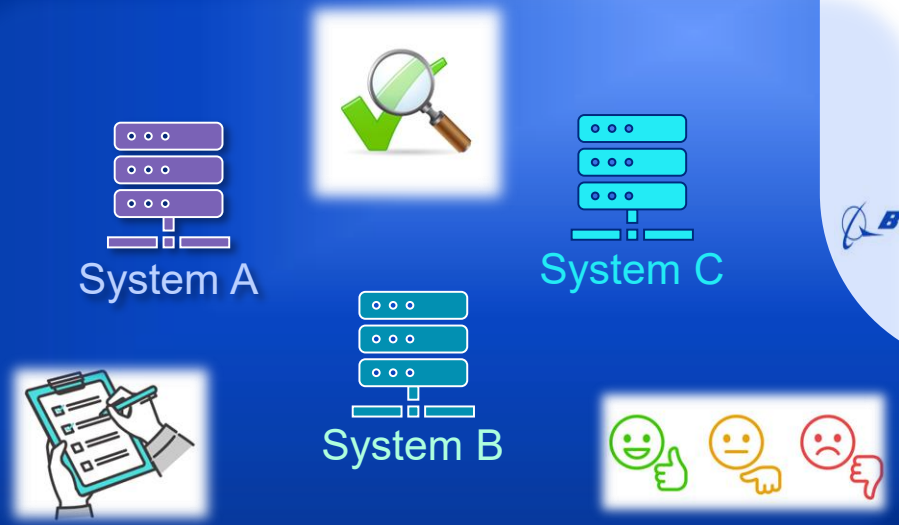
PLM Convergence: Assessing the Capabilities of your Company's PLM Systems



GLOBAL PRODUCT DATA

INTEROPERABILITY

SUMMIT 2025

BOEING ELYSIUM LOCKHEED MARTIN NORTHROP GRUMMAN Parker PDES, Inc.® Connecting the Digital Enterprise

David Pessin
Consulting Engineer
Northrop Grumman

Presenter's Bio – David Pessin

- **Consulting Engineer with 20+ years at Northrop Grumman (NGC)**
- **Works in the Aeronautics Systems sector (NGAS)**
- **Former Design Engineer turned PLM guy**

- **Married to wife Karen for 32 years**
- **Twin 24-year-old Daughters – Maya and Alissa**
- ***1 Son-in-Law***
- **Hobbies**
  - **Hiking**
  - **Brewing**
  - **Anything with my Weimaraner**

Presenter's Bio – David Pessin

Our Theme for the year: 5 surgeries…. **and a Wedding!**

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- **GPDIS 2024 Presentation**
  - **Review**
- **The Capability Assessment - Completed**
  - **Course Changes**
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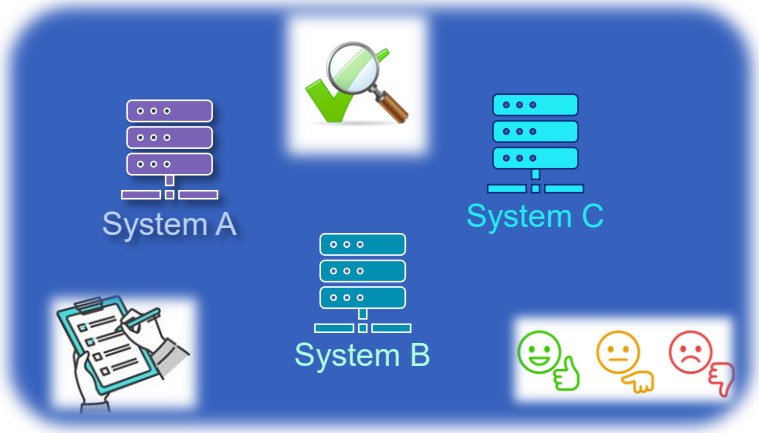
- **Uses Beyond the Capability Assessment**

