

Abstract Submission list

**Paper index:** [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [16], [21], [22], [25], [27], [28], [29], [30], [31], [32], [33], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44], [45], [46], [47], [48], [49], [50], [53], [54], [55], [56], [58], [59], [60], [61], [62], [63], [64], [65], [66], [67], [68], [69], [70], [71], [72], [73], [74], [75]

[3] Daniel Schrage (Georgia Institute of Technology). *Value Based Decision Making - The Missing Element in MBSE.*

**Abstract.** While there has been substantial progress in moving toward Model Based Systems Engineering (MBSE) and use of improved or modified Systems Engineering Vee Diagrams, a key element is missing. While Value Based Acquisition (VBA) was identified several decades ago for making value based decisions, it often hasn't been incorporated in defining new approaches for MBSE. The Georgia Tech graduate program in Aerospace Systems Design, the largest in the world, has built its foundation on a generic Integrated Product/Process Development (IPPD) methodology that makes a top down design decision-making process the centerpiece for conducting tradeoffs and making decisions using Systems Engineering and Quality Engineering methods and tools in a Computer Integrated Environment. This paper will address how value based decision-making can be added and used in advances to MBSE.

**Track:** MBSE

[4] Sunil Elanayar (Boeing IT) and Gee Kim (Boeing IT). *PLM on the Edge.*

**Abstract.** The Internet of Things (IoT) and the Industrial Internet of Things (IIoT) are displacing Cloud based centralized applications. Future IOT applications will bring together hyperconnectivity, edge computing, Distributed Ledger Technologies (DLT), and Artificial Intelligence. We explore the connotations for using PLM as an extended enterprise solution with involvement from suppliers and customers. We explore how PLM solutions will integrate mechanical, electronic, and software domains and support ALM-SLM integration for faster changes and upgrades.

The next generation of products have a mix of mechanical, electronic, and software components. One of the major problems with dealing with this multi-disciplinary design is the different language constructs spoken by disciplines in Engineering. One of the ways to address this is through Domain Specific Languages (DSL.) In past work, mechanical design using language constructs have been addressed through Knowledge Based Engineering (KBE) technologies, electronic design has been addressed through HDL (Hardware Description Language) and VHDL (Verilog.) We present a unified approach to design language construction and design compiler that results in real designed products. We also explore areas for future research by incorporating elements of simulation and exploratory what-if? capabilities by using specific case studies.

**Track:** Emergent Technology

[5] Alexander Niakoulov (Northrop Grumman Corporation). *Best Practices: Establish a Software Evaluation Lab to Propel Your Digital Manufacturing Initiative.*

**Abstract.** Are you a decision-maker responsible for tools and technologies in your organization? Have you introduced a software and immediately started customizing it to fit your existing processes without finding out why it was designed this way? Have you implemented a complex software without initial proof of value? If the answer is ‘yes’ to any of the questions above, this session is for you. It will discuss how Northrop Grumman Aerospace Systems addressed these concerns by establishing a software evaluation lab to support its Integrated Digital Enterprise initiative (NGIDE), which provides a design to sustainment model-based approach and enables the digital thread and digital twin. Digital transformation initiatives, such as NGIDE, introduce significant amount of change affecting people, processes, and tools. In the past, the company culture often mandated customization of commercial-of-the-shelf software solutions prior to implementation or development of custom software to fit existing processes and minimize amount of change for the people, resulting in systems disconnected from industry best practices, expensive, and hard to maintain, upgrade, and replace. To remedy these problem, the NGIDE leadership established the Evaluation Lab to prevent unnecessary customizations, reduce integration costs, and mitigate risks by evaluating of commercial off-the-shelf software with potential out-of-the-box benefits.

**Track:** Emergent Technology

[6] Subodh Chaudhari (Phoenix Integration) and Tony Davenport (Phoenix Integration). *ModelCenter MBSE: The next generation MBSE to Analysis integration tool.*

**Abstract.** Phoenix Integration is launching an entirely new analysis integration framework for MagicDraw and CAMEO Systems Modeler called ModelCenter MBSE. ModelCenter MBSE for MagicDraw has been designed from the ground up to be more flexible and easier to use than ever. It has been built on the lessons learnt from the success of MBSEPak, the first comprehensive MBSE to Analysis integration tool from Phoenix Integration. ModelCenter MBSE allows engineers to integrate any set of analysis tools with any SysML model element to validate system behavior, verify requirements satisfaction, and optimize the system design - reducing cost, shortening development times, and resulting in a better product.

**Track:** MBSE

[7] Kelli Howe (Boeing) and Tj Smith (Boeing). *Retrospective and Lessons Learned for Digital Threads through Model-Based Product Standards.*

**Abstract.** Creation of digital threads for data underlying product standards will improve production rates, production costs, product quality, and enable benefits of analytics & simulation. This can be achieved via the Second Century Enterprise Systems (2CES) platform by transforming product standards documents to a model-based format so that every consumer of product standards information receives exactly the information they need, when and where they need it. Nearly all product standards information is contained in PDF documents that must be read, interpreted, and re-entered into systems throughout the value stream.

