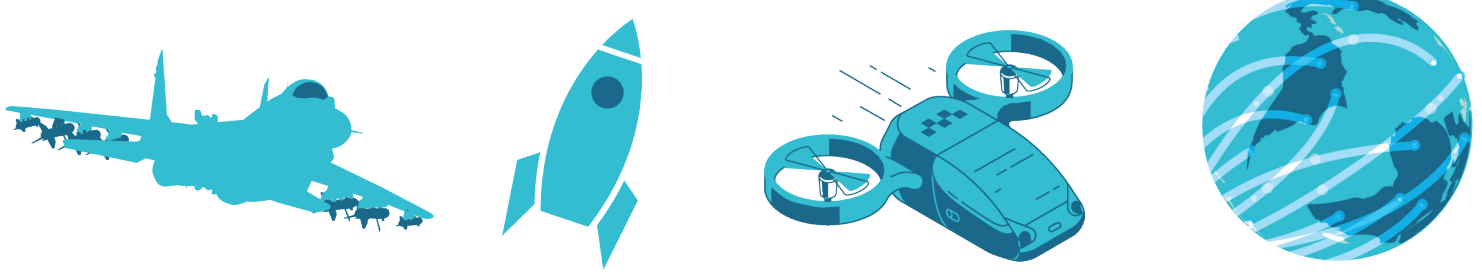SIEMENS
Ingenuity for life

Orchestrate your technical program and become more agile and efficient with Model Based Systems Engineering

Trends

Pressure to Reduce Program Cost and Schedule
Companies are under pressure to reduce program cost and schedule while meeting requirements for new products.

Increasing Program Complexity and Integration
Aerospace and defense products are becoming increasingly complex and highly integrated.
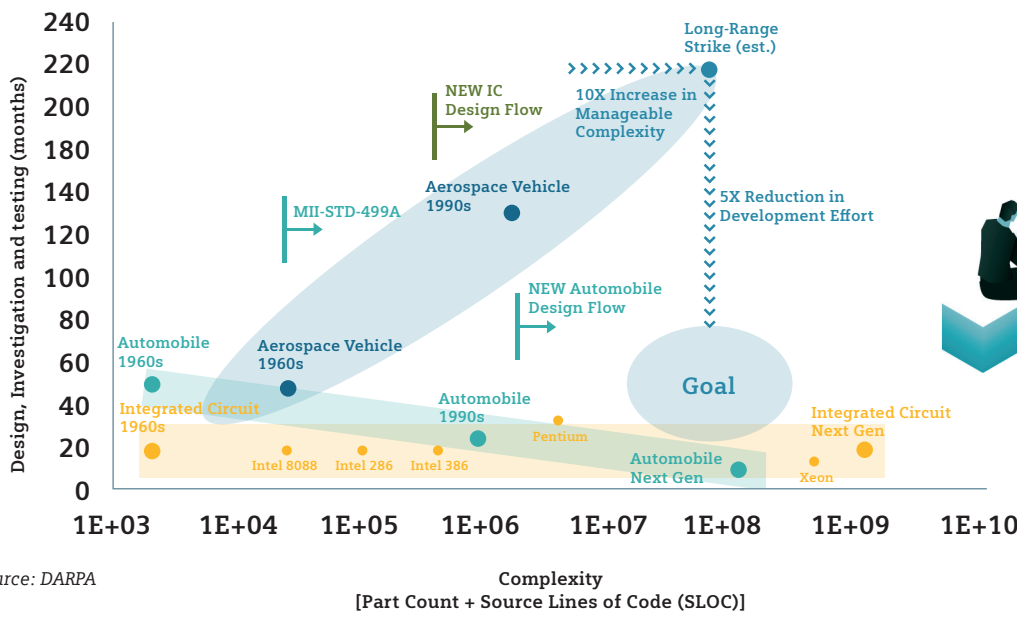
Increased Electrification of Products
Decarbonization, reliability, maintainability and performance of products are driving increased electrification.
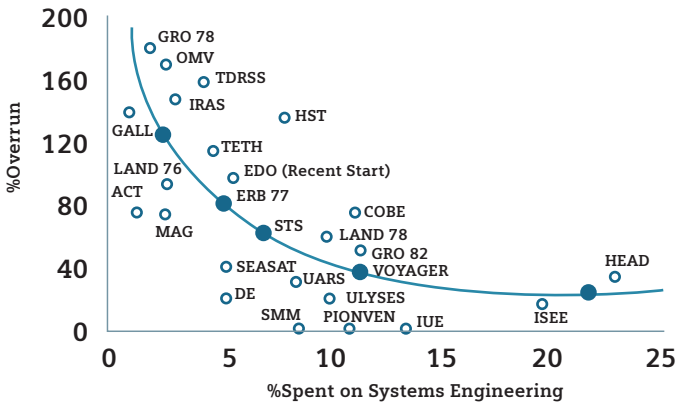
Globalization
Increasing globalization in company supply chains, workforce and the competition is driving changes to how companies collaborate both internally and externally.
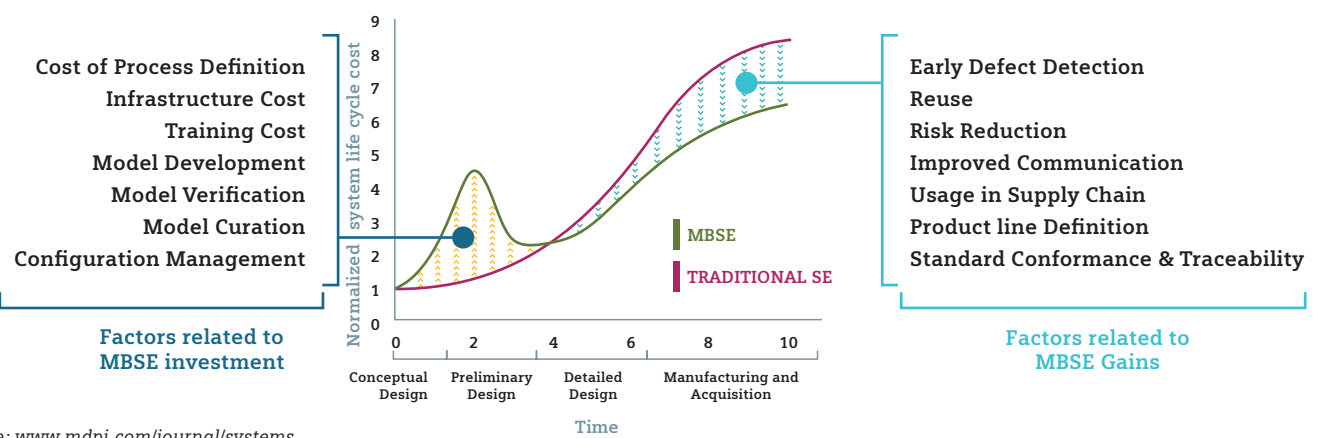
Complexity growth in A&D

