.2	29.6	29.1	28.6	28.1	27.6	27.1	26.7	26.2	25.8	25.4	25.1
58	63	30.5	29.9	29.3	28.8	28.2	27.7	27.2	26.7	26.3	25.8	25.4	25.0	24.6
59	64	30.2	29.6	29.0	28.5	27.9	27.4	26.9	26.4	25.9	25.4	25.0	24.6	24.2
60	65	30.0	29.4	28.8	28.2	27.6	27.1	26.5	26.0	25.5	25.1	24.6	24.2	23.8

Growing complexity in automotive...

- ~35 million automotive recalls in the US last year
- Per AlixPartners*, each recall costs ~\$500/vehicle, that's \$17.5 billion in direct costs fixing the problems in 2023
- Auto Manufacturers carrying ~\$113B in warranty reserves** (2.5% of revenue) on their books

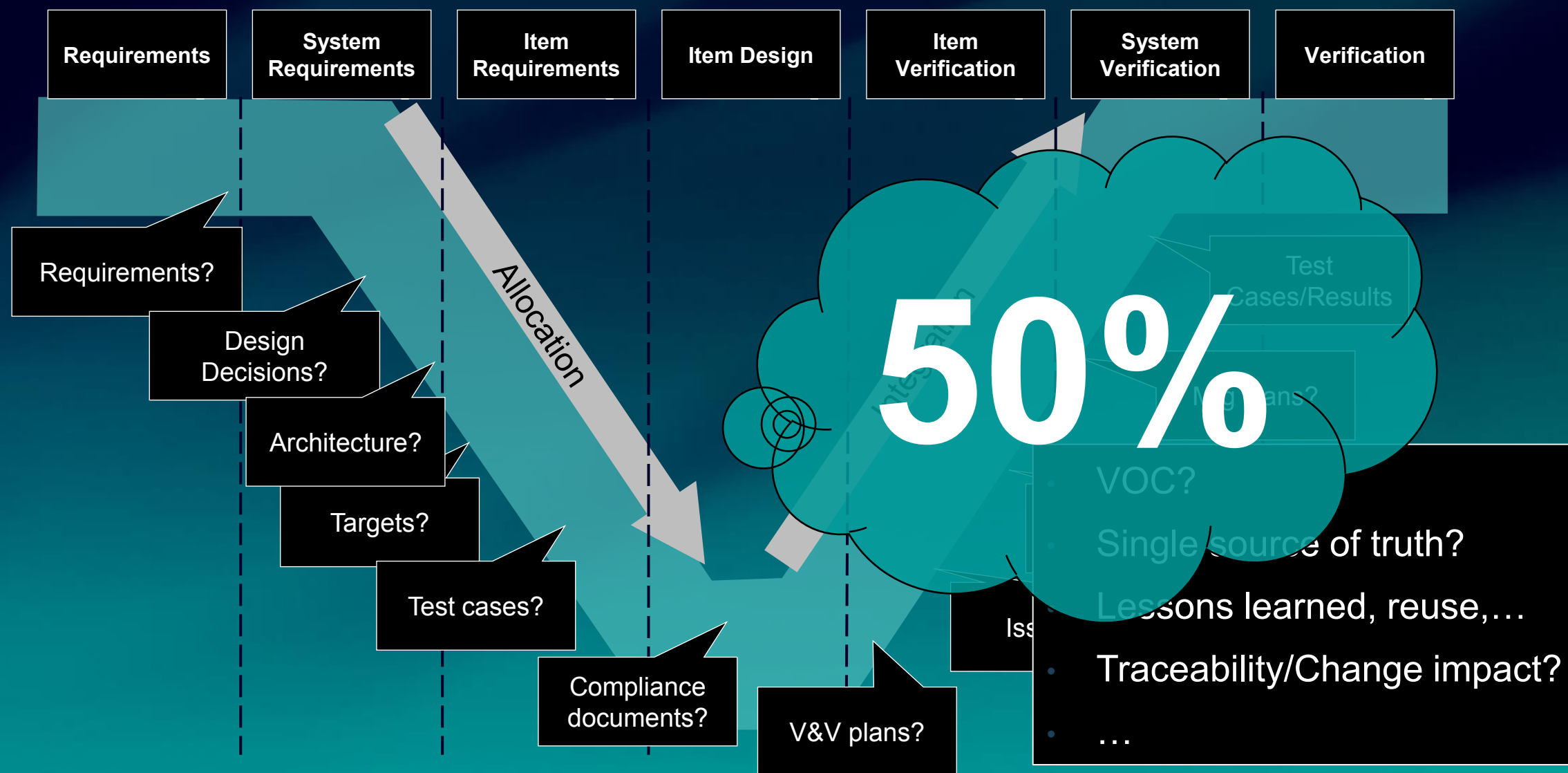
...mostly due to cross organization/interdisciplinary communication issues



* http://lite.cnn.com/en/article/h_a9a78e0bc97dc033569b8b2fefe63d47

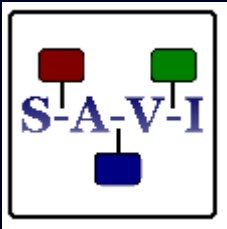
** <https://www.warrantyweek.com/archive/ww20200910.html>

The result of a siloed product development process...
Mel Conway was right *

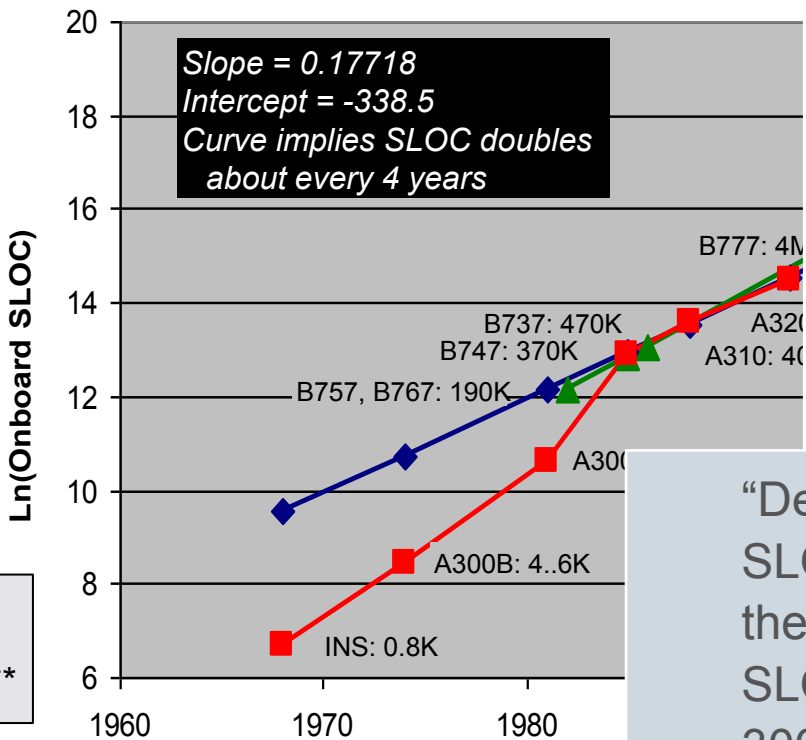


Unprecedented Product Complexity: becoming unaffordable...