For the 2CES effort, the BR&T Product Standards Office has dedicated resources to develop the digital thread for the most widely used product standards, i.e. process specifications, material specifications, and part standards.

This presentation is a follow-up to last year’s Model-Based Product Standard concept. We will discuss what has been attempted thus far, lessons learned, and the roadmap for moving forward.

**Track:** MBD

[8] Kenn Hartman (DSA). *Implementing the Model-based Enterprise for a Measurable ROI.*

**Abstract.** This session will outline the critical process & application components, implementation challenges, expected implementation durations, and provide evidentiary data from multiple client surveys regarding the real measurable ROI for a Model-based Enterprise

**Track:** MBD

[9] David Votaw (NGC). *DevOps - Driving quality through risk mitigation.*

**Abstract.** Abstract:

This presentation will provide a summary for automation and testing through DevOps addressing:

The Culture and atmosphere to support DevOps Test Driven Development (TDD), Manual acceptance testing, Automated regression testing, Process automation and Pipeline automation

DevOps can help reduce and mitigate risk through automation. Automated processes, testing and Test Driven Development (TDD) are a major culture change, and the change will require a significant amount of resources to establish, grow, and sustain. Developers often understand the weight of quality software development, but all primary stakeholders should be made aware and supportive of the efforts necessary to deliver a quality software product. Quality is a baked-in side-effect of automation, thus, resources will need to be made available to support this effort. Pipelines can automate the processes from development, testing, integration, staging, user testing, and production. Pipeline automation, TDD, and automated testing are examples of automation that support quality software. Nearly every task that is performed manually today has the potential for automation, and therefore should be automated.

**Track:** PDSTV

[10] Adrian Murton (Airbus Operations Ltd.). *Archiving MBSE data: the why, what and how.*

**Abstract.** The aerospace industry is in a phase of transition where many of the traditional documentation deliverables are best represented by models. The development and utilization of data and tool standards is also in transition resulting in widespread variation in how the models are created and preserved. What is required is the development of common principles and supporting applications needed for implementation. To satisfy regulatory requirements this “Model-based Systems Engineering (MBSE) data” will need to be archived and in a format that enables retrieval at a later stage.

To address this archive issue an MBSE working group has been established as part of the LOTAR (LOng Term Archiving And Retrieval) consortium. The purpose is to define a set of LOTAR standards, shared by international aerospace and defense industries for long term preservation of MBSE Information, taking into account the consistency with the other relevant LOTAR parts.

This presentation will provide a summary of the first year of the LOTAR MBSE working group, along with further details on the why, what and how of archiving MBSE data.

**Track:** MBSE

[11] David Selliman (CoreTechnologie) and Justin Sabol (CoreTechnologie). *A “STEP” forward for Product Lifecycle Management.*

**Abstract.** This presentation will review the significant problem of having countless proprietary file formats and the exchange of 3D CAD data since the beginning of 3D CAD modeling. CAD applications and methods using digital data are constantly changing, which predicates the need for a solution to share validated and accurately translated data in the industry. Long Term Data Archival and Retrieval (LOTAR) is a multi-party International consortium for the standardization of the archival and retrieval of digital product and technical data. This consortium is working with ISO and other standardization bodies to standardize across multi-CAD environments enabling them to share 3D data within a Model-Based Environment (MBE) or a digital enterprise. In order to ensure the preservation of design intent, validation properties which include geometric shape representation, assembly features, Product & Manufacturing Information (PMI), among others need to be verified and validated for compliance. Additionally, the presentation will explain the AIRBUS 380 case study which was one of the key driving forces behind the creation of LOTAR. The presentation seeks to answer the question: How can we share validated and accurately translated data as well as maintain data for archival and retrieval that will be relevant 70+ years from now?

**Track:** MBD

[12] Brandon Sapp (Boeing). *A Framework for Data Standard Readiness using AP242 as Case Study.*

**Abstract.** This presentation will provide a frame work for an organization to assess their readiness to implement a data standard.

This presentation will go over how to assess an organizations information requirements, business process needs, internal tool chain and supplier needs.

The presentation will use AP242 as a case study - but not limited to AP242 implementations.

**Track:** MBD

[13] Daniel Campbell (Capvidia). *Semantic MBD Workflows with QIF.*

**Abstract.** Model Based Enterprise (MBE) brings about Digital Transformation in two important ways: (1) encoding and automation of cyber-physical processes, allowing faster realization of higher quality products at lower cost, and (2) by providing traceability of massive quantities of measurement-related data to the authority product definition model.

The benefits of automation and business process systemization are made possible with meaningful, semantic data packaged in a common MBE standard data format called the Quality Information Framework (QIF). With Model Based Definition (MBD) data (i.e., PMI, FT&A, etc.) becoming more commonplace, QIF is becoming an attractive complete and unambiguous MBD delivery mechanism for industrial end users. In addition to automation benefits, QIF helps to provide data traceability in this age of Big Data, where traceability is sorely needed. MBE provides a paradigm for organizing this data by mapping it all to a meaningful product definition: the master model-based definition enabled by a product data management system. QIF is designed to instantiate this MBE approach to data management.