Design, Investigation and testing (months)
240 / 220 / 200 / 180 / 160 / 140 / 120 / 100 / 80 / 60 / 40 / 20 / 0

Long-Range Strike (est.)
NEW IC Design Flow
10X Increase in Manageable Complexity
5X Reduction in Development Effort
MIL-STD-499A
Aerospace Vehicle 1990s
NEW Automobile Design Flow
Automobile 1960s
Aerospace Vehicle 1960s
Automobile 1990s
Goal
Integrated Circuit Next Gen
Integrated Circuit 1980s
Automobile Next Gen

Complexity
[Part Count + Source Lines of Code (SLOC)]
1E+03 1E+04 1E+05 1E+06 1E+07 1E+08 1E+09 1E+10

Source: DARPA

Relation of SE investments and program cost overruns

%Overrun
200 / 160 / 120 / 80 / 40 / 0

GRO 78 / OMV / TDRSS / IRAS / GALL / HST / TETH / EDO (Recent Start) / ERB 77 / ACT / STS / COBE / LAND 76 / LAND 78 / MAG / GRO 82 / SEASAT / VOYAGER / QUARG / DE / ULYSES / SMM / JUE / ISEE / PIONVEN / HEAD

%Spent on Systems Engineering
0 5 10 15 20 25

Source: www.sebokwiki.org/wiki/Economic_Value_of_Systems_Engineering

MBSE factors related to investment and gains

Cost of Process Definition
Infrastructure Cost
Training Cost
Model Development
Model Verification
Model Curation
Configuration Management

Factors related to MBSE investment

Early Defect Detection
Reuse
Risk Reduction
Improved Communication
Usage in Supply Chain
Product line Definition
Standard Conformance & Traceability

Factors related to MBSE Gains

Normalized system life cycle cost
9 / 8 / 7 / 6 / 5 / 4 / 3 / 2 / 1 / 0

MBSE
TRADITIONAL SE

Conceptual Design / Preliminary Design / Detailed Design / Manufacturing and Acquisition
0 2 4 6 8 10
Time