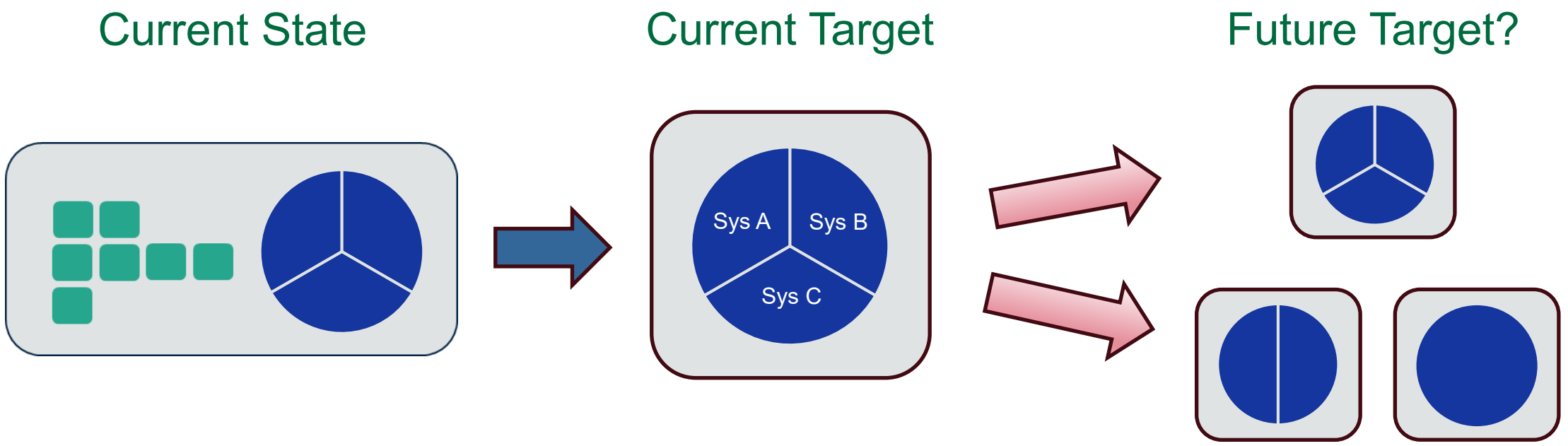


2024 GPDIS Presentation

Review: GPDIS 2024

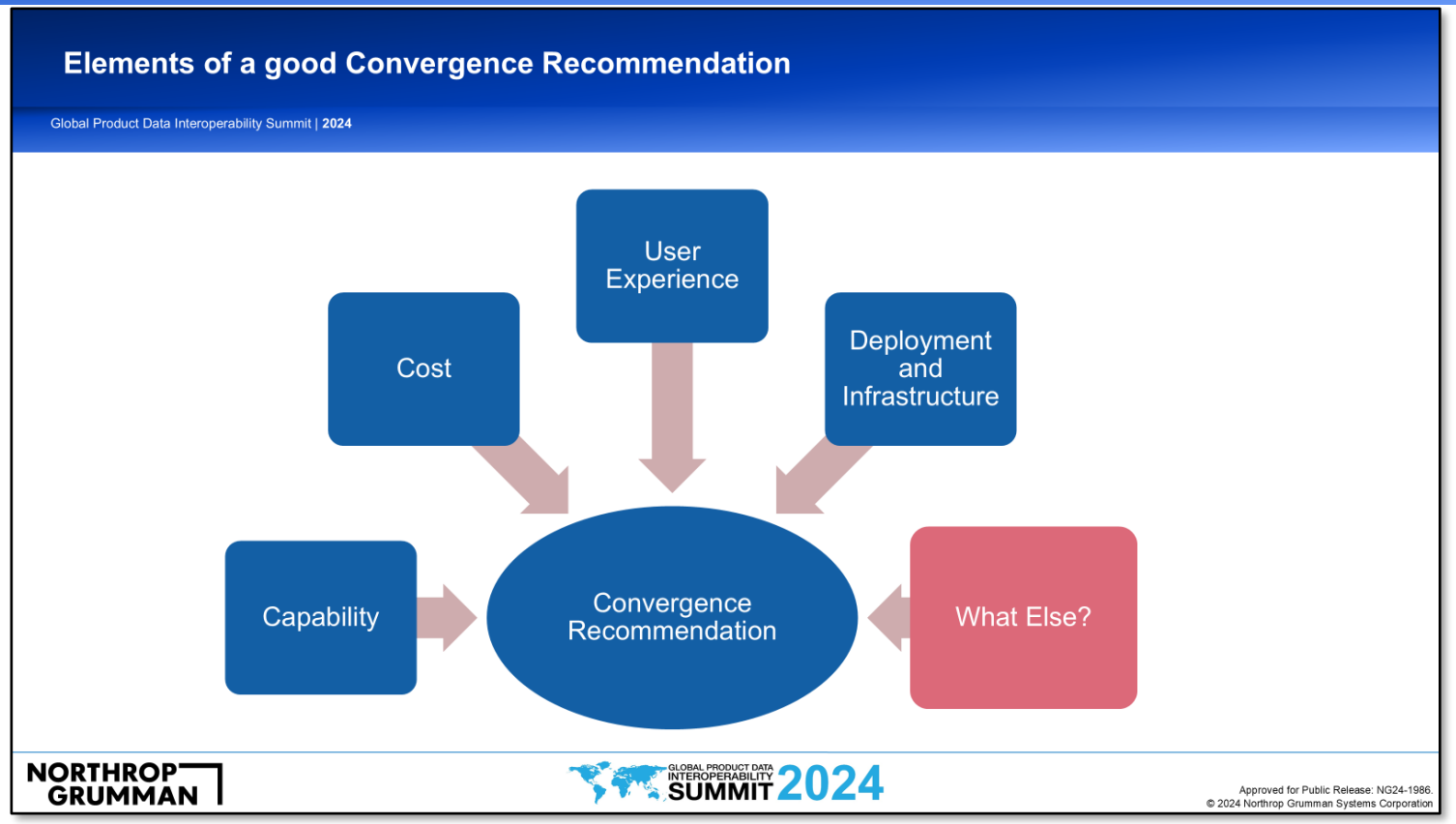
- **The Task – Make a Convergence Recommendation**
- **The Approach – A Capability Assessment... and other Assessments**

Review:
GPDIS 2024



The Task – Make a Convergence Recommendation

Review:
GPDIS 2024



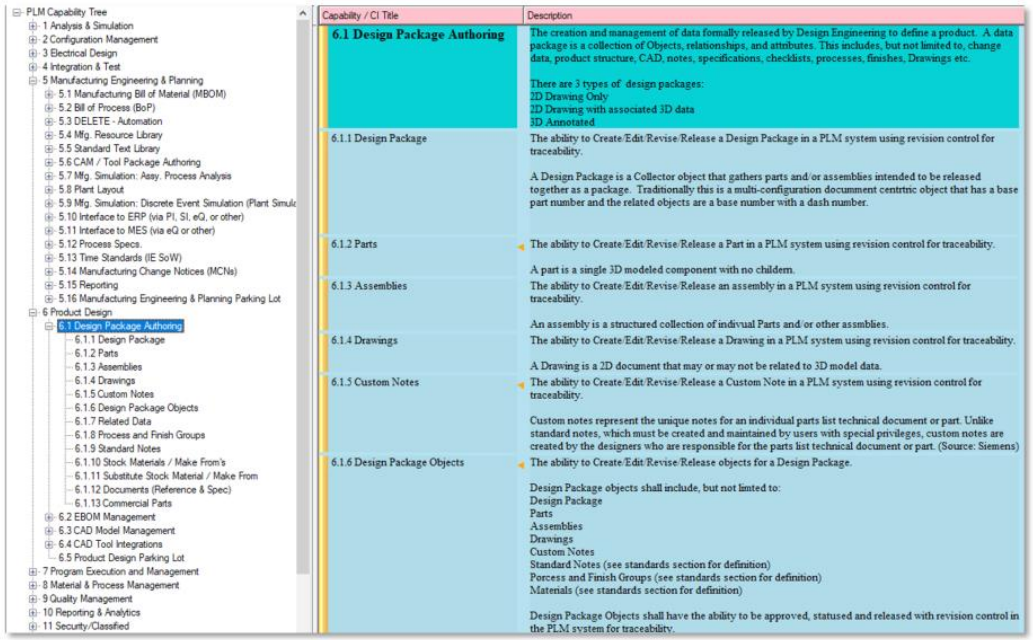
The Approach – A Capability Assessment... and other Assessments

Capability Tree Authored in Doors

Global Product Data Interoperability Summit | **2024**

Item Type	Count
Process Areas	16
Capabilities	90
CI's	418
Grand Total	**524**

Process Areas	Count of Capabilities	Count of CI's
Analysis & Simulation	3	57
Configuration Management	5	32
Electrical Design	9	47
Integration & Test	3	6
Manufacturing Engineering & Planning	14	77
Material & Process Management	6	22
Product Design	4	34
Program Execution and Management	5	13
Quality Management	10	32
Reporting & Analytics	2	12
Security/Classified	4	7
Software Development	1	19
Standards Management	7	28
Supplier Collaboration	5	2
Sustainment	9	19
Systems Engineering	3	11
Grand Total	**90**	**418**



All the Process Areas, Capabilities, and Capability Increments that make up an ideal, mature PLM system for NGC

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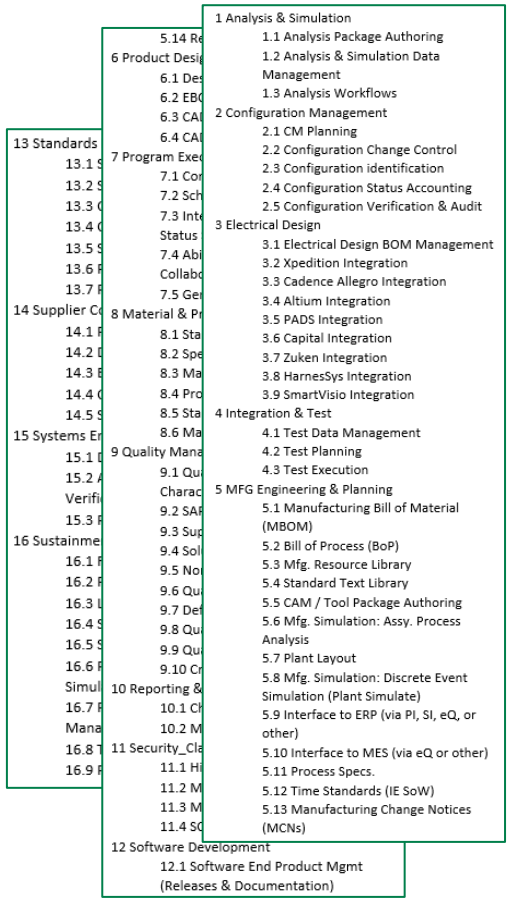
Capability Assessment - Methodology

Review: GPDIS 2024

1: **Develop Capability Tree**, a structured set of Process Areas (16), Capabilities (90), and Capability Increments (405) that describe an ideal, mature PLM System at NGC



2: **Perform Capability Assessment**, scoring each PLM System's Capability Increment Realization and Capability Maturity

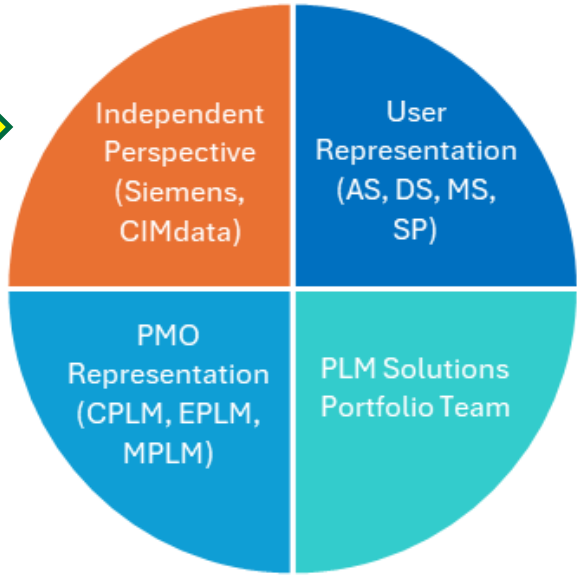
Does the System do the Capability?