Norm was right (Augustine's Law #16)*

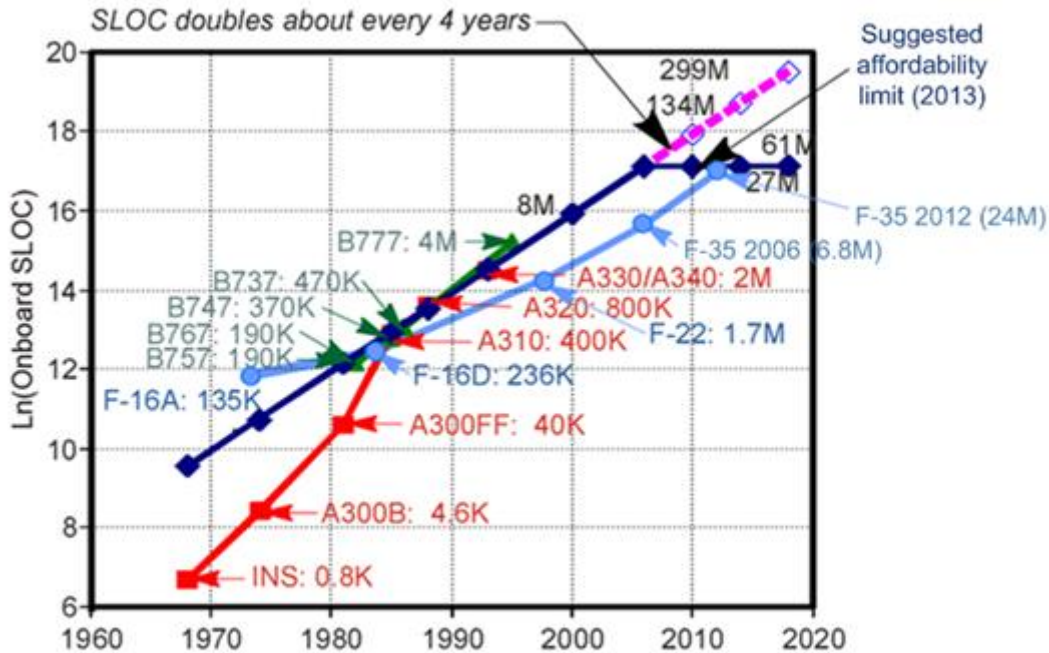


Estimated Onboard SLOC



“Integrate, then build”
AVSI**

One measure of system complexity ...



“Development effort, which increases exponentially with SLOC, is increasing at an alarming rate. For example, the F35 has approximately 175 times the number of SLOC as the F16. But, it is estimated to have required 300 times the development effort”

<https://savi.avsi.aero/about-savi/>

source: <http://savi.avsi.aero/>

[*https://en.wikipedia.org/wiki/Augustine's_laws](https://en.wikipedia.org/wiki/Augustine's_laws)

**avsi.aero

Result of late cycle integration discoveries... *Mitsubishi SpaceJet Program canceled*

- After years of delays, Mitsubishi Heavy Industries admits building Japan's first homegrown passenger jet was too difficult and probably not viable (Feb. 8, 2023)
- \$7.6B is written off on failed program

“Some test flights were aborted because of air conditioning defects and other software problems, and the delays meant revisions to the original design were required”

The Guardian

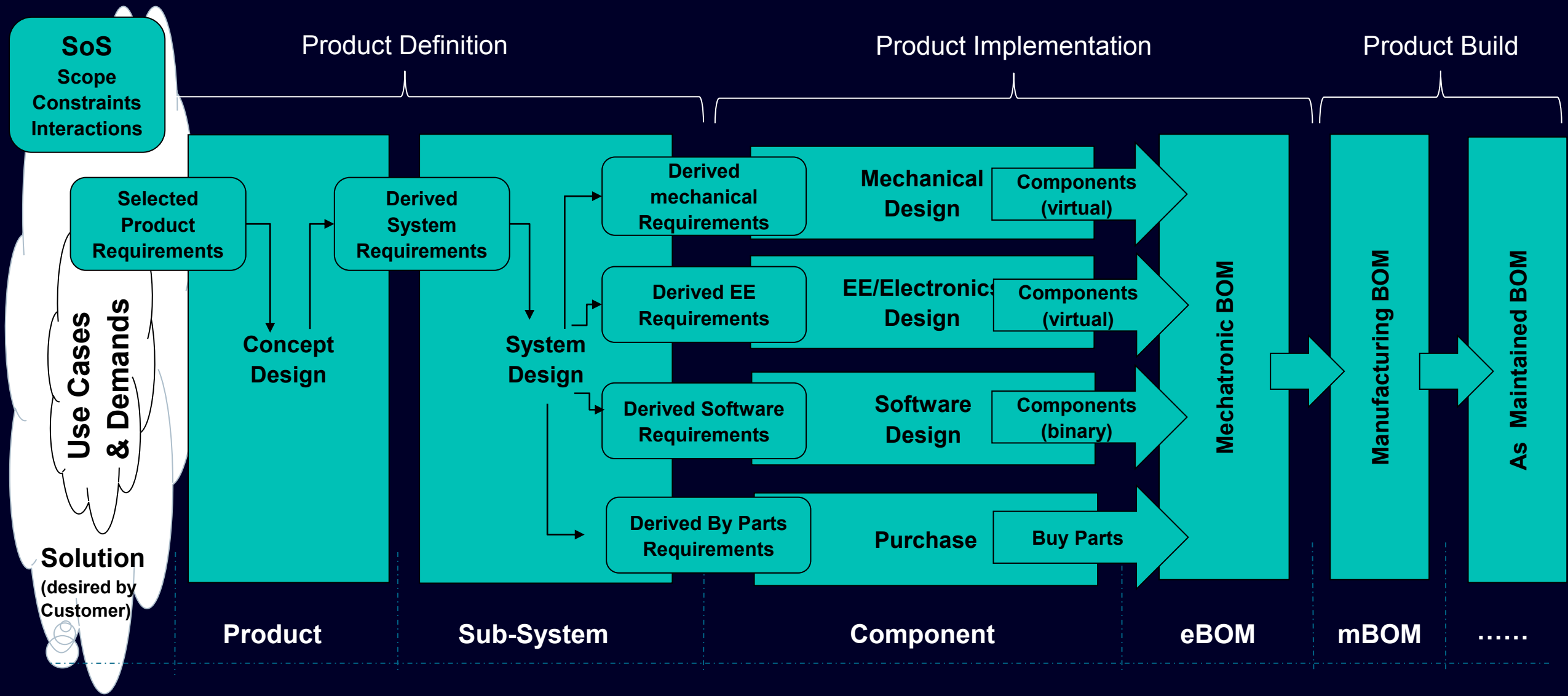


A Mitsubishi SpaceJet takes off during a test flight from Nagoya, central Japan, in March 2020. Photograph: 164811+0900/AP

<https://www.theguardian.com/world/2023/feb/08/japan-cancels-mitsubishi-spacejet-grounding-dream-of-homegrown-airliner>