This presentation will explain and show examples of how semantic MBE workflows can be accomplished in production settings using MBD standards like QIF.

**Track:** MBD

[16] Kirk Nelson (Boeing). *Moving Toward Integrated Digital Design.*

**Abstract.** The latest generation of Product Lifecycle Management (PLM) software suites promise an unprecedented level of integration across the entire lifecycle of an engineering design, but can they deliver on this promise? The answer is a qualified “yes.” A well-integrated engineering design lifecycle is possible, but may require an organizational commitment to changing the traditional design process. This presentation will explore some of the technologies and concepts that are critical in achieving the goal of an integrated engineering design including management of requirements and parametric data, templates, and automation.

**Track:** MBD

[21] Eugenio Rios (Collins Aerospace). *Using SysML and a Systems Engineering Approach for Manufacturing System Modeling.*

**Abstract.** Using SysML and a Systems Engineering Approach for Manufacturing System Modeling

Industrial and Manufacturing Engineers often see the introduction of a new piece of equipment as an isolated event with little or no impact on the rest of the production line. We focus on functionality and less on interoperability. We get excited about the reports it can generate and often fail to see the impact its integration has on existing infrastructure. When the need arises for tool-to-tool communication, we devise single-purpose “translator” tools to make the transfer and consumption of data possible. We seldom see it as a system in itself let alone a component of a larger integrated enterprise manufacturing system.

To address these tendencies and bring a systems engineering approach to manufacturing systems, we considered ways to model our production system to highlight gaps not readily obvious. We discovered how models of proposed process changes can communicate detailed requirements. We recognize the power of models to convey information and how more comprehensive models of our systems can be used to predict behavior especially when unexpected disruptions to the normal production flow occur.

This presentation discusses experiences in applying SysML and a systems engineering approach to manufacturing systems modeling.

**Track:** MBSE

[22] Jean-Yves Delaunay (Airbus). *Use of STEP AP242 ed1 to support MBD, PDM and RV&VM; summary of AP242 ed2 Enhancement.*

**Abstract.** New industrial projects are based on 3D Model Based Design and Manufacturing principles, aiming at supporting the digital thread with seamless communications across the full life cycle.

This presentation remind the scope of AP242 ed1 and sum up its status of implementation by CAD and PDM editors and integrators; it provides illustrations of use, e.g. CAD 3D GD&T, composite and PDM data exchange. It highlights the role of the CAx and PDM Implementer Forums, and sums up their 2019 deliverables.

It describes the enhancements of AP242 ed2 DIS2, planned to become “International Standard” end of 2019. It includes extensions to electrical wiring harness design, additive manufacturing, enhancements for 3D semantic PMI. It provides the results of the PDM harmonization between AP242 ed2 and AP239 ed3, planned to become the cornerstone information model for “through life cycle interoperability”.

It highlights the importance of communication actions to speed up the adoption of AP242 interoperability solutions.

The presentation sums the progress of the related ISO 10303 Application Protocols, covering Engineering, Manufacturing and Support, and their relationships with other standards, such as LOTAR and PDF 3D.

Finally, it highlights the importance of A&D industries cooperation to develop and use complex COTS PLM interoperability capabilities.

**Track:** MBD

[25] Garrett Thurston (Dassault Systèmes’), John Herrold (Boeing) and Lucas Aviles (Boeing). *Leveraging Dassault Systèmes’ 3DEXPERIENCE platform to Support Boeing’s Digital Thread.*

**Abstract.** Boeing is leveraging Dassault Systèmes’ 3DEXPERIENCE platform—including Cameo Enterprise Architecture application—in order to realize what might be called the “Digital Delta,” which is composed of the aforementioned digital twins and threads. With the usage of this solution portfolio, Boeing has a means to model and execute industry-standard architecture description models in conformance with any number of supported frameworks, i.e. UAF, NAF and UPDM.

A vital part of the digital thread is linking key Systems Engineering architecture description to downstream architecture and design digital definition elements and activities captured in Dassault Systèmes’ 3DEXPERIENCE platform. Boeing’s vision of its future system engineering is digitally integrating the system engineering and the elements of its enterprise digital backbone.

This presentation will provide the context of Boeing’s Digital Transformation initiative, as well as the motivation for creating an integration between the MBSE domain and the 3DEXPERIENCE platform including expanded digital twin definition, modeling and simulation, rigorous digital asset taxonomy, lifecycle management, regulatory, contract, project orchestration and accountabilities. The balance of the presentation will provide an overview and demonstration of the emerging technological integration being created between Dassault Systèmes’ No Magic Cameo and the 3DEXPERIENCE platform.