5.1 Manufacturing Bill of Material (MBOM)	Sys A	Sys B	Sys C
- Capability Increment Realization	5.00	4.38	3.13
5.1.1 Author MBOM Structure	1	1	1
5.1.2 Author Manufacturing Part	1	1	1
5.1.3 Consume Parts & Assemblies from EBOM (with Visualization)	1	1	0
5.1.4 Re-use MBOM Assys (as required)	1	1	0
5.1.5 Validate EBOM / MBOM Consumption (Accountability Check)	1	1	1
5.1.6 Apply Configuration (Variants, Effectivities)	1	1	1
5.1.7 Assign Alternate & Substitute Parts	1	1	1
5.1.8 Conduct Data Validation	1	0	0
Total Supported CIs	8	7	5

How well does the System do the Capability?

Automation	Usability	Digital Thread Connectivity	Usage
Full	Intuitive, Modern	Complete	Widely Used
All Manual	Frustrating, Antiquated	None	Available, but not used

3: **Review and Approve at Capability Assessment Board (CAB)**, a platform for discussion and debate; path for decisions to be made.



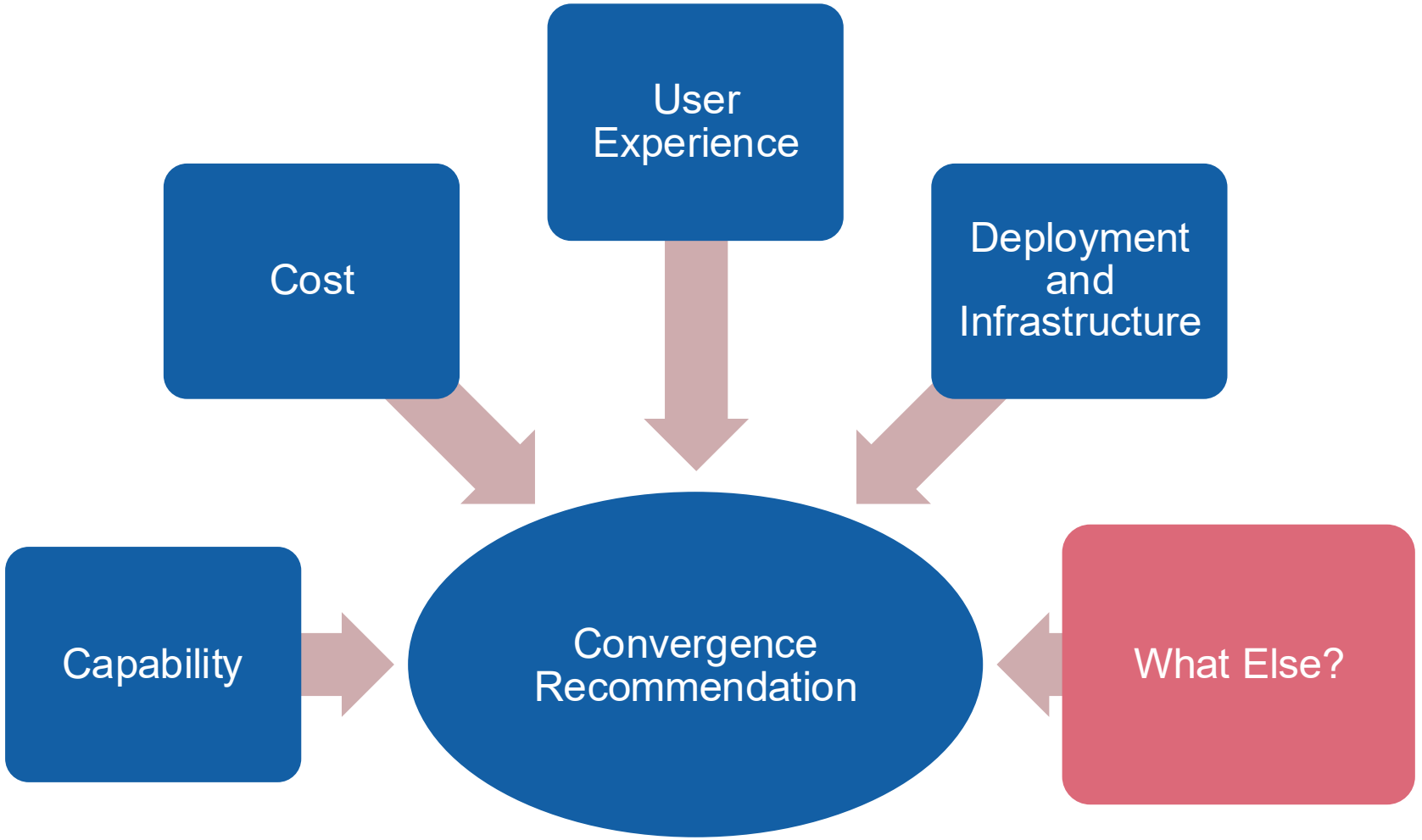
A standardized process, rigorous methodology, and effective collaboration across all sectors

What was Assessed?