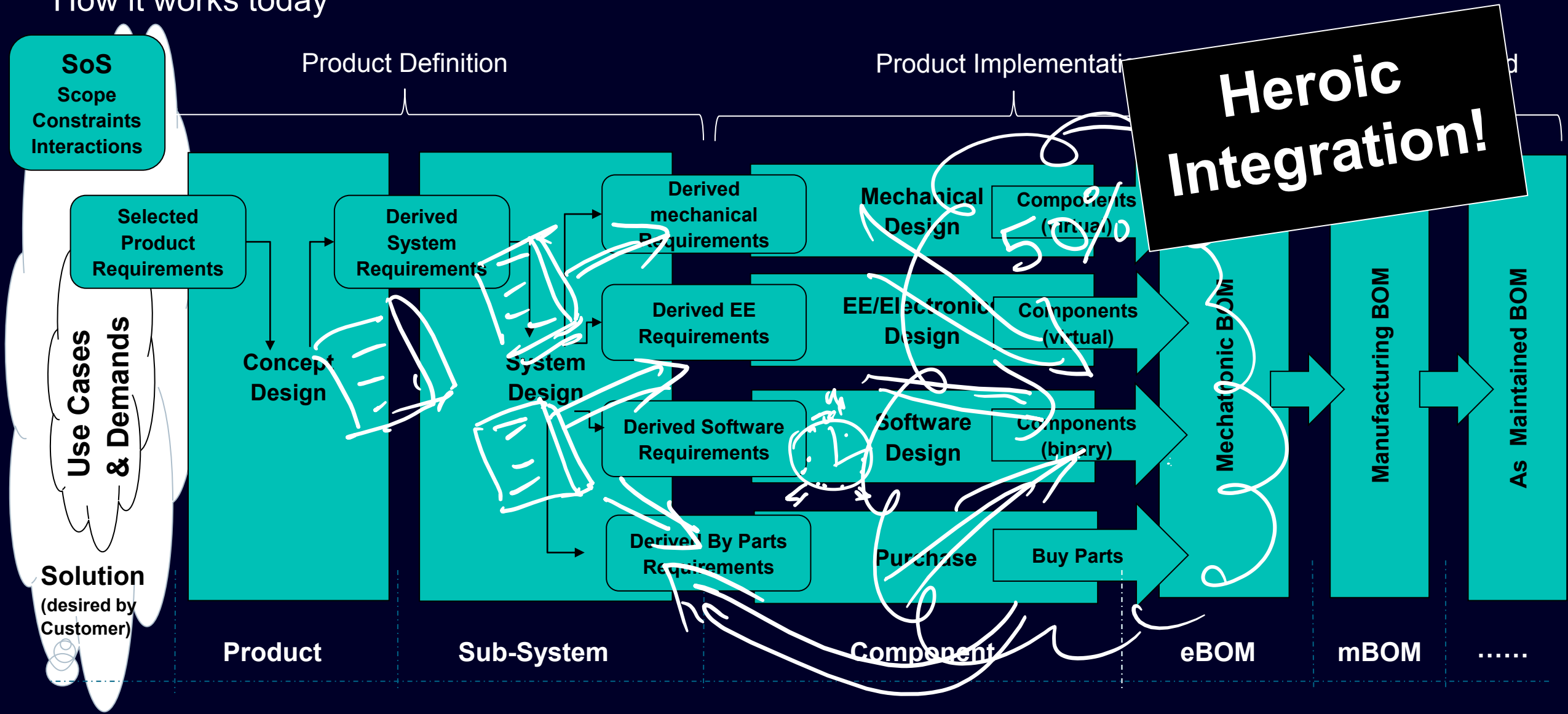
Systems Engineering Process...

Shifting left...



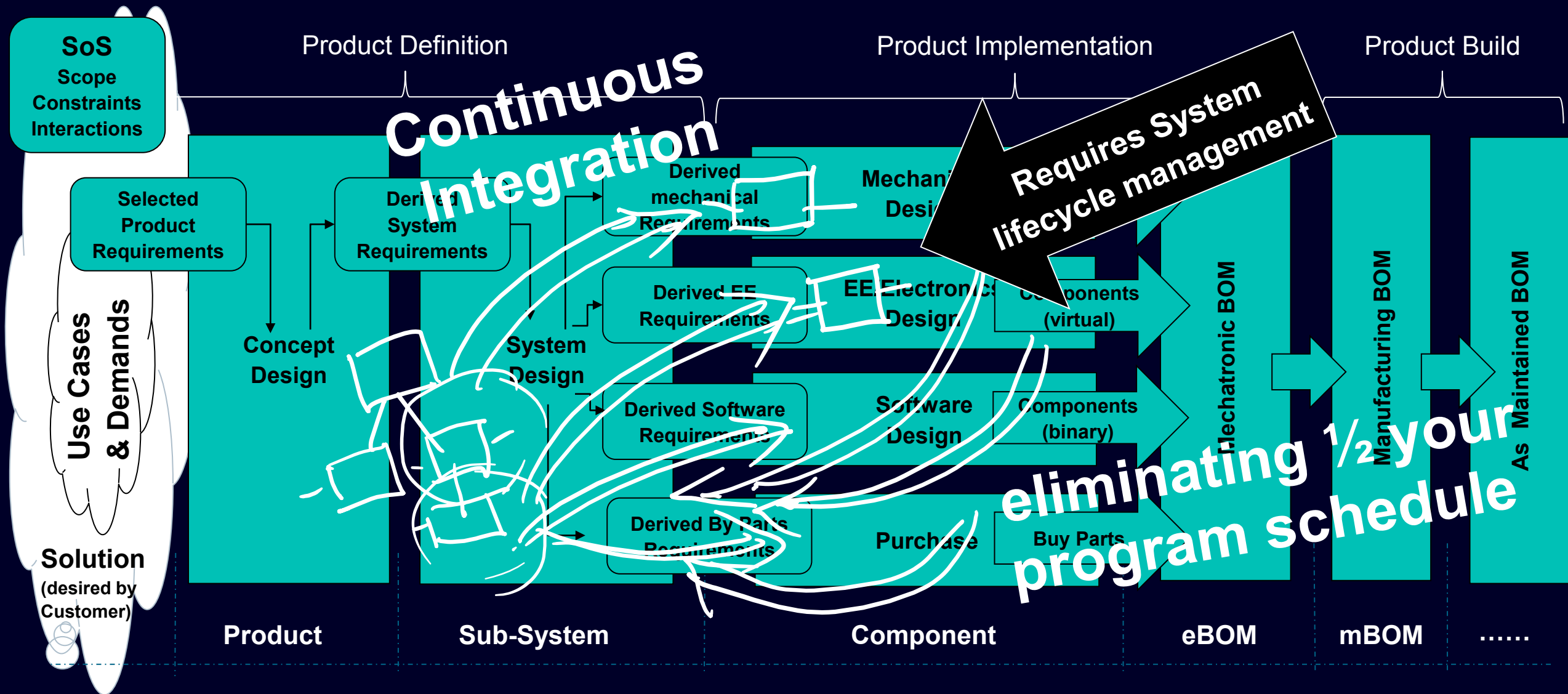
Integrated MBSE Process...