**Track:** MBSE

[27] Dinesh Khaladkar (eQ Technologic Inc.). *Accelerate Digital Transformation leveraging Data as a Service (DaaS).*

**Abstract.** Many organizations across the world are embarking on Digitalization or Digital Transformation of their businesses with multiple objectives: to gain long-term sustainable competitive advantages, to substantially increase their top-line and bottom-line performance, and to realize their organization’s full potential. They have established organizational goals to dramatically increase their ‘productivity’ and have embraced Digital Transformation / Digitalization as long-term strategies to realize those goals.

To achieve these productivity goals, there is a clear need to: efficiently and rapidly integrate many legacy systems and new COTS (commercial off the shelf) systems, responsibly retire legacy systems in an orderly manner without disrupting the business, rapidly implement intuitive end-user centric ‘for purpose’ applications, and provide on-demand ‘visibility’ across the business processes with analytics and business intelligence (A/BI). Essentially, a clear need to establish an enterprise class scalable framework that can offer Data as a Service (DaaS) in an Integrated Data Environment (IDE).

This presentation will discuss the eQube® platform capabilities for establishing an enterprise class scalable framework for DaaS.

**Track:** Emergent Technology

[28] Douglas McGowan (The Boeing Company) and Neil Lichty (The Boeing Company). *Co-Development of Model-Based Specifications in a Collaboration Exchange Environment.*

**Abstract.** Aerospace business success demands operating in a high energy, fast paced, and cost-conscious development environment. To be successful in this environment, companies are embracing Model Based Systems Engineering (MBSE) and Model Based Design (MBD) to achieve the effectiveness in developing aerospace products better and quicker.

As companies are implementing MBSE and MBE, product buy-package contents are changing from mainly textual based requirement sets to Model Based buy-packages that contain various types of engineering models along with supporting textual requirements. As in textual requirement based buy-packages, it is critical to have high quality Model Based buy-packages to reduce late engineering changes that lead to suppliers cost assertions.

Boeing is developing a supply chain interoperable environment that enables collaboration between OEMs and their suppliers. The system revolutionizes how we package requirements and exchange engineering models while maintaining configuration control and digital thread integrity. It provides a collaborative environment and data interoperability to extend the Boeing digital thread and requirements traceability across the supply chain.

This presentation will include exchange scenarios for model based specification development with suppliers:

•Collaboratively developing requirements and models to support model-based buy package specifications

•Configuration management of packages exchanged between parties

•Approaches to support intellectual property protection

**Track:** MBSE

[30] Jamie Kessel (Training and Professional Services). *Azure Platform Best Practices in Application Development and Deployment.*

**Abstract.** One of the popular Cloud based solution providers is Microsoft with the Azure delivering platform. What are the best practices for deploying in the Microsoft Azure environment? What does the typical architecture look like for applications? What is the best architectural approaches to develop applications using Azure services so that they meet 7X24X365 requirements with acceptable performance? This presentation will provide pertinent information on how to approach the development and deployment of applications using the Azure platform.

**Track:** PDSTV

[31] Brandon Seppa (Siemens) and Cynthia Zindle (Siemens). *Accelerate Custom Application Delivery with Agile and Model-Driven Development.*

**Abstract.** Companies around the world are leveraging their capacity to deliver fit-for-purpose software solutions at scale to create durable competitive advantage. In fact, according to Gartner, 75% of new business applications will be built not bought by 2021. This represents both a departure from the last decade+ of buying and customizing COTS solutions and a major challenge to IT as, again according to Gartner, three of every five solution development projects fail to meet expectations.

Given this shift and challenge, our mandate is to apply the concepts of visual, model-driven development that have been successful in other domains to application development, and to inculcate a culture in which developers, operations staff and business teams work more closely together to shorten feedback loops and improve outcomes.

In this session, we'll discuss the critical elements of a modern approach to Agile, model-driven development: from requirement and central feedback management to IDEs that make software development accessible to more types of developers (domain engineers, tech-savvy business people, etc.) to abstraction and automation that enables one-click deployment to cloud or on-premises infrastructure.

With the right tools and methodology, we can deliver custom solutions that hit the mark more often 10x faster than by traditional means.

**Track:** Emergent Technology

[32] Andy Beaupre (Kubotek3D). *Lessons Learned: Ten Years of Applying CAD Model Comparison.*

**Abstract.** Kubotek has been providing aerospace suppliers with solutions for validating CAD data translations and engineering change documentation for about 10 years now. Throughout this time, we’ve listened closely to our customers and used that feedback to develop the best tools possible to support CAD comparison needs and requirements for suppliers. In 2018, Kubotek launched the K-Compare brand, a line of all new Kubotek Kosmos-based CAD comparison applications. Kosmos is Kubotek’s proprietary application framework designed to preserve the geometry data structures used by all major CAD databases. The first product under the K-Compare brand is K-Compare Validate, a truly independent auditing tool for validating CAD data translations. K-Compare Revision, the second K-Compare product offering, is being introduced here at GPDIS 2019.

