



Elevating your Game from Systems Engineering to System Family Engineering

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Empowering more



onePLE

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From Systems Engineering to System Family Engineering



- Nobody builds just one
 - Product lines are ubiquitous
 - Almost every engineering organization builds their systems as a family of similar systems
- But traditional Systems Engineering practice focuses on a single *system of interest*
- This mismatch leaves gaps and tears in the digital fabric that have to be filled with non-digital tribal knowledge
- Successful Digital Engineering requires the *System Family* to be the system of interest

But wait, what about...

- Nuclear power plants
 - I hope it's not their first and only
- James Webb space telescope
 - It's a composition from many proven subsystem families
- Product lines with just a few members are not like automotive with tens of thousands of members
 - A product line with two members is a perfectly valid system family

Product Line Engineering (PLE) Defined

ISO 26580 Methods and Tools for Feature-based PLE

Product Line:

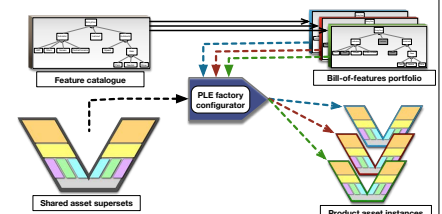
A family of similar products or systems with variations in features.
"Product Line" and "System Family" are interchangeable



International
Organization for
Standardization

Product Line Engineering:

the engineering of a product line using
shared engineering assets,
a managed catalog of features, and
an automated means of production...

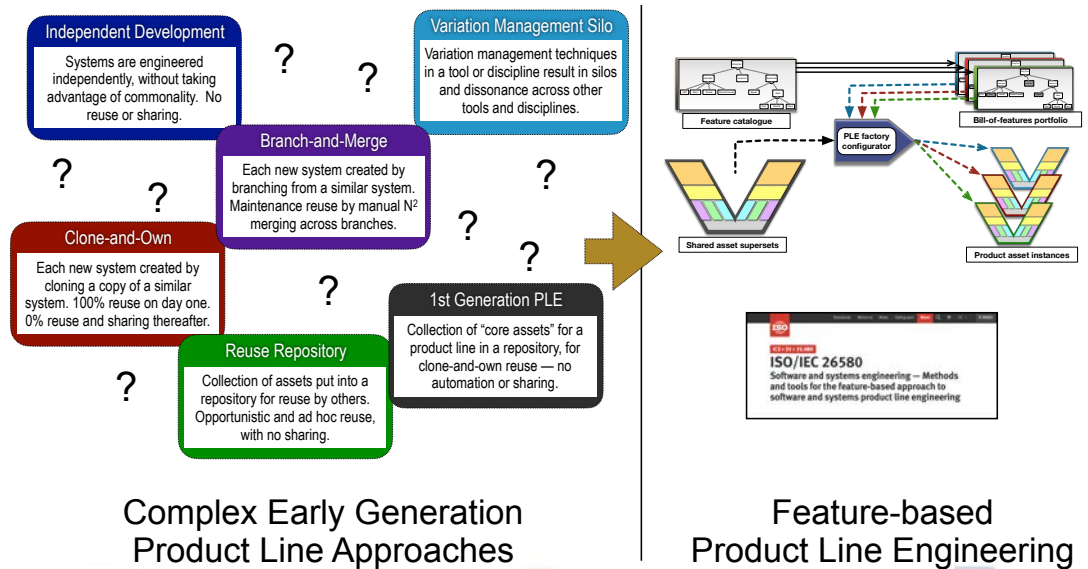


- taking advantage of the **commonality** shared across the family
- efficiently and systematically managing the **variation** among the products or systems

