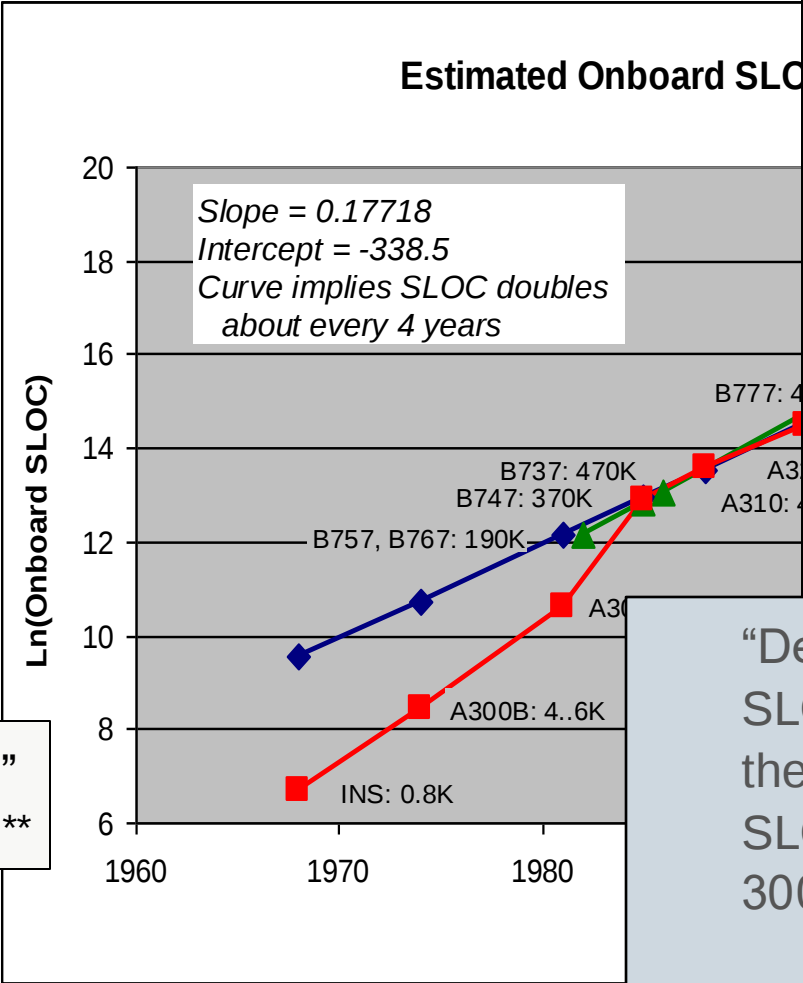
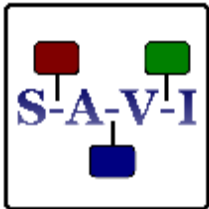