How it works today

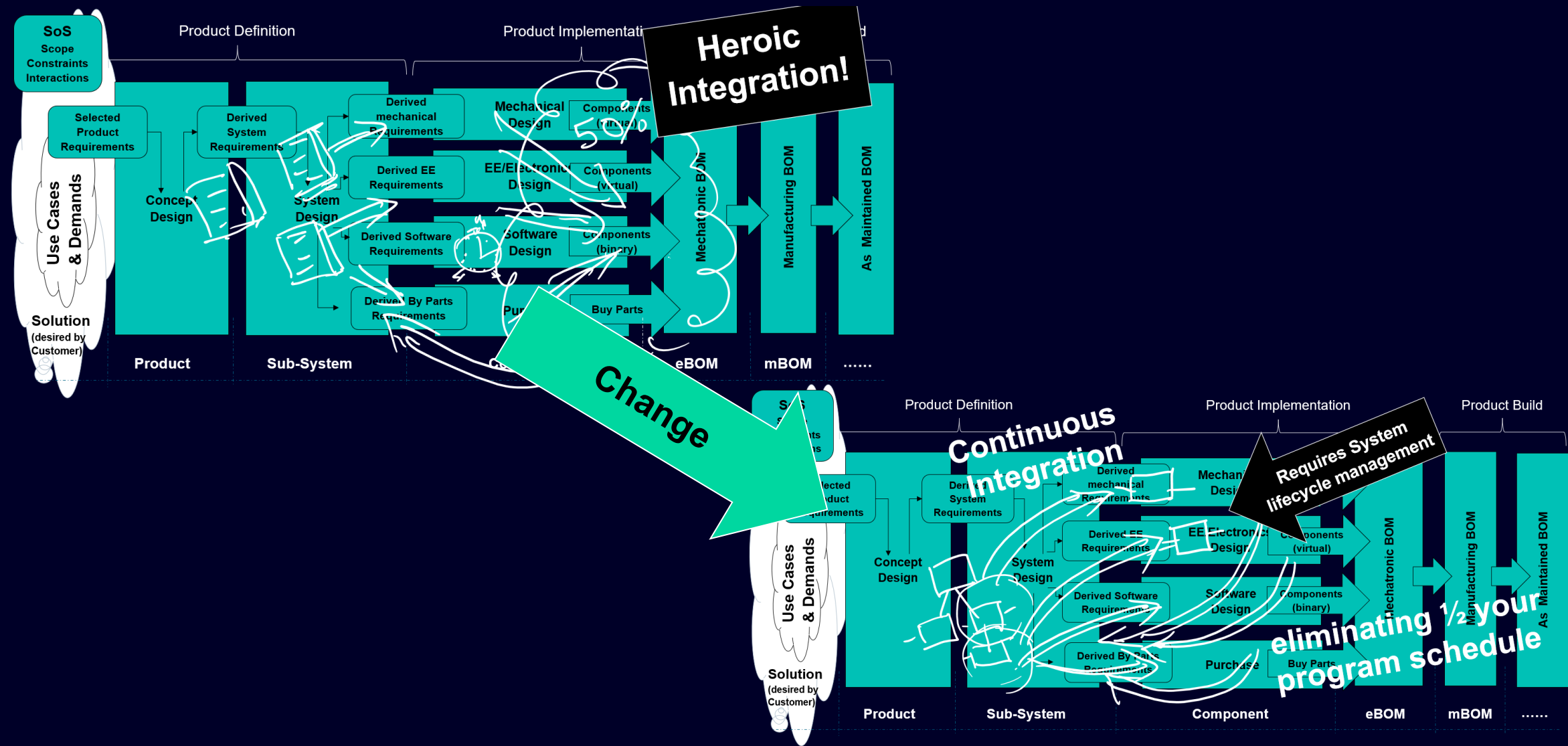


Integrated MBSE Process...

How it can work with a model-based integrated product architecture



This will require change...



The journey begins with knowing where you are...

Capability Assessment:	Basic	Low	Medium	High	Advanced
	Disconnected Communication with documents Disintegrated Integrated Continuous Communication with models				
	Integration Continuum				
System Modeling/Architecture		Visual models	Simulations	exchange/optimize	PL variation definition built into architecture decisions
PLE/Configuration (variation)	None	Variation documents, spreadsheets	Disconnected variation rules	Integrated variation rules	
Technical Risk (RAMS, cost,...)	None	Risk documents, spreadsheets	Integrated Risk Management Plans with aspects of RAMS (FMEA)	Standalone RAMS with FMECA Dash boards	Integrated RAMS, continuous risk assessment/alarms with dashboards
Interface Management	ICD in docs	Managed interfaces	Standard-based Interface library	Reused interfaces	Functions/logical allocation drives interface definitions
Logical Modeling	Logical description documents	Logical hierarchy	Isolated logical behavior models	Integrated logical behavior models	Logical architecture with allocation with traceability
Parameter Management	Unmanaged spreadsheets	Managed spreadsheets	Parameter library	Integrated with functions	Reusable parameter library with traceability
Feature/Functional Modeling	Functional description docs	Function hierarchy	Isolated functional behavior models	Integrated functional modeling	Functional arch with allocations & Traceability
Characteristic/Target Mgmt	None	Uncontrolled Excel/Docs	Controlled targets	Distributed targets/constraints	Integrated targets, budgets, with compliance reports
Change Management	Document-based change process	Isolated models included in change	Impact analysis & suspicion mgmt	Metrics with History for improvement	Project level reuse, starting point for next project
Requirement Management	Uncontrolled spreadsheets & docs	Managed Docs	Standalone solutions (disconnected)	RM/traceability exchange	Connected, configured, cross-domain traceability with reuse
Model Management	Uncontrolled, rules-of-thumb, hieristics	Uncontrolled, behavior models	Shared model repository	Integrated, component library	Model reuse with controlled parameters
Verification & Validation	Document-based test procedures	Managed test cases	Standard test libraries	Validation simulation & HIL/SIL	Focused testing, reuse results, swap out models
Design Management	unmanaged Cax/SW models	Locally Managed CAX/SW	Enterprise repositories	Integrated models (MIL, SIL,...)	Cross-domain design/optimization
CMMI Staged Levels:	(1) Initial	(2) Managed	(3) Defined	(4) Qualitative	(5) Optimizing

You are here...

Capability Assessment:	Basic	Low	Medium	High	Advanced
	DisintegratedIntegrated				
System Modeling/Architecture	PPT in docs	Disconnected Visio models	Sys Models with Simulations	Multiple model exchange/optimize	Integrated architecture models for cross-domain sim/optimize
PLE/Configuration (variation)	None	Variation documents, spreadsheets	Disconnected variation rules	Integrated variation rules	PL variation definition built into architecture decisions
Technical Risk (RAMS, cost,...)	None	Risk documents, spreadsheets	Integrated Risk Management Plans with aspects of RAMS (FMEA)	Standalone RAMS with FMECA Dash boards	Integrated RAMS, continuous risk assessment/alarms with dashboards
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CMMI Staged Levels:	(1) Initial	(2) Managed	(3) Defined	(4) Qualitative	(5) Optimizing

Barriers to implementation...