Feature-based PLE is a Paradigm Shift away from Early Generation Complexity

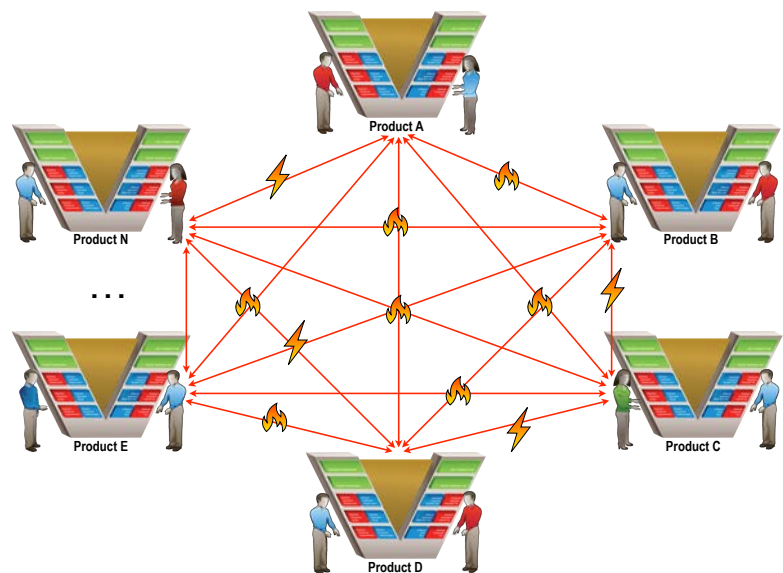
"The top driver of operational complexity in complex engineering organizations, as identified by surveys of hundreds of business leaders, is the number of product and system configurations engineered, manufactured, deployed, and sustained."

Michelle Boucher,
VP of Research for Engineering Practices,
Tech-Clarity



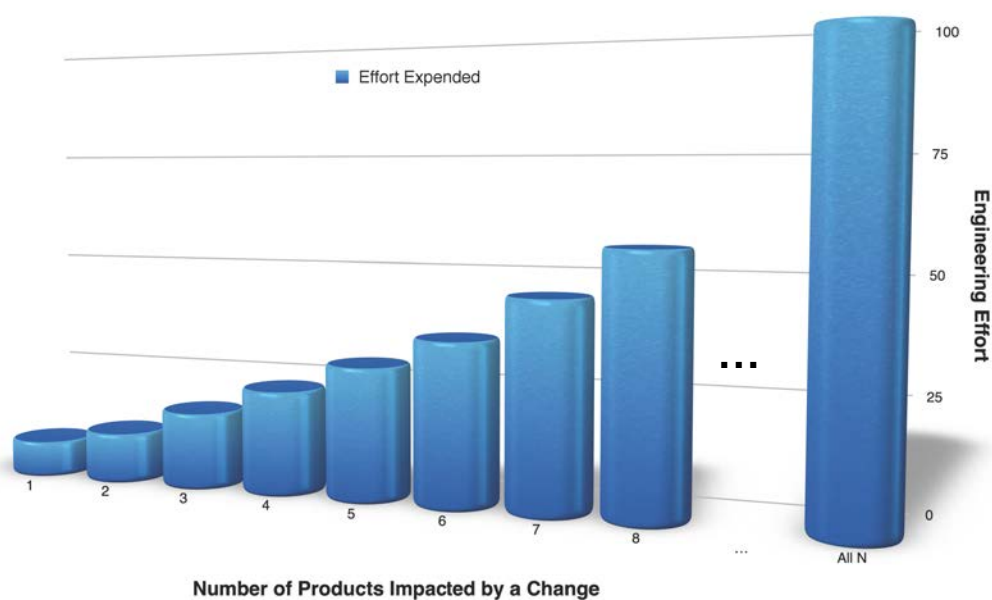
Early Generation Single-System Engineering

- Duplication, branch-and-merge, clone-and-own, self-inflicted N^2 complexity, ...
- Informality introduces significant risks in the form of defects, errors, and omissions
- Leads to delays, budget overruns, recalls, system failures, and opportunity losses



Single-System Engineering Effort

- Dominated by low-value, mundane, replicative work
- Deprives teams of time and energy better spent on high-value innovative work that advances business objectives



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Feature-based Product Line Engineering