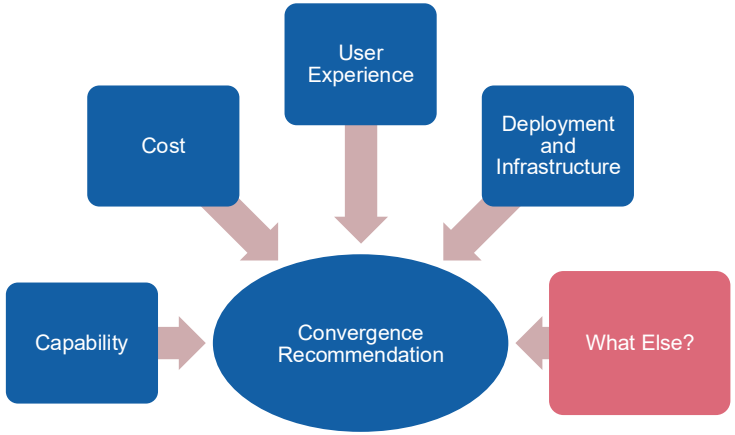
The Capability Assessment - Completed

- Course Changes
- Results
- What went well, what could be improved

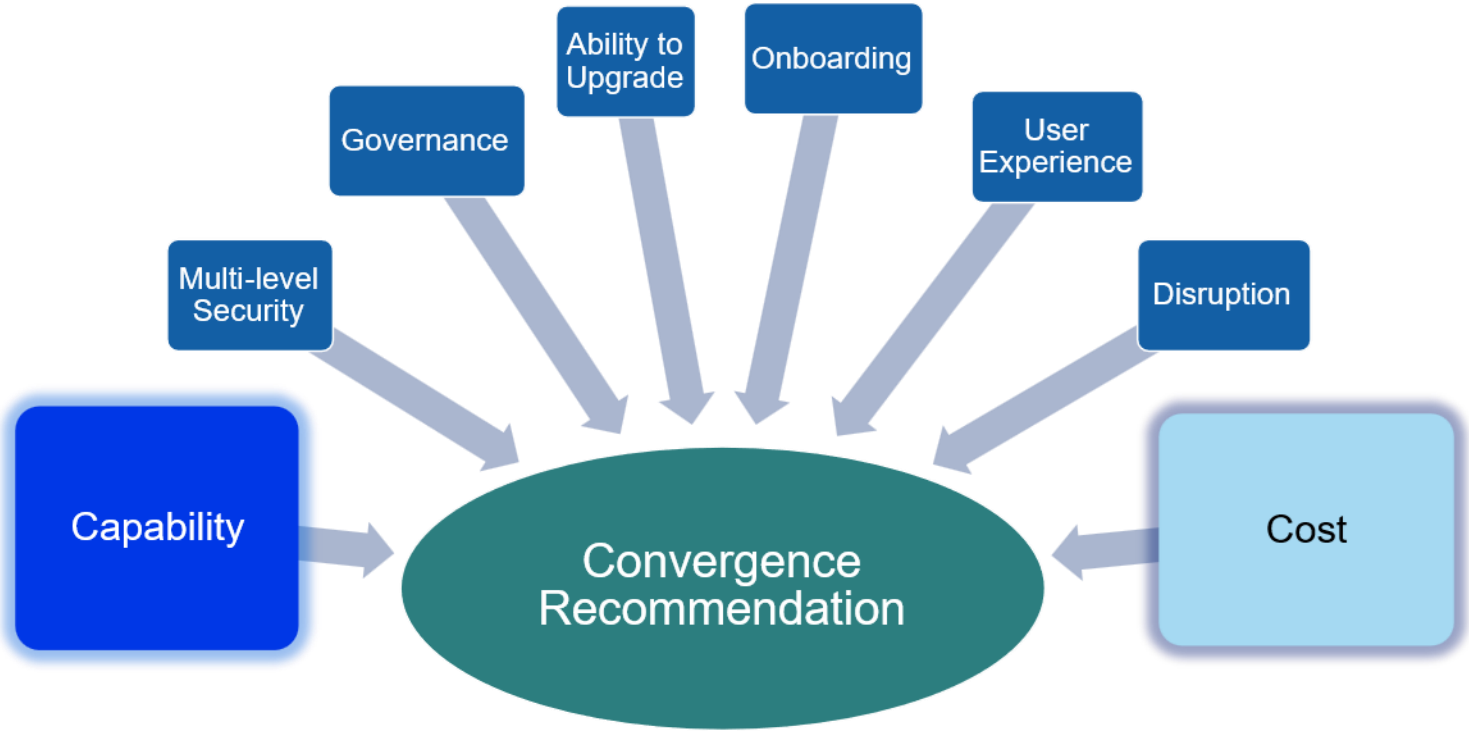
Course Changes

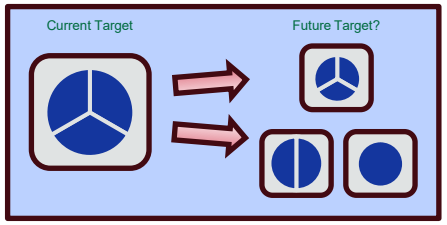


Course Changes

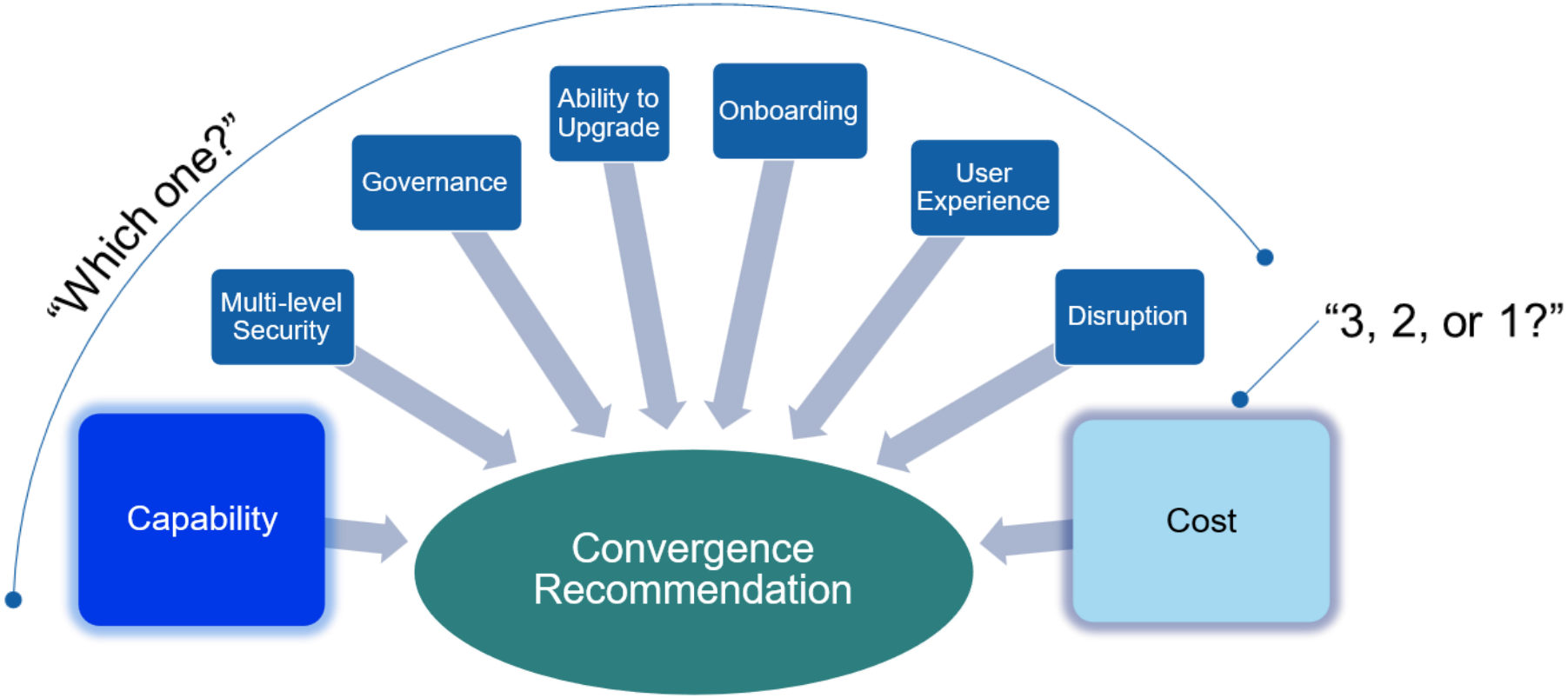


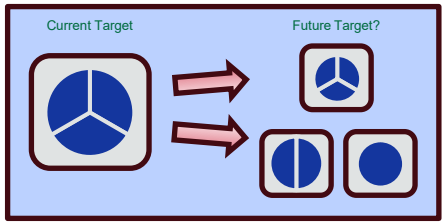
1. Capability Assessment remained a focus item
2. Operational Assessments were refined
3. Cost became a critical driver (…surprised !?!?)





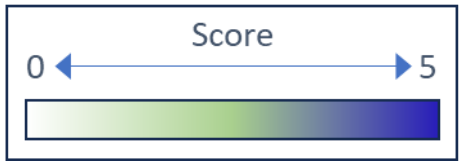
Course Changes





Capability Assessment - Scoring Summary

Process Area	Rank	Sys A	Sys B	Sys C	Target
Configuration Management	H	3.52	4.62	4.21	4.84
Manufacturing Engineering & Planning	H	3.73	2.47	2.83	4.59
Product Design	H	3.98	3.91	3.84	4.88
Standards Management	H	3.60	3.00	3.07	4.81
Analysis & Simulation	M/H	4.48	3.21	3.91	5.00
Material & Process Management	M/H	3.92	3.45	3.44	4.57
Electrical Design	M	2.64	1.26	3.52	4.19
Reporting & Analytics	M	4.22	4.32	4.50	4.73
Security/Classified	M	4.35	2.65	1.30	4.73
Integration & Test	L/M	2.77	3.12	2.77	4.60
Quality Management	L/M	1.55	0.87	0.00	2.58
Software Development	L/M	2.74	2.84	2.79	4.50
Supplier Collaboration	L/M	3.75	2.25	0.00	4.75
Systems Engineering	L/M	1.59	1.59	0.82	3.98
Program Execution and Management	L	3.98	3.24	3.42	4.40
Sustainment	L	1.59	2.01	0.69	3.09
Weighted Average		**3.61**	**3.15**	**3.12**	**4.62**



