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# Ontology-first Hub and Spoke Digital Thread

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PLM Road Map™ & PDT North America 2024  
*Value Drivers for Digitalization of the Product Lifecycle*  
*Insights for the PLM Professional—Why the investment, what are the returns,*  
*and how are they achieved?*  
May 8 & 9

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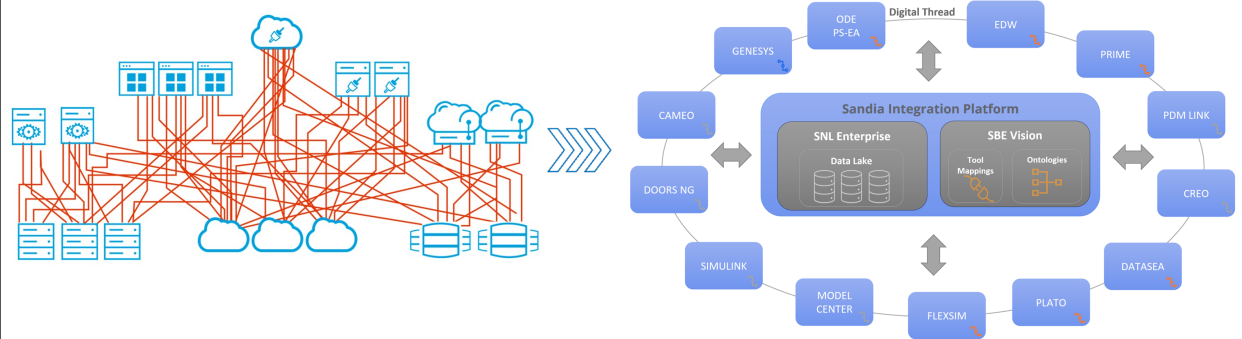