In this presentation we’ll talk about what we’ve learned, share some customer stories and survey results, as well as present Kubotek’s views on the implementation of CAD data comparison.

**Track:** MBD

[33] Bill Chown (Mentor, a Siemens Business) and Anthony Nicoli (Siemens Digital Industries Software). *Bridging Model-based Systems Engineering and Model-Based Design.*

**Abstract.** Modern aircraft employ hundreds of electronic systems and components, sophisticated communication networks, and miles of electrical wiring to deliver advanced functionality. Recognizing this increased complexity, the US Department of Defense identified the need to apply model-based approaches to enable innovation while keeping programs affordable and on schedule. This starts with systems engineering, proceeds to architectural definition and logical/physical design and extends into production and operational sustainment.

However, many program teams still use semi-manual methods and physical hand-offs to communicate between systems and design engineering teams. These obsolete methods uncover issues late in the program life cycle, forcing costly iterations, workarounds, and product delivery delays.

This paper describes a model-based approach to bridge systems engineering and the downstream lifecycle it guides. A variety of systems models, from SysML to simple text based descriptions, are normalized to drive development processes for multiple disciplines, e.g. electrical, electronic, and networks. A digital thread is established across the development lifecycle. This ensures rapid communication of requirements, operational concept and signal definition downstream, and timely information of interface control definition upstream. Furthermore, traceability from systems requirements and models is retained through the life cycle, facilitating compliance evidence generation and ensuring the fulfillment of each requirement.

**Track:** MBSE

[35] Donald Tolle (CIMdata Inc.). *Model-Based Systems Engineering (MBSE) meets PLM: Market Trends and Opportunities.*

**Abstract.** The exponential increase in the use of software and electronics has added a great deal of complexity to today’s cyber-physical products and systems, including now “systems of systems” in the interconnected universe of the Internet of Things and Industry 4.0/IIoT. With this increased systems complexity, product engineering teams now face new challenges that undesirable system-level behaviors will emerge due to cross-domain interactions that may not be adequately understood by any one functional domain of the product development team, including suppliers. This complexity demands that product development organizations move away from traditional stage gate and document-centric processes and increase reliance on agile and digital model-based processes that encompass all aspects of systems lifecycle design from initial requirements definition thru in-service use and re-use/retirement.

One of the greatest challenges to achieving the lifecycle Digital Thread goals is integrating the many different engineering models and data silos that exist today across systems engineering and the physics-based modeling/simulation domains. CIMdata will highlight the major industry efforts underway by both PLM/MBSE software vendors and end users in the integration of these heretofore largely disconnected domains including the industry interoperability standards and emerging technologies that will most strongly impact the required level of digital collaboration.

**Track:** MBSE Workshop

[36] Nabeel Mahmood (The Boeing Company). *Deploying MBSE to the Boeing Enterprise - Challenges Faced and Lessons Learned.*

**Abstract.** A Boeing team comprised of members across multiple divisions of the enterprise has been tasked with developing a Model-Based Systems Engineering (MBSE) tool and methodology set using a mix of commercial off-the-shelf software products, open source software, as well as custom-built solutions. Although considerable resources have been expended by the company to develop and implement MBSE for all programs with design and requirements analysis needs, the development team still faces significant challenges in developing the most ideal solution for all interested stakeholders, particularly in developing a solution that meets the critical program needs of ease-of-use, appropriate depth of functionality, and the ability to be integrated into existing Boeing engineering frameworks. These challenges are being addressed by several initiatives that the development team has introduced relating to best practices in iterative software deployment and communicating with the enterprise.

The MBSE development team at Boeing has also made progress in conquering many of these challenges and has been continually documenting the best practices that it has found to be helpful in response to challenges that were known beforehand, as well as unforeseen issues that only made themselves apparent as the software solution was increased in scope and complexity.

**Track:** MBSE

[38] Tatyana Vidrevich (XSB, Inc). *MODELS FOR UNSTRUCTURED, NON-GEOMETRIC INFORMATION OF TECHNICAL REQUIREMENTS.*

**Abstract.** Historically, model-based enterprise initiatives focused on geometry, dimensions and tolerances - the 3D models of parts. This did not address non-geometric information, communicated through free text on drawing notes and in documents created within the enterprise and standards bodies. These documents contain critical company data: material and process specifications, work instructions, test plans, and more. Their format obscures the complex web of concepts about parts, materials and processes that must be understood to ensure industry acceptable quality.

The inability to model and easily link to relevant concepts in drawing notes and Standards complicates configuration management and results in a lack of consistent interpretation of requirements throughout the product life-cycle. It also leads to the absence of bi-directional communication.

SWISS digital models expand the integrated view of engineering requirements to non-3D data. They facilitate more effective flow of information, analysis throughout the product lifecycle and enable assessment of change impact not feasible for legacy documents.

In this demonstration, XSB and Elysium will explore how engineers can understand the network of referenced concepts and their states from within drawings’ PMI. We will also show how an engineer can transform legacy specifications into smart, connected and change-aware assets within the enterprise PLM system.