<u>Comparative Strengths in key areas are consistent with current business needs</u>

- System A Strengths:
  - Manufacturing Engineering & Planning
  - Analysis & Simulation
  - Material & Process Management
  - Security/Classified
- System B Strengths:
  - Configuration Management
- System C Strengths:
  - Electrical Design
  - Reporting & Analytics

Notes:
- *Low scores may reflect absence of requirements from current users*

Capability Assessment - Scoring Detail Examples

Process Area	Rank	Sys A	Sys B	Sys C	Target
Configuration Management	H	3.52	4.62	4.21	4.84
Manufacturing Engineering & Planning	H	3.73	2.47	2.83	4.59
Product Design	H	3.98	3.91	3.84	4.88
Standards Management	H	3.60	3.00	3.07	4.81
Analysis & Simulation	M/H	4.48	3.21	3.91	5.00
Material & Process Management	M/H	3.92	3.45	3.44	4.57
Electrical Design	M	2.64	1.26	3.52	4.19
Reporting & Analytics	M	4.22	4.32	4.50	4.73
Security/Classified	M	4.35	2.65	1.30	4.73
Integration & Test	L/M	2.77	3.12	2.77	4.60
Quality Management	L/M	1.55	0.87	0.00	2.58
Software Development	L/M	2.74	2.84	2.79	4.50
Supplier Collaboration	L/M	3.75	2.25	0.00	4.75
Systems Engineering	L/M	1.59	1.59	0.82	3.98
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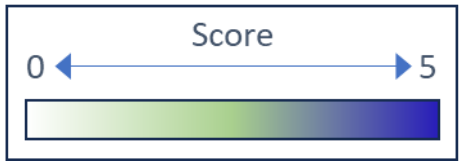


	Weight	Sys A	Sys B	Sys C
Configuration Management		3.52	4.62	4.21
Configuration Change Control	0.33	4.00	4.50	4.38
Configuration identification	0.25	3.75	4.75	4.75
CM Planning	0.20	3.50	4.50	4.25
Configuration Verification & Audit	0.12	1.75	4.75	2.75
Configuration Status Accounting	0.10	3.50	4.75	4.00

	Weight	Sys A	Sys B	Sys C
Standards Management		**3.60**	**3.00**	**3.07**
Specification Management	0.20	3.50	4.50	4.00
Commercial Part Management	0.20	3.25	2.79	3.23
CAD Model Management	0.20	3.38	3.63	4.00
Standard Note Management	0.20	4.50	0.00	0.00
Part Classification	0.10	3.50	4.00	4.00
Standards Request Management	0.05	3.40	4.00	4.40
Reporting	0.05	3.00	4.25	4.00

Each Process Area score = the weighted average of its Capability Scores

Notes:

- *Low scores may reflect absence of requirements from current users*

Capability Assessment – Key Score Drivers (1/2)

Process Area	System A	System B	System C
Configuration Management	Score 3.52 ↓ Often used as a repository for program data after approval workflows in external systems	Score 4.62 ↑ **All program documentation fully processed & executed within PLM**	Score 4.21 ↑ Automated workflows for approval routing
Manufacturing Engineering & Planning	Score 3.73 ↑ **ERP & MES interfaces**	Score 2.47 ↑ MES interface for EWI (hyperlink)	Score 2.83 ↑ ERP interface: Parts, MBOM
Product Design	Score 3.98 ↑ Check-Mate & DFMPro ↓ Requires Rich Client	Score 3.91 ↑ **Both Separated & Integrated CAD** ↑ Check-Mate & DFMPro	Score 3.84 ↑ Check-Mate with results leveraged
Standards Management	Score 3.60 ↑ **Standard Notes management**	Score 3.00 ↑ Links to IHS (Accuris)	Score 3.07 ↑ Internal NG specifications management
Analysis & Simulation	Score 4.48 ↑ **Supports the most tools overall & the most integrated tool launches**	Score 3.21 ↓ Less mature capabilities overall	Score 3.91 ↑ Passes data beyond geometry (inputs, models, boundary conditions)
Material & Process Management	Score 3.92 ↑ Automated material management & product process management	Score 3.45 ↑ **Links to external system (IHS) for specification management**	Score 3.44 ↑ Highly automated Standards Request
Electrical Design	Score 2.64 ↑ Most mature integration with Xpedition, Capital, and HarnesSys	Score 1.26 ↓ No control of in-work designs (System B only stores released versions)	Score 3.52 ↑ **Integrations with the most tools (Xpedition, Cadence, Capital, Zuken)**
Reporting & Analytics	Score 4.22 ↑ Extracts have process monitoring & more consolidated code	Score 4.32 ↑ eQube reports integrated with AWC	Score 4.50 ↑ **Data extracts 3x/day or hourly**

Capability Assessment – Key Score Drivers (2/2)

Process Area	System A	System B	System C
Security / Classified	**Score 4.35** ↑ Low to high sync capability ↑ Automated classification markings	**Score 2.65** ↑ Classification marking & standard notes are available	**Score 1.30** ↓ **No classified capabilities currently available in production**
Integration & Test	**Score 2.77** ↓ Test Procedures business object is extremely limited and not used	**Score 3.12** ↑ **Dedicated business objects for test procedures and test reports**	**Score 2.77** ↓ Do not yet have full EWI and BoP capabilities that will increase digital thread connectivity
Quality Management	**Score 1.55** ↑ **Quality Package Authoring & Quality BOP auto-fill into MES**	**Score 0.87** ↑ Supports supplier quality change requests & procurement data lists	**Score 0** ↓ No capabilities. MS has well-developed tools & a strategy for quality management in SAP
Software Development	**Score 2.74** ↓ No automation for SW packages, parts, documentation, or releases	**Score 2.84** ↑ **Tailored workflows for SW parts & associated document types**	**Score 2.79** ↑ Software Solution Package includes multiple parts (e.g. CSCI) and dependencies
Supplier Collaboration	**Score 3.75** ↑ **Supplier Collaboration briefcase for some data sharing with partners and suppliers**	**Score 2.25** ↑ External users with Workday accounts can author and approve in PLM	**Score 0** ↓ Data sharing done manually outside of the system
Systems Engineering	**Score 1.59** ↓ **Cannot import / export requirements**	**Score 1.59** ↑ Can support OOTB capabilities	**Score 0.82** ↓ No requirements hierarchies or spec trees
Program Execution and Management	**Score 3.98** ↑ Scheduling capabilities and integration with ESEV	**Score 3.24** ↓ Contract authoring is less mature	**Score 3.42** ↑ **AWC fully leveraged → more usable**
Sustainment	**Score 1.59** ↑ Mature support equipment design process	**Score 2.01** ↑ **Manages spares and needs locations** ↑ Some logistics analysis through TCSIM	**Score 0.69** ↓ No sustainment capabilities except depot repair and support equipment

Capability Maturity Insights

Capability Realization
Does the System do the Capability?

Capability Maturity
How well does the System do the Capability?