Silos locked-in by tools creating automated chaos

NxN problem...

Capability Assessment:	Basic	Low	Medium	High	Advanced
System Modeling/Architecture	PPT in docs	Disconnected Visio models	Sys Models with SysML	Multiple model exchange/optimize	Integrated architecture models for cross-domain
PLE/Configuration (variation)	None	Variation documents, spreadsheets	Disconnected variation rules	Integrated variation rules	PL variation definition built into into architecture decisions
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Change Management	Document-based change process	Isolated models included in change	Impact analysis & suspicion mgmt	Metrics with History for	Project level reuse, starting point for next project
Requirement Management	Uncontrolled spreadsheets &	Managed Docs	Standalone solutions (disconnected)	RM/traceability exchange	Connected, configured, cross-domain traceability with
Model Management	Uncontrolled, rules-of-thumb, hieristics	Uncontrolled, behavior models	Shared model repository	Integrated, component library	Model reuse with controlled parameters
Verification & Validation	Document-based test procedures	Managed test cases	Standard test libraries	Validation simulation &	Focused testing, reuse results, swap out models
Design Management	unmanaged Cax/SW models	Locally Managed CAX/SW	Enterprise repositories	Integrated models (MIL, SIL,...)	Cross-domain design/optimization
CMMI Staged Levels:	(1) Initial	(2) Managed	(3) Defined	(4) Qualitative	(5) Optimizing

Barriers to implementation

Problem is information synching not data exchange

PLM is about information; SysLM managing the digital thread

Capability Assessment:	Basic	Low	Medium	High	Advanced
System Modeling/Architecture	PPT in docs	Disconnected Visio models	Sys Models with SysML	Multiple model exchange/optimize	Integrated architecture models for cross-domain
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Logical Modeling	Logical description documents	Logical hierarchy	Isolated logical behavior models	Integrated logic behavior m	
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Feature/Functional Modeling	Functional description docs	Function hierarchy	Isolated function behavior m		
Characteristic/Target Mgmt	None	Excel			
Change Management	Document-based change process	Isolated models included in chan			
Requirement Management	Uncontrolled spreadsheets &	Ma		RM Tools	
Model Management	Uncontrolled, rule of-thumb, hi				
Verification & Validation	Document test			Test DB	
Design Management	Un				
CMMI Staged Levels:					

PLM → SysLM

How to implement technology change... Meta-Dishonesty

“Semmelweis Reflex”

*...to dismiss/reject out of hand any information,
automatically, without thought, inspection, or experiment*

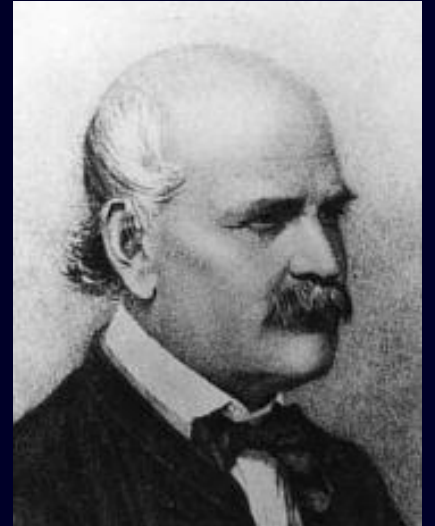
Fore-ordained answers

...will the answer be accepted

Don't waste your time on the wrong answers, unless...

Dr. Ignaz Semmelweis
(1818-1865)

Early Germ
Theory



Wash Your
Damn Hands

Organization Pre-prep...

Is your organization prepared to accept the answer?

- Management & customer backing
 - Do you have time to apply the tools
 - Do customers understand what you are doing
 - ...otherwise tools are thrown overboard to get over the next schedule pass
- Properly supported support organizations
 - Who's going to take care of the tools?
 - Who's responsible to maintain, support, answer questions about the tools
- Timely Application of the tools
 - SE tools are time sensitive
 - Money & resources start when...
 - ..."Catch-22" programs don't get resources until after SE decisions are made

**"We are going on a journey.
We will carry the wounded,
but we will shoot the stragglers."**

--Hallmark Cards

Organization SDB's...

- No time/money to use tools
- No backing for resources
- No training on tools
- Expecting tools to run themselves
- Thinking tools are static
- Not convincing the customer of the tool benefits
- No process for the tools to work within
- No mechanism for using tool results
- Applying the tool to everything
- Funneling everything through a gate keeper
- Expecting “paper” results from tools
- “where’s the hardware?”
- Rewarding fire-fighters vs. fire-preventers
- Blockading support organizations (...they cost too much, etc.)

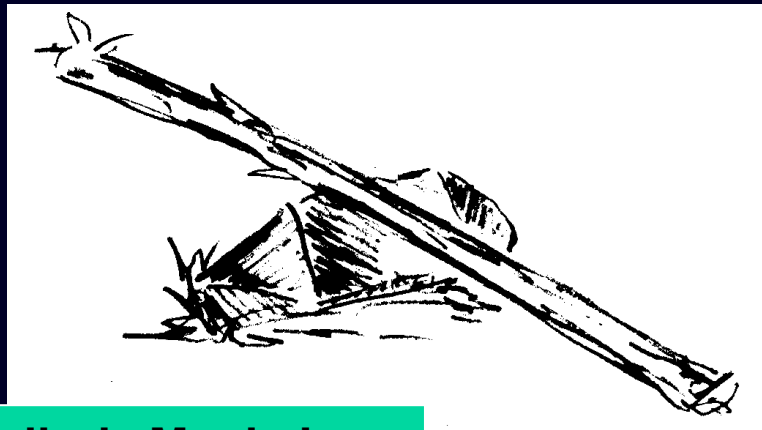
...next year you will have a
90% probability of this failure...
But you will do nothing about it!

Dr. Stephen Wheelwright

Organizational SDB's cont...

How prepared is your organization?

Culture change vs. getting lucky...



Buckminster Fuller's Magic Log

SE tool management acceptance checklist	Y	N
Did the tool support group help with the proposal?		
Has the manger forecast time & money for tool usage?		
Did the project manager help get the tools for his project?		
Has the manager forecast time & money for tool training?		
Is the manager willing to let the tools be upgraded mid project or are we stuck at this tool version?		
Is the manager willing to let his tool power users share lessons learned, be involved with user groups, etc.?		
Is the manager active in convincing his customer or the benefits of the tools?		
Are the tools used during customer reviews?		
Is there a development process being followed on the project?		
Is there a mechanism for doing something with the results of the tools?		
Is the manager involved with defining requirements?		
Does the manager see "one or two" engineers managing the product requirements?		
Does the manager have a "lets get something built" before requirements are defined mentality?		
Does the manager think the value of the tool is in its paper generation capability?		
Does he want/let the engineering automation support his project?		

Cultural Considerations

After choosing a process, picking tools, convincing management/accountants to buy them, how do you get them to “stick”?

- Goal of tools to accelerate SE
- Change is required
- How to get technology/change to stick?