Source: www.mdpi.com/journal/systems

Challenges with certifying and managing programs

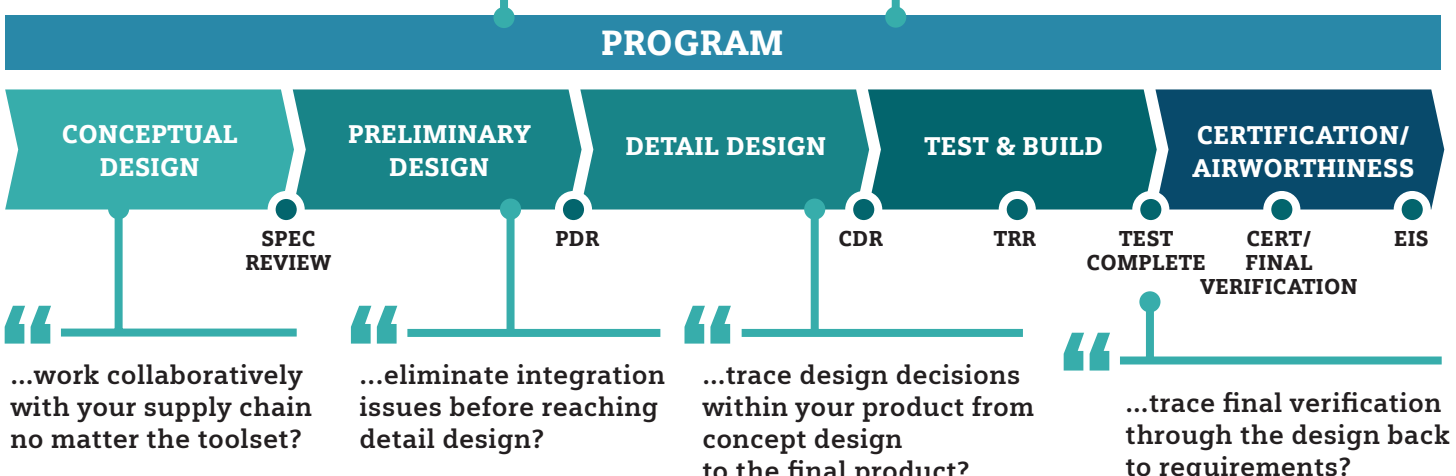

Compliance with regulatory requirements

Difficult to manage document-centric systems engineering processes

Increased cost and risks due to integration of complex systems and supplier relationships

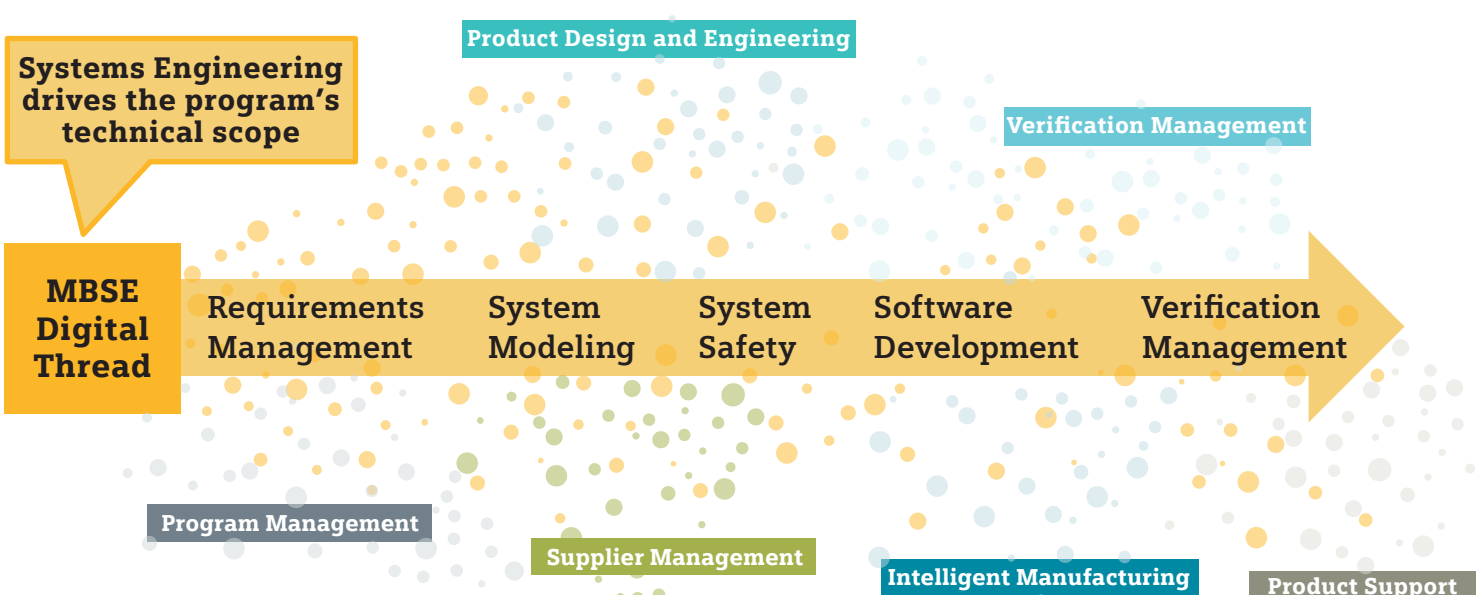## Model Based Systems Engineering... What if you could...?