		Realization Score			Maturity Score		
Process Areas and Capabilities	Rank	System A	System B	System C	System A	System B	System C
Configuration Management	H	4.70	5.00	4.70	2.34	4.24	3.72
Manufacturing Engineering & Planning	H	4.87	3.75	3.44	2.59	1.19	2.22
Product Design	H	4.65	4.49	4.35	3.31	3.34	3.34
Standards Management	H	4.75	3.37	3.69	2.44	2.63	2.44
Analysis and Simulation	M/H	4.26	3.37	3.67	4.70	3.05	4.16
Material & Process Management	M/H	4.76	4.15	4.39	3.07	2.76	2.49
Electrical Design	M	2.95	1.57	4.38	2.33	0.94	2.65
Reporting & Analytics	M	5.00	5.00	5.00	3.44	3.63	3.99
Security/Classified	M	5.00	4.00	1.50	3.70	1.30	1.10
Integration & Test	L/M	3.33	3.33	3.33	2.20	2.90	2.20
Quality Management	L/M	2.00	1.23	0.00	1.10	0.50	0.00
Software Development	L/M	3.50	3.50	3.50	1.98	2.19	2.07
Supplier Collaboration	L/M	5.00	2.50	0.00	2.50	2.00	0.00
Systems Engineering	L/M	2.15	2.15	0.79	1.03	1.03	0.85
Program Execution & Management	L	4.60	3.93	3.83	3.35	2.55	3.00
Sustainment	L	1.76	2.90	0.76	1.41	1.12	0.61
Weighted Average		4.38	3.75	3.59	2.83	2.56	2.66

Opportunity for improvement

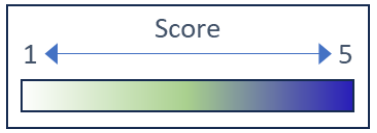
Capability Score

- Capability Realization
- Capability Maturity

Operational Assessments

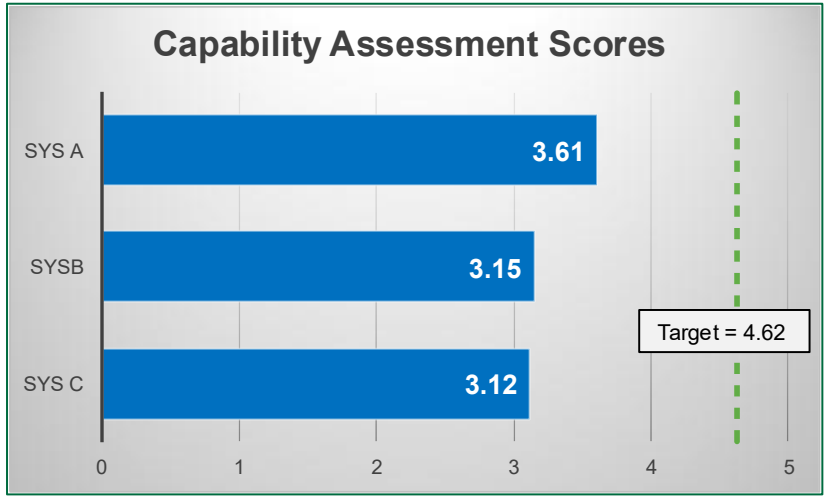
		Scores				Key Score Drivers		
Assessment Dimension	**Rank**	Sys A	Sys B	Sys C	Target	Sys A	Sys B	Sys C
Ability to Upgrade	H	1.60	3.00	3.40	4.00	↓ No CICD pipeline ↓ No deployment automation	↑ **Matured deployment automation**	↑ **Matured CICD pipeline** ↑ Developing auto-test
Governance	M/H	3.70	4.00	3.30	4.25	↑ **Periodic backlog meetings** ↓ No steering committee	↑ **Support for process variability** ↑ Site-level configuration	↓ Limited support for process variability
User Experience	M/H	3.30	3.20	2.00	4.00	↑ Rated highest in Interface & Connectivity	↑ Rated highest in PMO resources	↓ **Rated lowest by users in every category**
Degree of Disruption	M/H	3.14	3.33	3.27	3.75	↑ Rated best in Need to Update Partner Interfaces	↑ Rated best in User Interface ↑ Rated best in Process Change	↑ Rated best for Integrations ↑ **Most predicted users**
Multi-level Security Support	M	4.00	2.20	1.00	4.50	↑ **5 classified instances** ↑ Same Data Model Sync interim capability	↑ 2 classified instances ↓ Manual export and import	↓ No classified instances
On-boarding Approach	M	3.20	3.30	3.50	4.00	↑ Shortest learning curve ↓ Little hypercare/OCM	↑ Strong hypercare/OCM	↑ **Strong hypercare/OCM with metrics** ↓ Longest learning curve
Weighted Average		**2.97**	**3.26**	**2.89**	**4.04**			

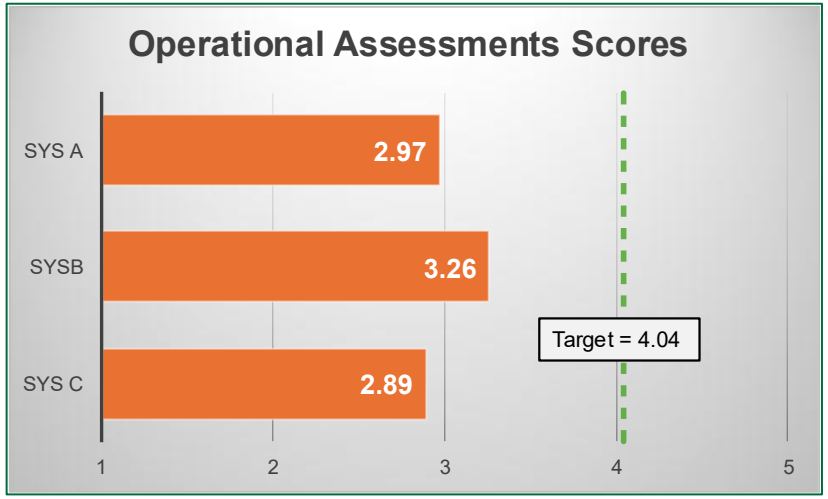
Operational Assessments, along with Capability Assessments, provide key information for convergence decisions



Results and Value Summary

- **Documented The NGC PLM Capability Tree is the most comprehensive structured list to date of what an ideal, mature PLM for NGC should be**
- **Captured an in-depth, documented understanding of what each PLM System does, where each systems excels, and where each system is behind**
- **Identified areas where all 3 PLMs can benefit from shared and leveraged capability development**
- **Developed a basis for estimating Capability Uplift development costs**
- **Established a precedent where all 3 PLM PMO's talked in detail about their systems**





Capability and Operational Assessments:

- A detailed comparison of System A, System B and System C capabilities and features
- A foundation for NGC's PLM Convergence decisions

Observations and Takeaways

What Went Well

- **Capability Assessment Board (CAB) Harmony**: The identification and active participation of CAB members and support staff improved the assessment process
- **Strong Collaboration**: The collaborative nature of the Assessment and the CAB format facilitated consensus on assessment scores, even when significant differences existed among solutions
- **Systems Engineering Approach**: The establishment of the PLM Capability Tree proved to be a valuable resource to assess system capabilities consistently and effectively