**Track:** MBD

[39] Brett Nungesser (Siemens), Mike Denley (Siemens) and Tim Wormus (Siemens). *Closed-loop Industrial IoT: giving the model-based ecosystem a reality check.*

**Abstract.** The meaning of IIoT may change depending on whom you talk to. To some, it’s simply about condition monitoring or predictive maintenance of shop floor equipment, to others it is about creating new and differentiated service offerings and business models, or perhaps it is seen as a solution to better understand complex supply chains. None of these perspectives is wrong, though perhaps incomplete when viewed in silos. In truth, Industrial IoT is a much more pervasive, ubiquitous concept for which most are only just now scratching the surface. Harnessing the ability to easily connect to physical assets, understand and assess what they experience in real life, and then holistically analyze/represent those experiences against other key business systems and processes across an enterprise is what is required to breathe life into any model-based ecosystem – and thus, is a key requirement to fully realizing Industry 4.0 objectives. Without closing the loop between virtual and physical - or closed loop digital twin - your model based ecosystem will be unable to accelerate into the future, as it will always be wanting for critical, real-world insights that are otherwise lost in a labyrinth of silo’d processes, systems, and people.

**Track:** CAMSC

[40] Dan Dezarov (Elysium Inc). *FLEXIBLE TECHNICAL DATA PACKAGES: TEMPLATES & USE CASES.*

**Abstract.** Creating, modifying and representing TDP information in a recognizable and universally accepted way is very difficult, and often leads to the need or desire to customize the way that content is created or manifested from data available today. The inability to quickly modify and create templates for your data that can be used to process a variety of different inputs to fulfill TDP goals and objectives can be crippling.

Data Package Studio (DPS) provides a way to quickly and easily create and maintain templates for a variety of use cases using a user-interface that was built from the ground up to alleviate the struggles of real-time template creation. HTML and 3D PDF outputs provide multiple ways to view and share deliverables.

Join Elysium for an in-depth look at a variety of use-cases supported by TDPs. By reducing the amount of time spent customizing or designing templates and providing users with the tools to seamlessly link different data sources together inside of a 3D PDF or HTML report, TDP requirements can be expanded upon faster and represented more clearly without the intervention of a third party. Demos for DPS template creation, HTML/3D PDF outputs and XSB integration/collaboration will be shown

**Track:** MBD

[41] Christopher Fernando (The Boeing Company) and Cindy Hsu (The Boeing Company). *Business Process Instruction (BPI) Modeling using SysML to support Model Based Systems Engineering Implementation at Boeing Company.*

**Abstract.** Model-based Systems Engineering (MBSE) is gaining momentum across many industries, including the Aerospace and Defense. As part of the Model-based Enterprise strategy and digital transformation efforts, MBSE practices have been one of the major drivers for the need to model the Boeing Business Process Instructions (BPI).

The Boeing Company is driven by the business instructions documented in thousands of paper-based BPI documents. When demonstrating quality in a production system, it is the process that is assessed or audited. Business Capabilities are demonstrated through having effective processes defined and the ability to execute them. A model-based business process practice will provide necessary capability in identifying critical integration points, flow times, requirements verification and validation, Key performance indicators, and process optimizations. Therefore, it is essential for processes to be modeled using the same notation that are used for systems engineering with capabilities to analyze and simulate the processes. With this mindset, a small team of 6 members developed a pair modeling methodology to model BPIs in CAMEO modeling tool using SysML standards. Many Boeing Behaviors were realized during Process Modeling within the team.

This presentation includes the simple pair modeling methodology and description of BPI models developed along with their capabilities.

**Track:** MBSE

[43] Rob Donath (Dassault Systemes), Bob Deragisch (Parker Hannifin) and Nichole Berg (Dassault Systemes). *Cut Costs and Timelines through Part Reuse and Sourcing Optimization.*

**Abstract.** Learn how one manufacturer has reduced its design cycle by 70% through part reuse and sourcing optimization. By aggregating and analyzing decades’ worth of legacy data from disparate systems, engineers can quickly find the ideal part for any project and identify similar components. Drag-and-drop any 3D model into the search bar, and immediately find all similar parts in other formats, as well as understand what percentage they are similar. Find related documentation for the part with just a click and visualize relationships between different assemblies and components. Using a marketplace of tens of millions of catalogued parts, procurement leaders can define their own standardized catalogue of sourceable components in just a few clicks, reduce duplicates and monitor part reuse throughout the project.

**Track:** CAMSC

[44] Nathan Nalven (eQ Technologic Inc) and Sanjeev Tamboli (eQ Technologic Inc). *Live demonstration: Improving US Navy mission readiness with predictive maintenance.*

**Abstract.** The US Navy has initiated a mission to improve its air and sea mission readiness and vehicle reliability. This presentation will show a live ‘for Purpose application that ingests sensor data to determine aircraft health using live Analytics against a machine learned model to predict mission readiness and vehicle health. The demonstration will show the power of the digital thread and digital twin by automated creation of: Analytics dashboards with eQube-3D-Insight from the design System of Record, Teamcenter Problem Report, SAP Service Request, Inventory management and management of the as maintained aircraft configuration. This demonstration shows the power of eQube® - a DaaS platform connecting the big rock systems from As Designed, As Built, As Maintained and Inventory Management Systems.