Rogers Technology Diffusion Theory

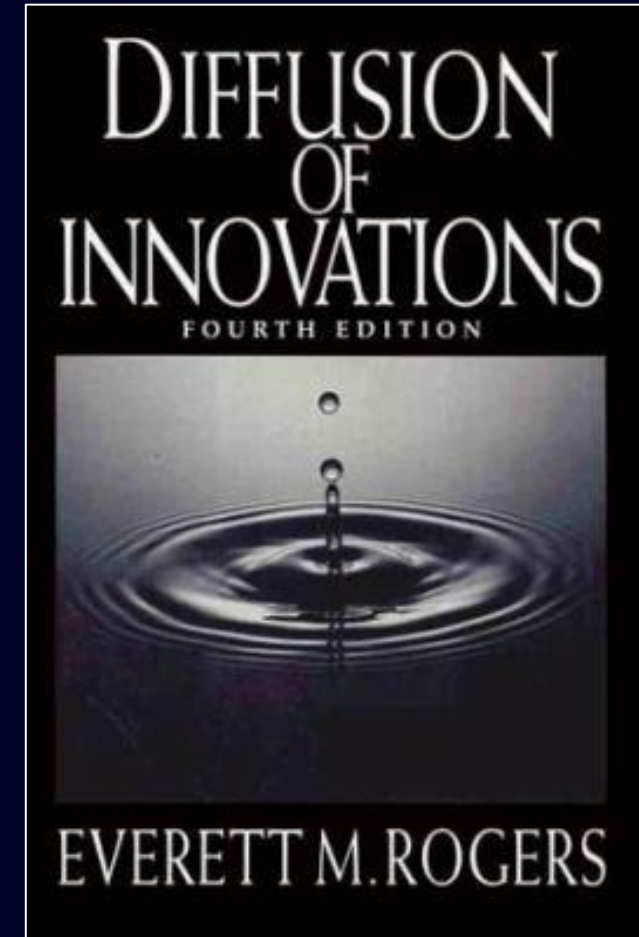


[Rogers, 1962]

Diffusion of Innovations...

5 characteristics of innovations that affect acceptance:

1. Relative Advantage—perceived as better
2. Compatibility—consistent with values
3. Complexity—how difficult to understand & learn
4. Trialability—experimented with
5. Observability—results visible to others

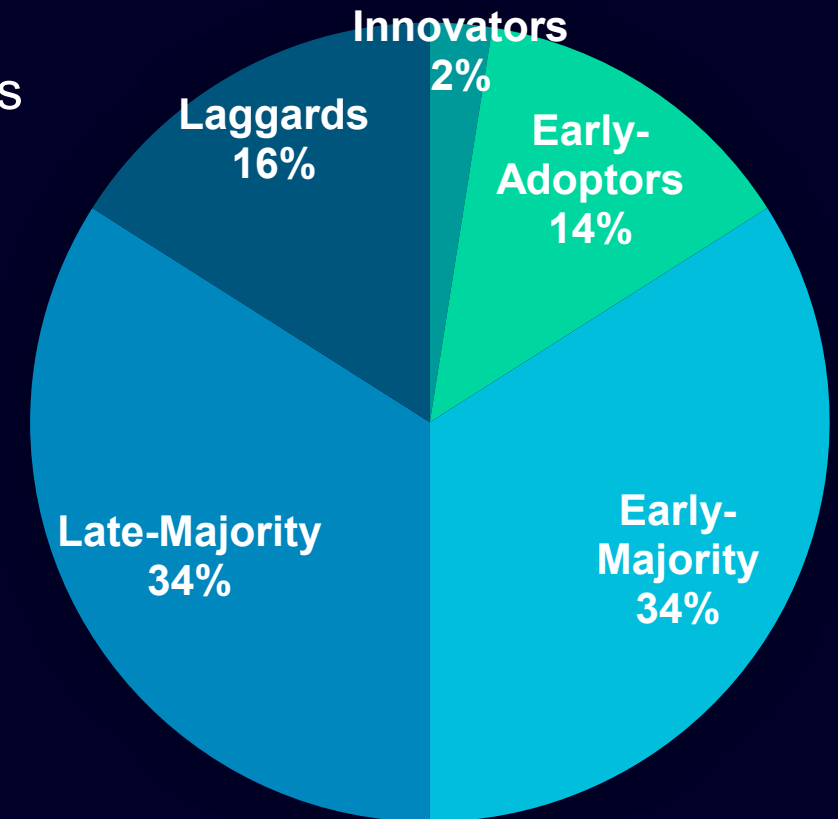


[Rogers, 1962]

Diffusion of Innovations...

5 kinds of people in organizations...

1. Innovators (2.5%)—risk takers, information from many sources, adventure-some
2. Early-adopters (13.5%)—social leaders, popular, fast trackers
3. Early-majority (34%)—deliberate, informal social circles
4. Late-majority (34%)—skeptical, traditional,...
5. Laggards (16%)—fear of change, resistant, militant...

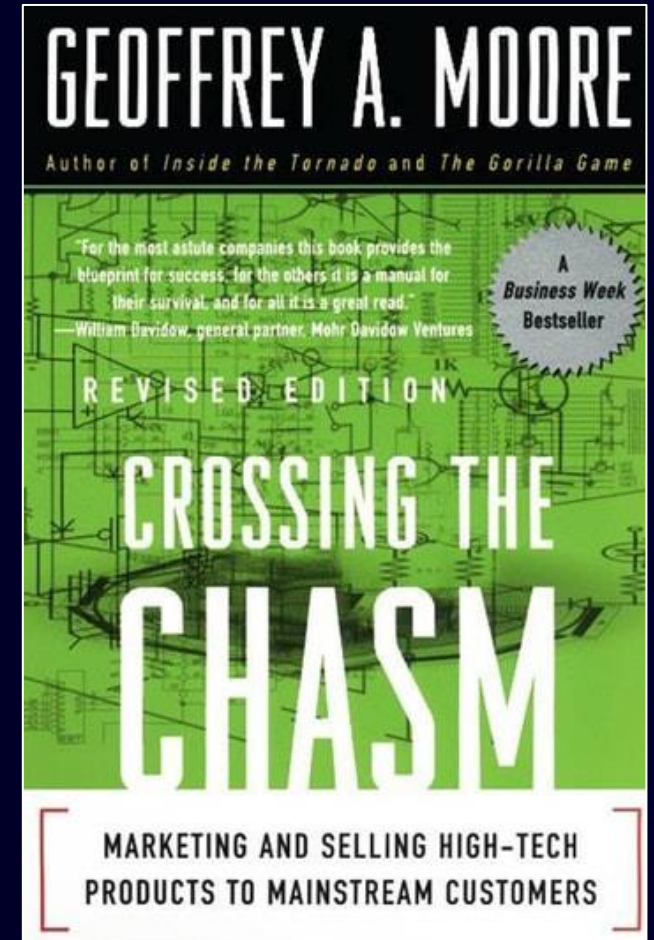


[Rogers, 1962]

Diffusion of Innovations...

...the way people perceive an innovation matters more than the merits of the tool itself. Rogers' Theory Suggests:

1. Start with pioneers on your first project application—innovators, anxious to make it go, & move on to the next new thing
2. Pass it on to early adopters who find the relative advantages (even if it takes considerable effort)
3. Use these opinion leaders/champions to take it across the “chasm” to the early/late majorities



Diffusion of Innovations... Remember the Fireflies...