ISO 26580 Methods and Tools for Feature-based PLE

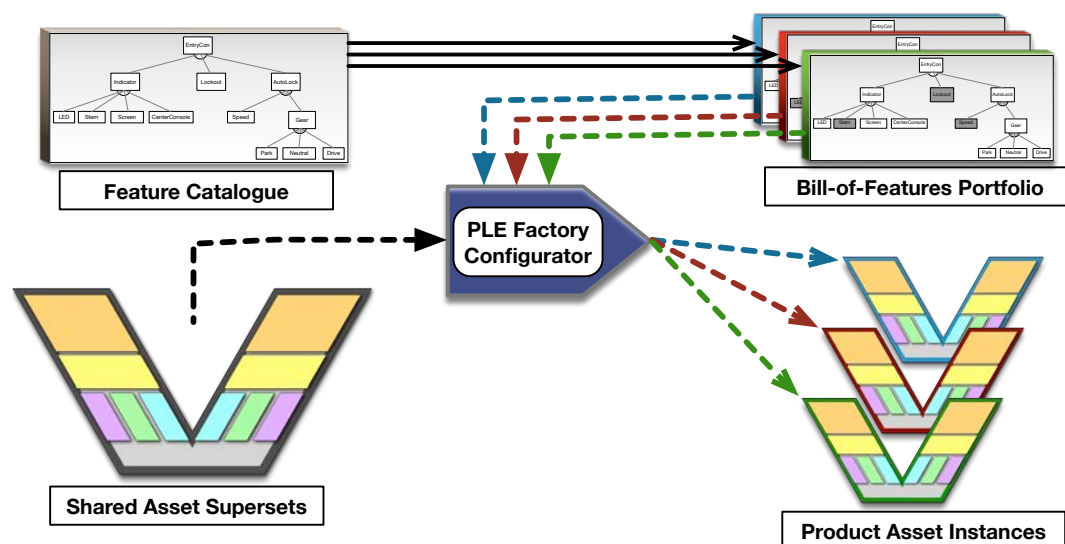
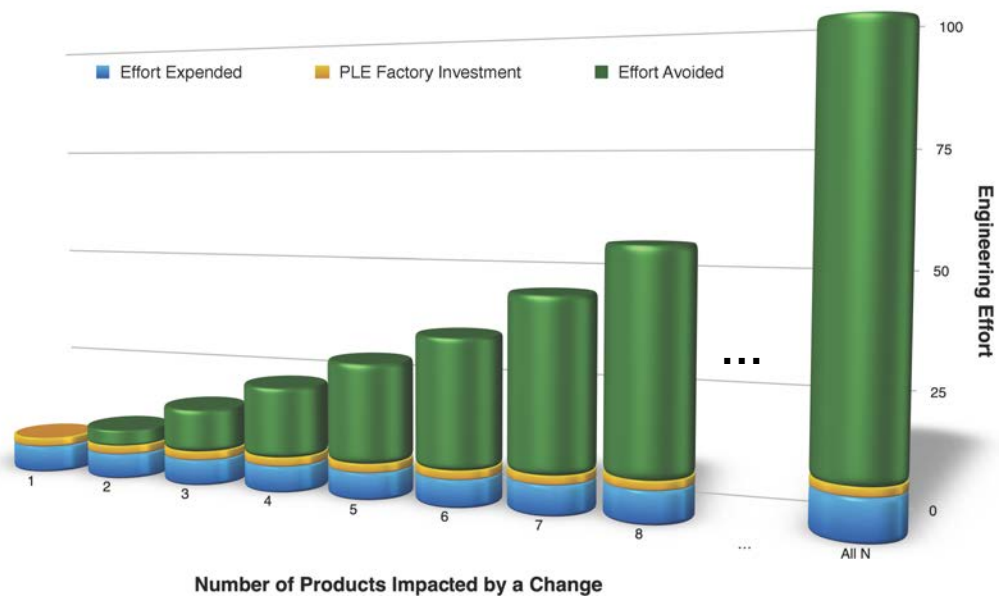


Figure from ISO/IEC 26580
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<https://www.iso.org/standard/43139.html>

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Feature-based PLE Effort Avoidance

- What if your engineers could do their normal day's work before lunch?
- What would you have them do in the afternoon?

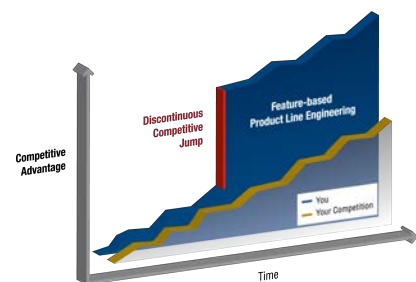


Benefit Hierarchy of Feature-based PLE

Competitive Advantage

Strategic Business Benefits

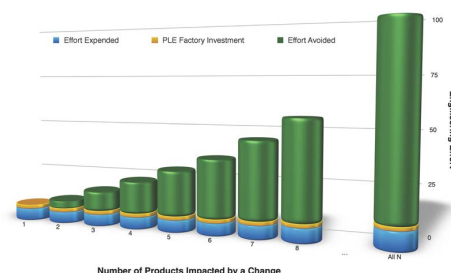
- More competitive pricing, more wins, higher sales
- Beat competitors to market with new innovations
- Higher quality, better reviews, better perception, fewer recalls, happier customers
- Higher engineering effectivity mitigates staff retention and hiring challenges