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## Hub-and-Spoke Model





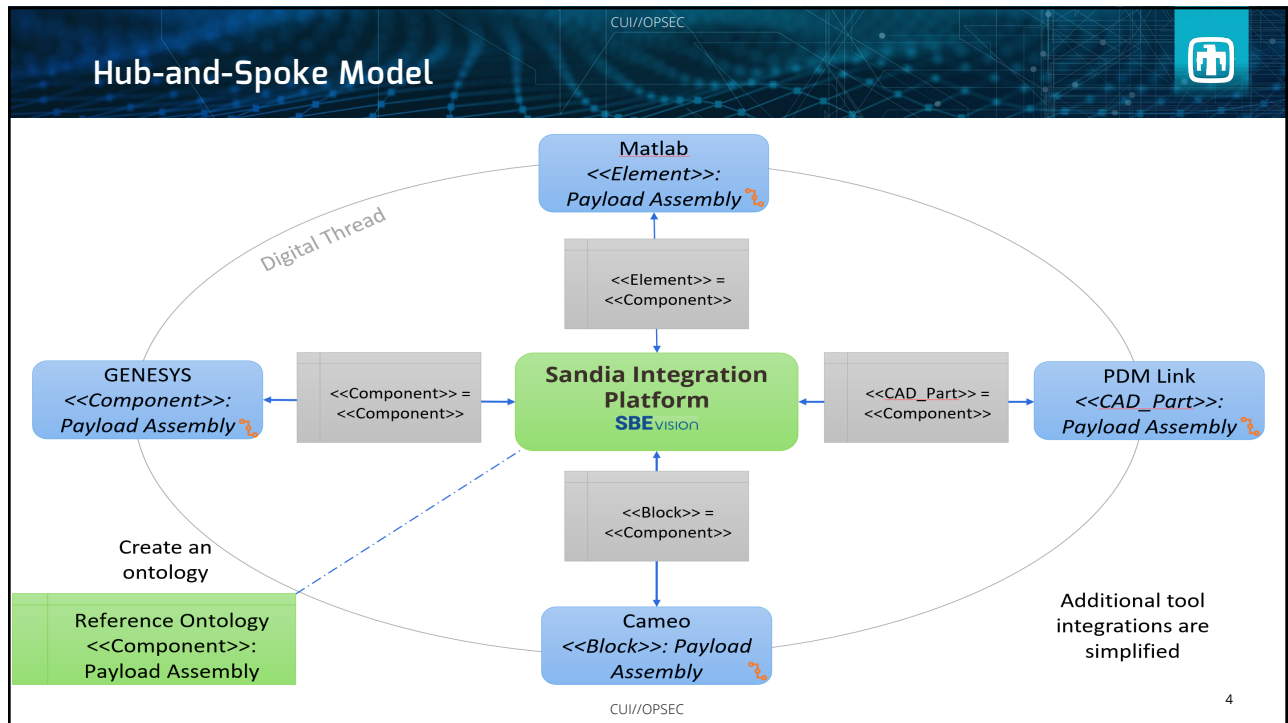
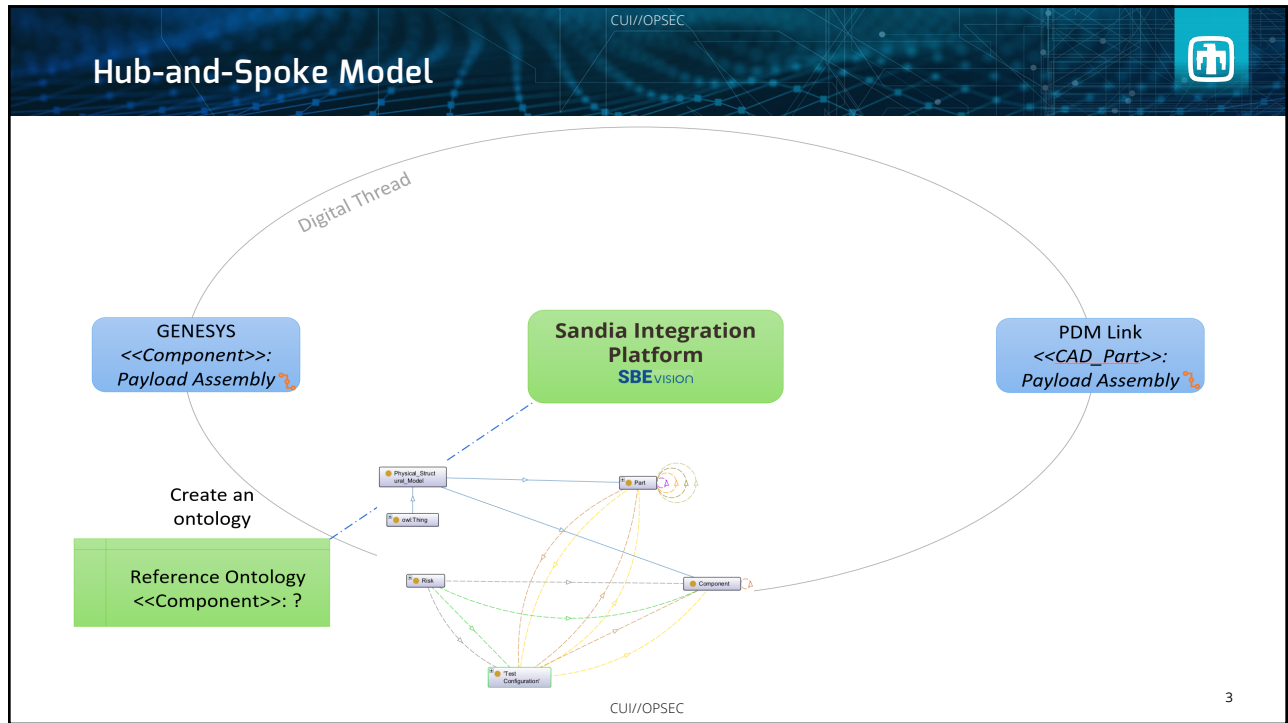
**Sandia Integration Platform**

SNL Enterprise (Data Lake) ↔ SBE Vision (Tool Mappings, Ontologies)

GENESYS ↔ ODE PS-EA ↔ Digital Thread ↔ EDW ↔ PRIME ↔ PDM LINK ↔ CREO ↔ DATASEA ↔ PLATO ↔ FLEXSIM ↔ MODEL CENTER ↔ SIMULINK ↔ DOORS NG ↔ CAMEO ↔ GENESYS

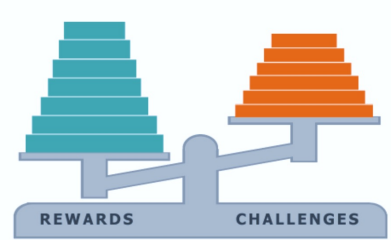
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# Notable Implementation Challenges