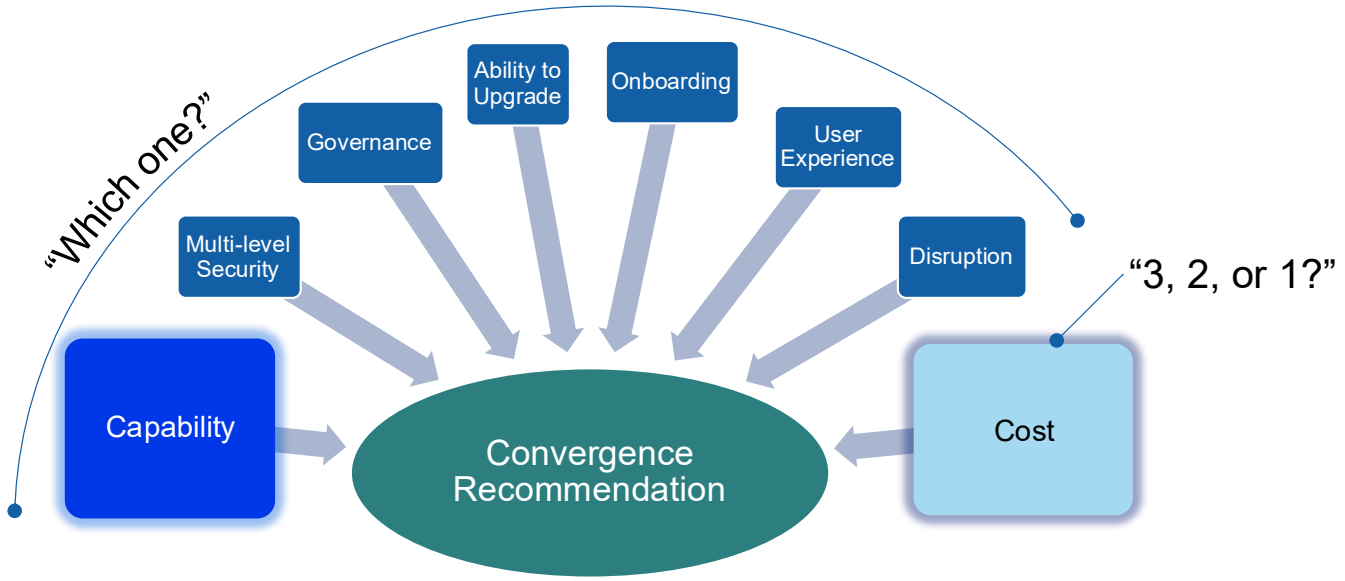
Challenges/ Lessons Learned

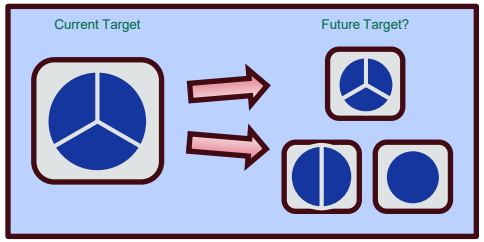
- **Leveraging Commonalities**: Several PLM areas exhibit common needs across all three solutions, highlighting potential benefits from shared or coordinated development efforts
- **Consistent Commitment**: The need for ongoing support from SMEs throughout the process enables efficient scoring to maintain schedule
- **Clear Interpretation of Scores:** Even though the assessment was purely an assessment of current capabilities, CAB participants were very concerned about the results being misinterpreted as “user needs not met”. It’s important to be clear on what scores represent.

Things We Would Do Differently

- **Earlier Identification of Recommendation Criteria**: Identifying key recommendation factors (e.g., resource and cost considerations) up front reduces schedule restrictions at end of project
- **Prioritization**: If assessment speed is prioritized vs. consensus, reformat the assessment to include demonstrations by SMEs followed by individual scores from CAB representatives
- **Maturity Definition**: Redefine Capability Maturity by setting an "acceptable" maturity level (Score=3) rather than the Maximum (Score=5) and Minimum (Score=1) levels

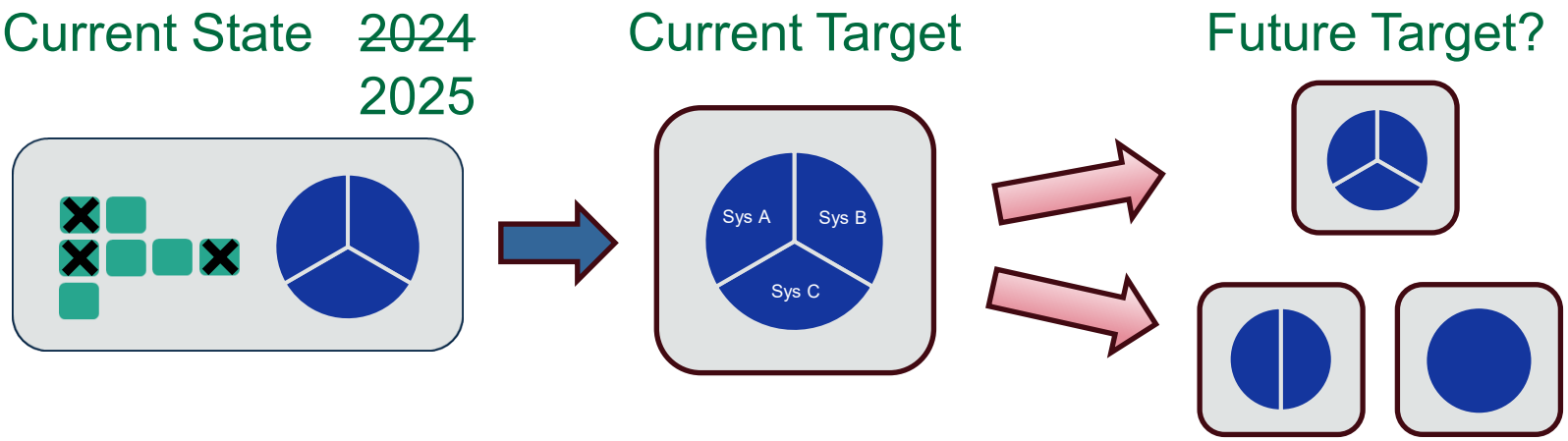
Notes on the Convergence Recommendation





Notes on the Convergence Recommendation

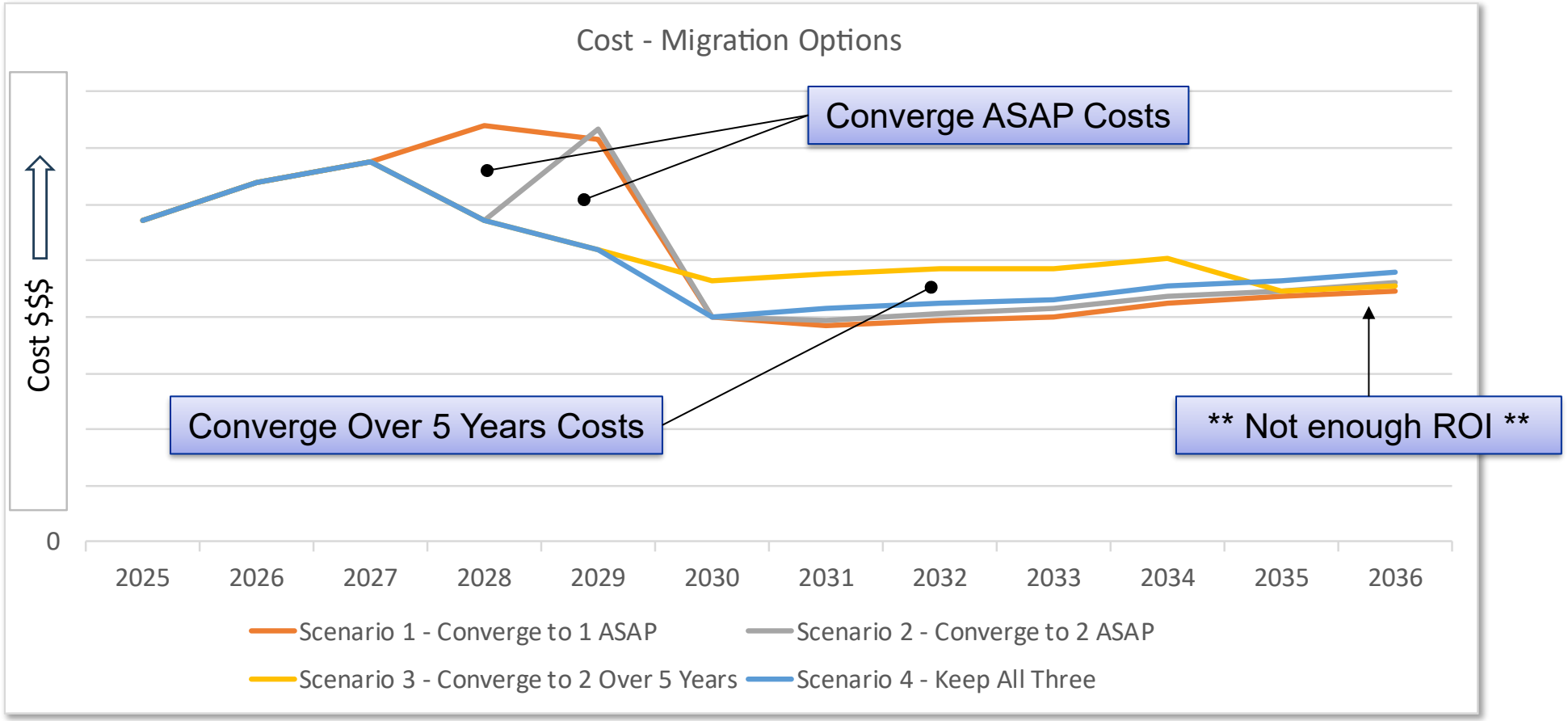
Still progressing to "Current Target"