Strategic Engineering Benefits

- Higher productivity, shift from low value to high value effort
- Higher quality, lower defect density
- Faster time to market for new features and new products
- Greater scalability of the product line

Root-cause Engineering Effort Avoidance





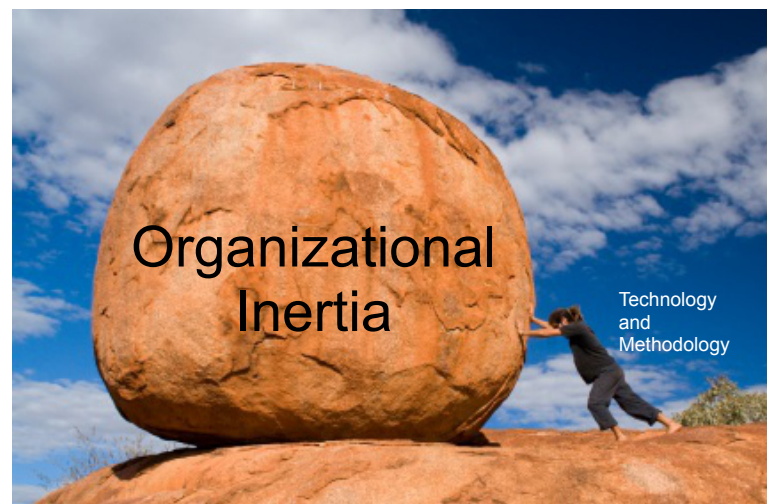
AEGIS Weapon System for US and International Navies	Live Training Transformation: US Army, Air Force, Marines. Plus enterprise initiative.	One of the largest and most complex product lines, comprising millions of instances per year	Rapidly growing and evolving portfolio of the world's most advanced missile systems	Helicopter engines for all configurations of the new US Army Future Vertical Lift (FVL) program
High cost of old approach threatened loss of entire contract	Innovative low-cost solution essential to win and retain major contracts	Significant challenges to provide suppliers with a family of complex specs for electronic controller unit families	Traditional methods of creating and testing prototypes are too slow, imprecise, expensive to meet mission demands	Demand to maximize sharing and reuse to prevent multiplicative costs for flight certification

Feature-based PLE Results with BigLever

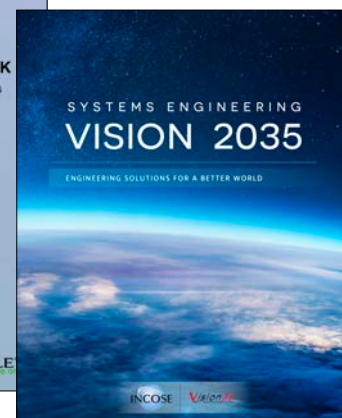
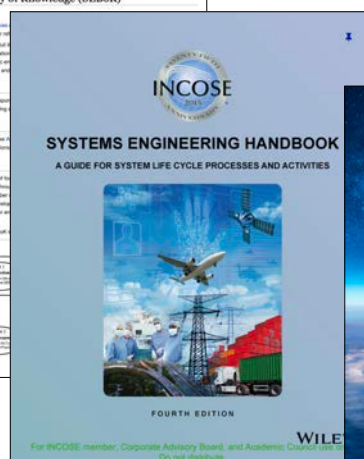
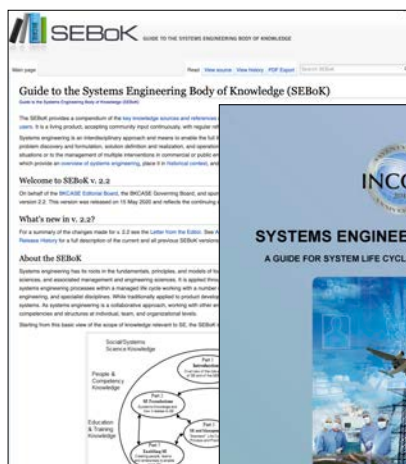
Turned an at-risk program into an enthusiastic long-term relationship by eliminating low-value redundant effort	Grew a \$2B+ business from scratch with the US DoD. Delivering 3x more capability within budget, to the delight of the customer	Digital transformation to a digital supply chain by applying PLE to MBSE	Using Feature-based PLE to proliferate best candidate simulations to find optimal solution within a trade space	Using a single Feature-based PLE Factory with a single collection of shared engineering assets for the full engineering lifecycle
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“Change is good. You go first.”