...orchestrate the technical content and scope of your program throughout the entire lifecycle?

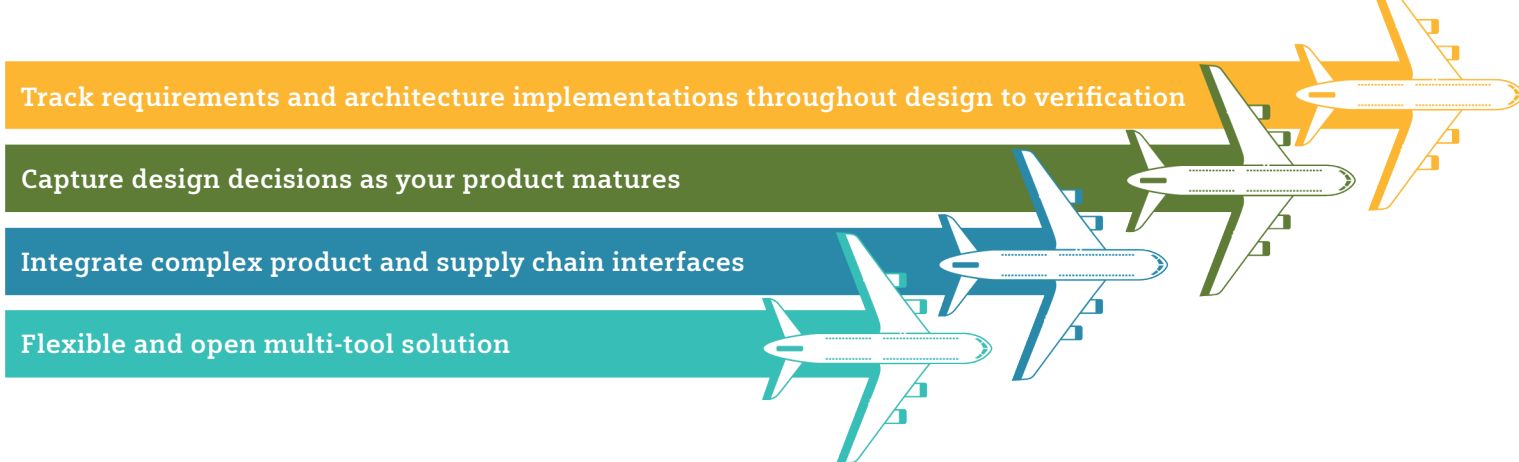...continuously monitor with real-time access to key technical performance indicators?

PROGRAM

CONCEPTUAL DESIGN	PRELIMINARY DESIGN	DETAIL DESIGN	TEST & BUILD	CERTIFICATION/ AIRWORTHINESS
	SPEC REVIEW	PDR	CDR	TRR	TEST COMPLETE	CERT/ FINAL VERIFICATION	EIS

...work collaboratively with your supply chain no matter the toolset?

...eliminate integration issues before reaching detail design?

...trace design decisions within your product from concept design to the final product?

...trace final verification through the design back to requirements?

MBSE Digital Thread to orchestrate your technical program

One thread to connect and guide all domains

Systems Engineering drives the program's technical scope

Product Design and Engineering
Verification Management

MBSE Digital Thread
Requirements Management / System Modeling / System Safety / Software Development / Verification Management

Program Management
Supplier Management
Intelligent Manufacturing
Product Support

Drive scope by moving from system modeling to the comprehensive MBSE digital thread

Track requirements and architecture implementations throughout design to verification

Capture design decisions as your product matures

Integrate complex product and supply chain interfaces

Flexible and open multi-tool solution

Accelerate your new product development and become more agile

Get your design right the first time through up-front systems engineering

Manage complex product and supply chain integration

Full lifecycle solution to deliver safe, reliable products faster – and within budget

Reduce risk

Speed to market

Ensure compliance

Beat the competition

For more information, visit:
siemens.com/plm/mbse