Pioneer Aptitude Test	Y	N
Pioneers keep up with trade journals, computer magazines, etc.		
Pioneers work on computers at home-- i.e., they don't get enough at work		
Pioneers are always looking for new ways and tools to help them do their job (they may even go buy the tool themselves)		
Pioneers are known throughout their project as the first to adopt any new technology that comes along and come up with new and unique ways of applying the tools		
Pioneers are the informal support person in the project (project folks go to them for help on the tools)		
Pioneers are almost always positive on what tools can do for the project		
Pioneers are willing to put in a lot of work to make the tools work		

1. Create a bright spot. Make your pioneers/champions successful
2. Give them opportunities to communicate successes (opportunity to “nudge” others)
3. Give them a career path to spread the innovation (Design Centers,...)

Where do we start
our MBSE Journey?

Target rich
environment

Solution	(1) Initial	(2) Managed	(3) Defined	(4) Qualitative	(5) Optimizing
Product engineering	Uncontrolled	Controlled Documents	Isolated models	Enterprise Integration	Continuous Engineering
System Architecture Modeling <i>Product architecture definition</i>	PPT in docs	Disconnected Visio diagrams	Standalone SysML with simulations	Fine-grained integrated system architecture	Continuous integration via PLM-based architecture drives closed-loop MBDC
Planned Product Variability <i>PLE/Configuration/Variation</i>	None	Variation documents & spreadsheets	Disconnected variation rules	PLM Integrated variation rules	PLM variation definition drive architecture decisions
Reliability & System Safety Analysis <i>Technical Risk (RAMS)</i>	Risk documents & spreadsheets	Combined Risk Mgmt plans with manual RAMS artifacts (FMEA)	Disconnected RAMS tools output artifacts (FMECA)	RAMS analysis tools integrated with product architecture via PLM	Integrated RAMS, continuous risk assessment, alarms, dashboards..
Cross domain services					
System Definition & Design Integration <i>Logical modeling & Interface mgmt</i>	ICD & logical description documents	Managed interfaces & logical hierarchy	SE artifacts linked to Logical models & Std interface libraries	Integrated fine-grained logical arch with interfaces	Logical architecture carries across domains. Interfaces everywhere
Integrated services					
Feature Engineering <i>Feature/Functional Modeling</i>	Feature/Functional description docs	Functional hierarchy	Isolated functional behavior models	Integrated fine-grained functional modeling	Functional arch with allocations & traceability
Parameter/Target Mgmt <i>Characteristic/Targets/TPM</i>	Uncontrolled Excel/Docs	Controlled spreadsheets/Docs	Project-based Parameter/Target libraries	Enterprise PLM parameter/target mgmt & reuse	Integrated parameters, targets,... drive continuous compliance monitoring
Change management	Document-based change process	Isolated models included in change	Change impact analysis & suspension mgmt	Complete PLM configuration with models, parameters, history...	Cross-project level reuse, starting point for next project
Content Management					
Requirements Analysis <i>Requirements engineering & mgmt</i>	Uncontrolled spreadsheets & docs	Managed requirements docs	Disconnected RM tools with exchange	Integrated requirements & traceability inside PLM	Compliance through connected, configured, cross-domain traceability & reuse
Behavior Model Management <i>System, performance, et al simulation</i>	Uncontrolled models on desktops	Version controlled models	SE artifacts linked into models	Integrated model & product configuration with simulation	Continuous, focused simulation & multi-domain dashboards
Verification Management & Governance <i>Product Test/V&V</i>	Document-based test procedures	Managed test cases	SE artifacts linked to test	Devops-like V&V simulation	Focused testing, model swap out
Physical Design Management <i>CAD, CAE, ... control/mgmt</i>	Unmanaged CAx models	PDM controlled CAx	SE artifacts linked into CAD	Cross-domain fine-grained PLM integration	Continuous physical design verification (Digital Twin)

You are here

Best Auto
(best case)

Best Aero
(best case)

Don't make us come rescue you... Ignoring the advice

If you lead with tools (ignoring principals, process, & diffusion)...

- Sunk cost
- Cost of rescue
- Wasted engineering time
- Delayed project schedules
- Missing ...product architecture
- Late discovery of integration problems
- MBSE black eye...

Choose tools that include/support standard processes (the more OOTB the better)

- Define/Train on processes
- Show how tools support the processes,
- Give users/projects a chance to share their experiences

Torowee Point
North Rim Grand Canyon



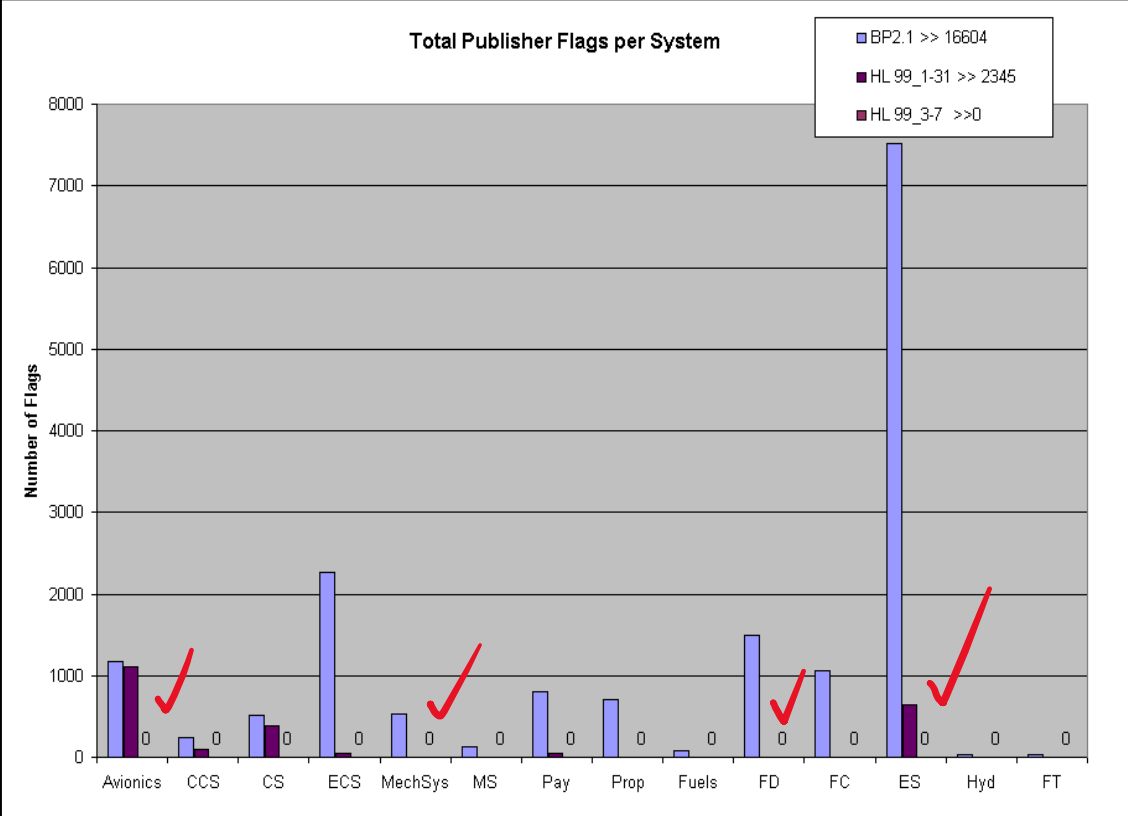
The value of continuous integration

The impact of managing system interfaces and interactions across product development