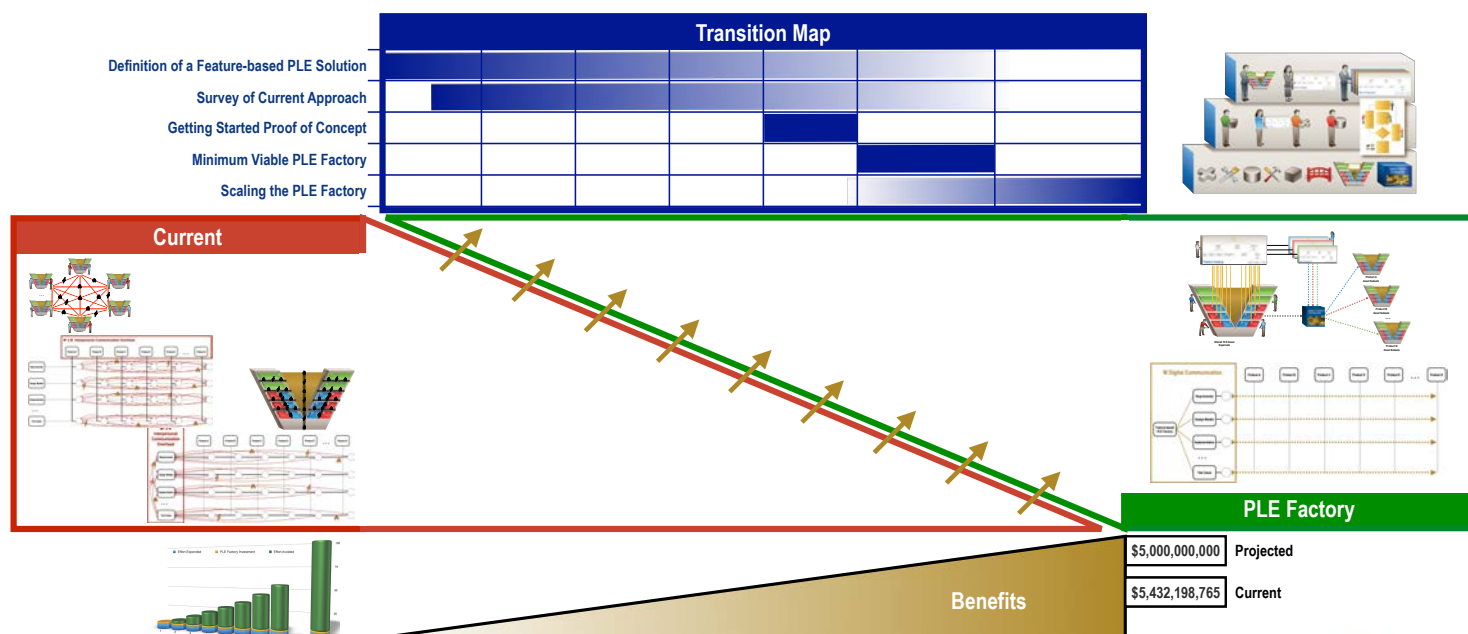
- Proven technology, methodology, and successful practice exists today
- Where is everybody?
- Broader awareness and adoption are lagging significantly
- Organizational Change impediments
 - technology is easy, people are hard
 - too busy to save time, can't afford to save money



Lowering the risk of organizational change by elevating System Family Engineering to a standard practice in the industry



Architect Studio for Systems Engineering to System Family Engineering



Summary

- Nobody builds just one
- The systems engineering community must elevate our thinking from Systems Engineering to System Family Engineering
- The release of ISO/IEC 26580 is good news
 - Can be readily and unambiguously applied to create a full lifecycle digital fabric for system family engineering
- The better news is that Feature-based PLE does not need a break-in period
 - It's been here all along with proven and validated successes



Learn more:

- [ISO/IEC 26580:2021](#). Software and systems engineering — Methods and tools for the feature-based approach to software and systems product line engineering
- [INCOSE Product Line Engineering Primer](#)
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