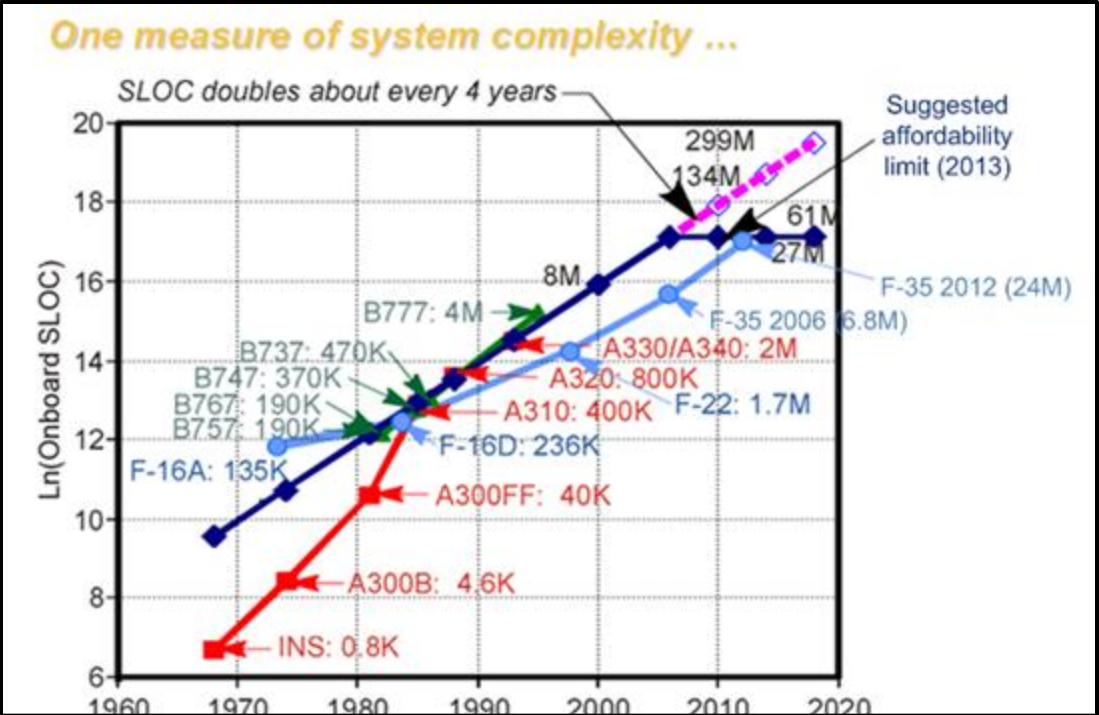
MBSE Standard Slides

Unprecedented Product Complexity: becoming unaffordable...

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



“Integrate, then build”
AVSI**



“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/>

Insane Design Behavior

Solving the same problems over & over

Problem resurface metric: how long does a problem once solved take to come back

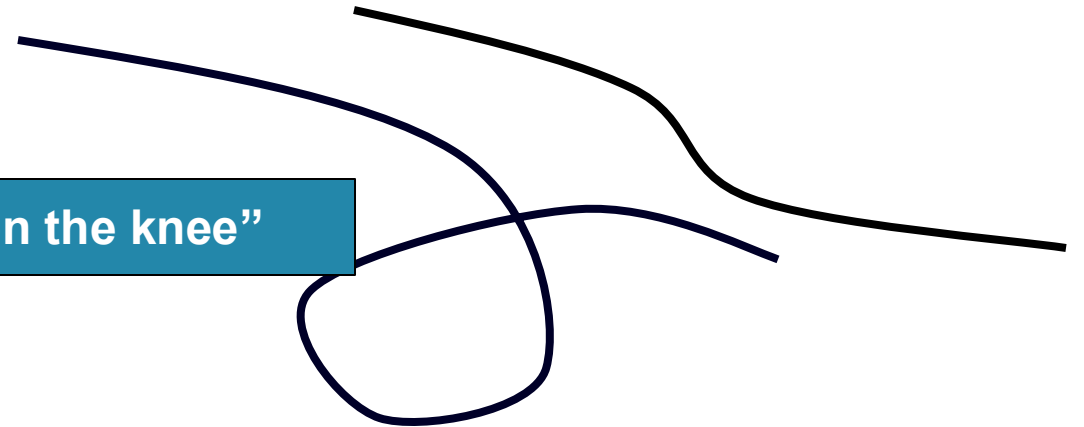
- Auto: ~3 years
- High Tech ~6 mo.
- Aero ~15 years



“Water on the knee”

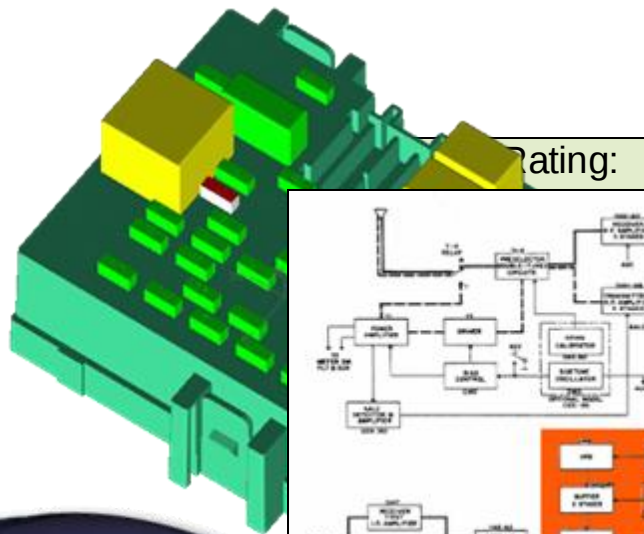
Cross-Domain problems result from:

- Siloed/Disconnected Decisions
- Form follows function, Problems follow functions
- Everyone involved, including purchasing
- Disconnected requirements
- Uncommunicated change
- Happen at domain/organizational boundaries
- Migrate with people (overt or covert)
- Missing/disconnected product architecture

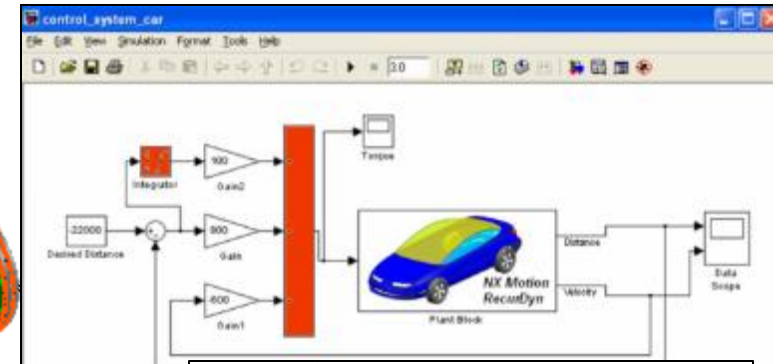


What does the integrated digital thread look like...

What does the integrated digital thread look like...



Hydraulic Fluid:
SAE 1340 not-compliant



Ages																				
Rev.	Age	Male		35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
		Male	Female	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
rust	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	41.7	41.4	41.1	40.8	40.5	
	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	40.8	40.5	40.2	39.9	
	37	42	45.3	44.8	44.3	43.9	43.5	43.1	42.7	42.3	41.9	41.5	41.2	40.9	40.5	40.2	39.9	39.6	39.3	
	38	43	44.9	44.3	43.8	43.3	42.9	42.4	42.0	41.6	41.2	40.8	40.5	40.1	39.8	39.5	39.2	38.9	38.6	
	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	38.9	38.6	38.3	38.0	
	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	38.3	38.0	37.7	37.4	
	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	38.1	37.8	37.5	37.2	36.9	
	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	37.2	36.9	36.6	36.3	
	43	48	43.0	42.3	41.8	41.2	40.6	40.1	39.6	39.1	38.6	38.2	37.7	37.3	36.9	36.6	36.3	36.0	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	36.1	35.8	35.5	35.2	
rust	45	50	42.3	41.7	41.1	40.5	39.9	39.3	38.8	38.3	37.8	37.3	36.8	36.3	35.9	35.6	35.3	35.0	34.7	
	46	51	42.0	41.4	40.8	40.1	39.5	38.9	38.4	37.8	37.3	36.8	36.3	35.9	35.5	35.2	34.9	34.6	34.3	
	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	34.7	34.4	34.1	33.8	
	Ages																			
			Male		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			
	rust	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	39.0	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	37.2	37.0	36.8	36.6	36.4	36.2	36.0	35.9	35.7					
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	35.6	35.3	35.1	34.8	34.6	34.4	34.2	34.1					
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	35.9	35.5	35.1	34.8	34.5	34.2	34.0	33.7	33.5	33.3	33.1	32.9	32.7					
rust	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	32.5	32.0	31.7	31.4	31.1	30.8	30.6	30.3	30.1					
	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	31.0	30.5	30.1	29.7	29.3	29.0	28.7	28.4	28.1	27.8					
	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	26.6					
rust	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	26.2					
	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					

Minimum Turn Radius: 24 ft.

Automatic Dry Pavement Braking
Distance at 60 MPH : ~~110~~ ft. 90 ft



Value of staying integrated... Continuously managing system interactions/interfaces...



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 - Recorders
- e-Enabling (Crew Information S
- Maintenance Systems

Flight Controls

- Flight Controls Electronics
- High Lift
- Primary Flight Controls
- Autoflight
- Integrated Standby Flight

Environmental Control Systems

- Equipment Cooling
- Moisture Control
- Humidification
- CACTCS
- Cabin Pressure Control System

Mechanical

- Wheels and Brakes
- Brake Control and Monitor
- Landing Gear Actuation
- Nose Wheel Steering

Cabin Systems

- Broadband Offboard Satellite S
- Cabin Services Systems
- Emergency Lighting System
- Inflight Entertainment System
- Telephone System
- Video Surveillance System

Fuels

- Fuel Quantity Indicating System
- Nitrogen Generating 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