Cost Analysis

- In depth financial analysis
- Recurring and non-recurring PLM costs
- Assessed by sector and by tool
- Incorporated cost to achieve desired capability levels
- Estimated multiple scenarios out 12 years

Convergence Recommendation Cost Analysis



Conclusion: Lowest cost scenario is to remain with three primary PLM systems

Uses Beyond the Convergence Recommendation

Uses Beyond the Convergence Recommendation

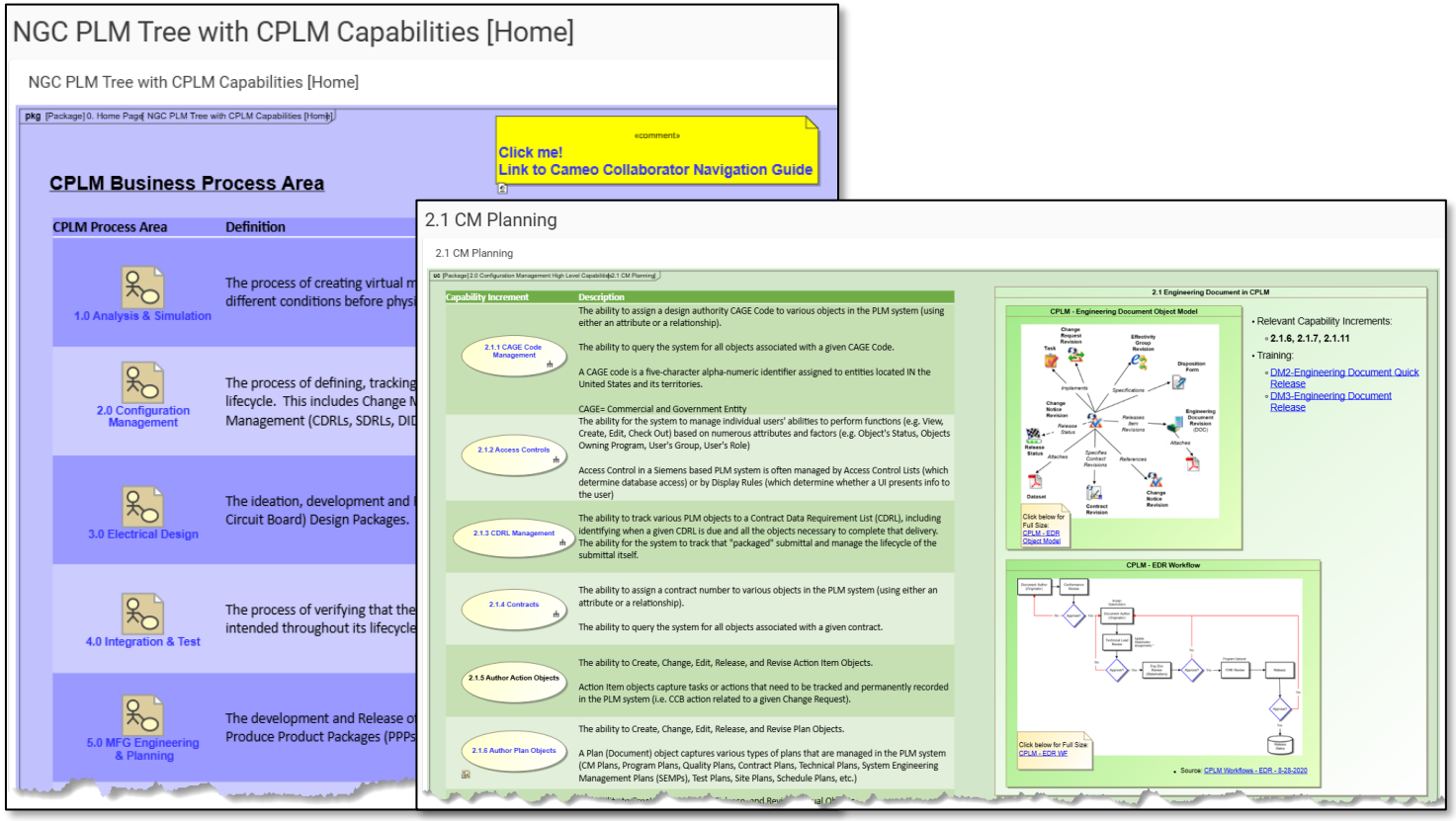
1. Starting point for making the three PLM systems complementary
2. Basis for on-going assessments
   - Target capability scores tailored to the needs of user base
3. A guide for new programs when choosing which system to use

5.1 Manufacturing Bill of Material (MBOM)	Sys A	Sys B	Sys C
- Capability Increment Realization	5.00	4.38	3.13
5.1.1 Author MBOM Structure	1	1	1
5.1.2 Author Manufacturing Part	1	1	1
5.1.3 Consume Parts & Assemblies from EBOM (with Visualization)	1	1	0
5.1.4 Re-use MBOM Assys (as required)	1	1	0
5.1.5 Validate EBOM / MBOM Consumption (Accountability Check)	1	1	1
5.1.6 Apply Configuration (Variants, Effectivities)	1	1	1
5.1.7 Assign Alternate & Substitute Parts	1	1	1
5.1.8 Conduct Data Validation	1	0	0
Total Supported CIs	8	7	5

Automation	Usability	Digital Thread Connectivity	Usage
Full	Intuitive, Modern	Complete	Widely Used
All Manual	Frustrating, Antiquated	None	Available, but not used

Uses Beyond the Convergence Recommendation

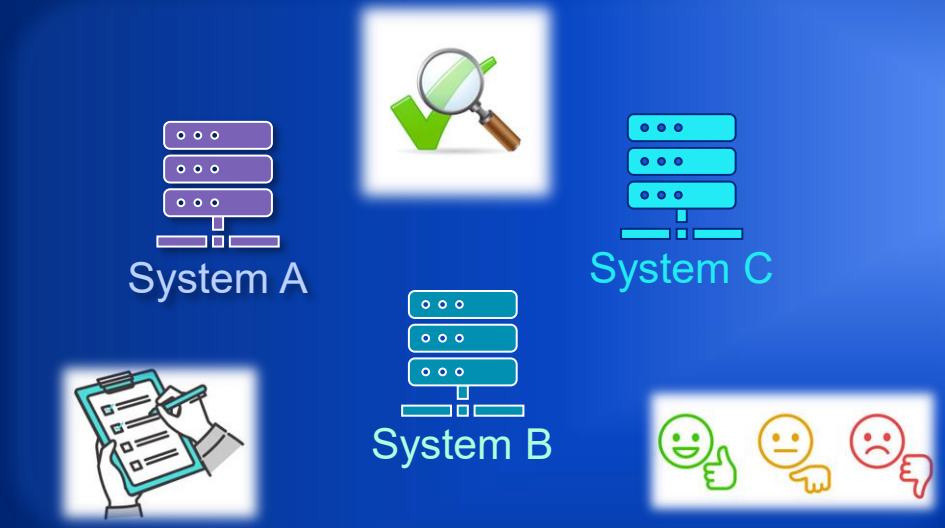
4. Capability tree: a road map for business process discussions in a migration
   - Structured way to highlight capabilities of target system in each process area
   - Helps users and SME's think through their current PLM system capabilities
   - Aids in identifying potential process gaps



CAMEO model:

- Full structured PLM tree with descriptions
- Detailed information on target system capabilities
- Links to training and other resources

Questions??



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