**Track:** Emergent Technology

[45] Carl Coryell-Martin (Pivotal). *Steal, or Innovate then Steal. Two Emergent Practice Strategies to Exploit Technical Evolution.*

**Abstract.** It’s not enough to develop or adopt new technical innovations; people, teams, and organizations need to innovate their practices and process to exploit the benefits or risk being replaced by those who do.

The technologies underlying the Model Based Ecosystem are an opportunity to create radically better working practices. Realizing the economic value and remaining competitive will require innovating and changing organizational working practices along with adopting new tools.

Two strategies for developing and installing necessary practice innovations are to steal successful innovations from industries that have experienced a comparable transformation in testability and automation (ex: software development) and build an internal process innovation and theft practice.

In this session, you’ll see analogous practices from software development including test driven development, balanced teams, and continuous delivery to steal for your own development and an application of Simon Wardley’s Pioneer, Settler, Town Planner model as an institutional framework for supporting your own internal innovation \*and\* adoption.

**Track:** Emergent Technology

[47] Cory Kinsel (Northrop Grumman). *Implementing the Complete Digital Thread.*

**Abstract.** It is often said that we need to break down the walls between engineering silos in order to be competitive in the 21st century. This position comes from the desire to reduce design cycle time and better leverage engineering expertise across disciplines. What if I told you we could accomplish these goals, and enable the integration of analytic modeling with Model Based Systems Engineering by embracing our silos as the centers of excellence they are and empowering them to connect with one another through managed and verified interfaces? What if I also told you we could integrate these techniques with prescriptive models using fit-for-purpose SysML constructs that allow for the generation of a complete digital thread? This is the goal of the System Hierarchical Analysis Simulation and Modeling (SHASaM) methodology, leveraging proven concepts and techniques from across industries such as Model [software] as a Service (MaaS) and DevOps. This presentation will introduce the concepts of MaaS and DevOps along with their integration with a prescriptive SysML model.

**Track:** MBSE

[48] Bernd Feldvoss (Airbus Operations GmbH) and Kenneth Swope (The Boeing Company). *Aerospace and Automotive Cooperation for practical MBSE Standards.*

**Abstract.** Aerospace systems engineering challenges are of enormous complexity. Our industry’s systems pose enormous challenges in terms of system complexity and requirements with an ever growing focus on time to marked, maturity of the products, and key performance challenges such as program lead-time, development cost, program profitability, etc.

Model-Based Systems Engineering (MBSE) proposes to employ Models and Simulation to transform system engineering practices of the aerospace industry. MBSE based on modeling and simulation will enable deep collaboration between disciplines, and between OEMs and their respective supply chains.

Peer industries face similar challenges in adopting MBSE to face their particular challenges. For example, our peers in the automotive industry pursue a strong cooperative push towards MBSE in the pursuit of developing and certifying autonomous driving capabilities.

In this presentation we will share a unique collaborative approach to develop MBSE cooperation practices based on modeling and simulation using digital capabilities. In particular, we will share a cooperative set-up between the Aerospace & Defense PLM Action Group, gathering the key commercial aerospace OEMs, with the prostep ivip association, gathering the world’s key automotive OEMs. Together, the two groups strive to cooperate to develop standardized processes and formats for MBSE in a cross-industry approach.

**Track:** MBSE

[49] Bruce Bookbinder (Aras Corporation). *Managing a Digital Thread across the Global Supply Chain.*

**Abstract.** Extending the Digital Thread across organizational boundaries to include global supply chains can be a challenge for companies – but those who accomplish this can realize new business opportunities, expand market footprints, and achieve a competitive advantage. Industry-leading companies that design, develop, and manufacture today’s complex products are challenged to “disrupt or be disrupted” by improving products and services, operational efficiencies, and strategic approaches. Managing a Digital Thread of product information is imperative. A Digital Thread provides a robust record of a product’s development for traceability and change control—accelerating access to information, ensuring its accuracy, and providing stakeholders with the means to act on it in a coordinated way with other teams. This session will demonstrate practical approaches global companies have taken across their supply chains to manage digital product data and processes within the Digital Thread while ensuring data security, tool connectivity, and team collaboration. It will present successful use cases spanning industries and complex processes, technical approaches to data management across globally distributed teams, and a review of the value and transformative results that a Digital Thread across an enterprise can offer.

**Track:** CAMSC

[50] Malcolm Panthaki (Aras Corporation). *Enabling Enterprise Systems Thinking requires an Effective SPDM Foundation.*

**Abstract.** Despite decades of software development, simulation continues to mostly exist within organizational silos that are geographically-distributed and isolated, not just from each other but from all other enterprise engineering processes and platforms. Also, simulation processes are limited to a small number of experts, is highly manual and error-prone, and hence, do not meet the global competition-driven need for rapid innovation and quick time-to-market.