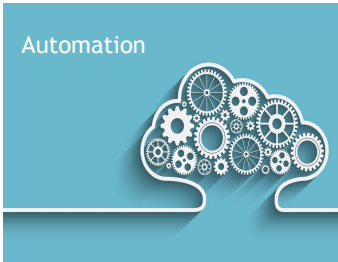
1. Complexity
  - Developing ontologies
  - Customer requirements
2. Volume
  - 3<sup>rd</sup> party adapters
  - Test data
3. Data Classification
  - Caution when aggregating government data
4. Configuration Management
  - Systems
  - Instances
  - Networks
  - Ontologies
  - Customers



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# Notable Benefits



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Tableau

Requirement	Requirement Id	Description	Obligation	Owner	Pentagon Designation	Evidence	Method Of Ver	Verification	Verification Requirement	File Location	Rationale	Ver Activity	Test Configuration	Component
The system shall have an inertial guidance system		Use accelerometers and gyroscopes to measure vehicle's acceleration and rotation	Requirement (shall)	SNL, CA - Sandia National Laboratory California	/D/	Null	Certification	Null	Null	Null	Null	Null	Null	Null
The system shall withstand temperatures of 2800 degrees Fahrenheit	ID1	During re-entry the system needs to withstand extreme levels of temperatures	Requirement (shall)	SNL, NM - Sandia National Laboratory New Mexico	/S/	Verification Document 01	Test	In Progress	Verification Requirement - Heat	snl//Sharepoint/Evidence/Artifact105	VR Test Title 1	Thermal Test Activity	Thermal Test Verification Parameters	Heat Shield
The system shall reach speeds of 5000 m/s	ID2	The system needs to achieve high levels of speed to escape the Earth's atmosphere.	Requirement (shall)	SNL, NM - Sandia National Laboratory New Mexico	/M/	Verification Document 02	Demonstration	In Progress	Verification Requirement - Speed	snl//Sharepoint/Evidence/Artifact108	VR Test Title 2	Speed Test Activity	Speed Test Verification Parameters	Propulsion Rockets
The system shall have a chemical propulsion system	ID3	Combustion of chemical propellants to produce thrust	Requirement (shall)	SNL, NM - Sandia National Laboratory New Mexico	/V/	Verification Document 03	Demonstration	In Progress	Verification Requirement - Chemical	snl//Sharepoint/Evidence/Artifact1112	VR Test Title 3	Chemical Reaction Test	Chemical Test Verification Parameters	Combustion Chamber

#### Key Verification Metrics

Total Requirements	180
Not Verified Requirements	240
Verification Requirements Completed	35%

#### Overall Verification Requirement Statuses

Not Started	Planned	Not Yet Planned	In Progress	Completed - Satisfactory	Completed - Unsatisfactory
10%	20%	15%	20%	15%	20%

#### Requirement List

Status	Verification Strategy	Environment Verification Strategy	Verification Activities	Verification Evidence	Exception
<span style="color: green;">●</span>	Requirement Verification Strategy for HT/Gear CD.14	Verification strategy for CD.100 in Transportation Vibration	VB100		
<span style="color: red;">●</span>	Requirement Verification Strategy for HT/Gear CD.14	Verification strategy for CD.100 in Transportation Vibration	VB100		
<span style="color: red;">●</span>	Requirement Verification Strategy for HT/Gear CD.14				<a href="#">RDX Document</a>
<span style="color: green;">●</span>	Requirement Verification Strategy for HT/Gear CD.14				
<span style="color: green;">●</span>	Requirement Verification Strategy for HT/Gear CD.28				
<span style="color: green;">●</span>	Requirement Verification Strategy for HT/Gear CD.28				

#### Verification Requirement Completed Burn Up Chart

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7
Requirement 1	D	A					
Requirement 2	-	-	-	D			
Requirement 3							
Requirement 4							
Requirement 5							

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Lessons Learned

1. Use case development is iterative
  - Define, refine, finalize use cases for a system involves multiple cycles
  - Use cases evolve as new requirements emerge or an understanding of existing requirements deepens
2. Work with upstream partners effectively and early in development
  - Showcase a new capability that is not yet in production
3. Digital Engineering requires data consistency across domains and environments
  - Things change - Involve subject matter experts, customers, and partners
  - The method on how a customer verified requirements changed
4. Unrepresentative data in our Development and Quality environments
  - Inefficiency in our development delivery cycle

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## Next Steps

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- Continue to build our digital thread within Sandia to incorporate design engineering
- Include our external production partners



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Q&A



Thank You!

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