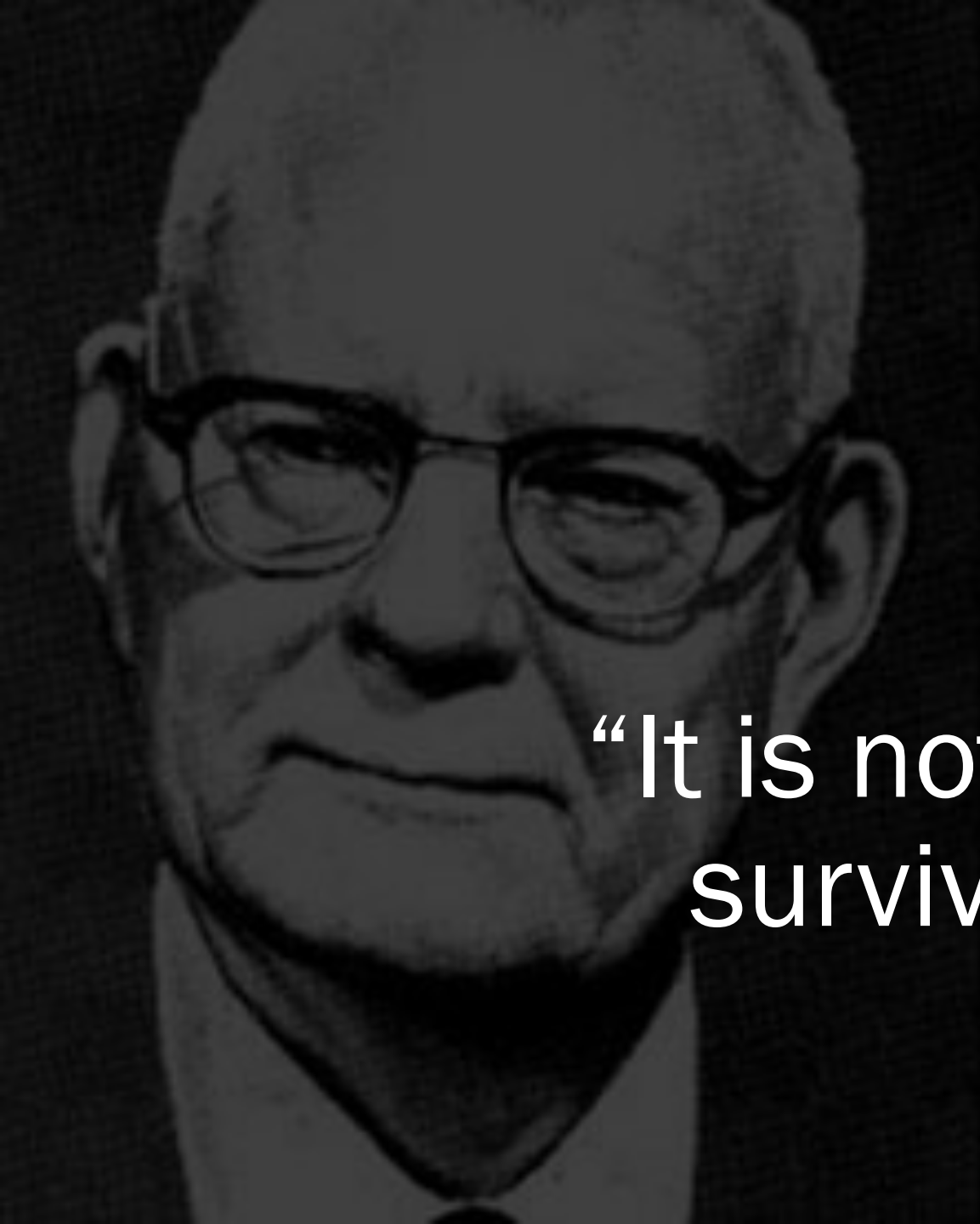
- Avionics**
 - Common Core System (CCS)
 - Navigation – FMS
 - Navigation – TMS
 - Navigation – ADRS
 - Navigation – ERS
 - Navigation – IRS
 - Navigation – CM App
 - Displays and Crew Alerting
 - Integrated Surveillance
 - Communications – SATCOM
 - Communication – Record
 - e-Enabling (Crew Informa
 - Maintenance Systems
- Cabin Systems**
 - Broadband Offboard Set
 - Cabin Services Systems
 - Emergency Lighting Sys
 - Inflight Entertainment Sys
 - Telephone System
 - Video Surveillance Syste
- Fuels**
 - Fuel Quantity Indicating
 - Nitrogen Generating Sys

- Flight Controls**
 - Flight Controls Electronics
 - High Lift
 - Primary Flight Controls
 - Autoflight
 - Integrated Standby Flight
 - Displays
- Electrical Sub-systems**
 - Cargo Compartment Lighting
 - Electrical Power Conversion
- Environmental Control Systems**
 - Equipment Cooling
 - Moisture Control
 - Humidification
 - CACTCS
 - Cabin Pressure Control System
 - Cargo Air Conditioning, Ventilation
 - EE Cooling
 - Power Elect Cooling
 - Integrated Cooling System
 - Compressor Ice Prot. System (CIPS)
- Mechanical**
 - Wheels and Brakes
 - Brake Control and Monitor
 - Landing Gear Actuation
 - Nose Wheel Steering
- Flight Deck**
 - Flight Deck Control Panels
 - Flight Deck Area Illumination
 - Flight Deck Access System



...we have modeled the logical interfaces of virtually the entire airplane and created a database that software design tools can assimilate with minimal human intervention.

Mike Sinnett 787 Chief Systems Engineer

A grayscale portrait of W. Edwards Deming, an older man with glasses, wearing a suit and tie. The image is dark and serves as a background for the text.

“It is not necessary to change,
survival is not mandatory”

- W. Edwards Deming,
Data Scientist

We can help you with change...

Mark Sampson
Systems Engineering Evangelist
(469) 855-1461
msampson@appliedcax.com



[CIMdata; 2019] “Model Based Systems Engineering (MBSE) Data Interoperability”

[Sampson, Mark; 2000]. “Getting Tools to Stick”, Paper delivered at INCOSE 2000 International Symposium, Melbourne, Australia

[Sampson, Mark; 1997], IEEE Computer,, [“Allegory of the Humidifer”](#) 8/97 edition

See also INCOSE YouTube Channel for TED/Lightning version (<https://www.youtube.com/watch?v=2XsUARD7MQE&t=29s>)

[Sampson, Mark, et al; 1994] Systems Engineering Design Automation Landmark Study

[Rogers, Everett M.], Diffusion of Innovations (3rd Edition), The Free Press, New York, 1983

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