The primary emphasis of simulation point tools to accurately simulate more and more complex phenomena, while required, has had the unintended side effect of encouraging and often requiring siloed organizational structures. These silos isolate the simulation experts, their difficult-to-master point tools, and the related data, resulting in incorrect inputs, simulation models that only the experts can use and outputs not available to the enterprise in a timely manner. This combination of expert-driven point tools and organizational silos thwarts the need for multidisciplinary and multi-physics simulation automation and enterprise engineering data management – for simulation to be an effective enterprise tool, something fundamental needs to change.

The authors will present use cases in the aerospace & defense, automotive and heavy equipment industries to demonstrate how various global companies are achieving greater ROI from their simulation investments.

**Track:** MBSE

[53] James Martin (Anark), Tony Provencal (ITI) and Jim Merry (Anark). *Publication and Validation Strategies to enable a Model Based Ecosystem.*

**Abstract.** This technical discussion will be a review of standards based technical data formats and data streams, and strategies for achieving automation in publication and validation. Well known formats including 3D PDF, STEP, and QIF will be discussed, and the conversation extended into emerging structured data streams such as HTML5 and GLTF. Different strategies and processes exist for publishing and validating

files versus data streams. File-based approaches (such as MIL-STD-31000 Technical Data Package delivery based on 3D PDF & STEP) have been automated and deployed for DoD data delivery in 2018. These represent a significant step in advancing the Model Based Enterprise for defense and are being rapidly adapted by other industries. Emerging structured data streams provide expanded possibilities for data consumption in a Model Based Enterprise. TF is one standard being rapidly adopted for communication and collaboration strategies for XR applications. The opportunities and challenges associated with publishing and validating digital data streams will be explored. As the the industry leaders in production-quality technical publishing and validation, Anark and International Technegroup (ITI) combine over fifty years of experience helping clients unlock the value of their digital data and accelerating the deployment of Digital Thread and Model Based Enterprise initiatives.

**Track:** Emergent Technology

[54] Andrew Schain (Stardog) and Ian Maddox (NASA Contractor). *Accelerating Model Based Systems Engineering with a Knowledge Graph.*

**Abstract.** NASA faced the typical systems engineering challenges in the federal space; working across multiple government organizations, large and small contractors, and multiple disciplines and viewpoints; all wanting to see the information as it pertains to their job function.

With a Knowledge Graph, NASA engineers were able to identify and apply a method to institute a federated, tool-agnostic way to interconnect and relate data, supporting decision makers at all levels within the organization. Each related data source across the organization, from math models to hazard records to requirements were made visible in the knowledge graph. The graph model made this possible by expressing interconnected data relationships, regardless of the tool used for authoring or individual data. NASA decision-makers can now quickly see the data they expect, and catch quality issues earlier for data they do not expect.

Join this talk to learn how the Stardog team helped NASA accelerate its system engineering processes by introducing a knowledge graph into its engineering tool ecosystem.

**Track:** MBSE

[55] Nathan Eskue (Northrop Grumman). *Your Roadmap to AI-Driven Supply Chain--We Have the Technology.*

**Abstract.** The use of AI (artificial intelligence) has created everyday miracles in our lives. Amazon delivers exactly what I need without me 100% sure I ordered it. My teenagers mumble at their phone--I don't understand them, but Siri does.

This is AI.

I will show you how this same technology can be used to create similar "miracles" and move toward what our supply chain needs most: omniscience and oracle-insight. I will also show how a focus on interoperability creates exponentially more ROI than you probably expect. After a quick AI primer, we'll walk through several use-cases and dive into the types of AI that are needed to create this roadmap. I will also share a key technique that has worked best for first creating such an ambitious roadmap, then backing into the individual stepping stones that will take you from today to an AI future.

You don't need to be an AI expert to benefit from this discussion. You don't need to have millions to invest in a super computer. All you need is an understanding that supply chain AI is possible (yes, where YOU work), and its successful implementation will fully maximize the benefits of an interoperable supply chain.

**Track:** Emergent Technology

[56] Bruce Mayer (Engineering). *Integrating “Smart Documents” into PLM and the Digital Thread.*

**Abstract.** We have all encountered documents which “refer” to other documents. What if one document could actually “talk” to another document? A document which talks could tell others that reference it that something changed! That table copied into a drawing would "know" that a value in the source document has changed! What if the Manufacturing BOM or Bill Of Process could raise a flag when the material specification for that widget has changed! What if your Test or Inspection specification could tell you the acceptance criteria changed! Think of the time, frustration and money that can be saved. Making documents talk to each other is the definition of “Smart Connected Documents” and when coupled with CAD & PLM is a game changing combination.

The session begins with the challenge, describes the journey and finishes with a summary of the benefits and future potential of Smart Documents.

**Track:** PDSTV

[58] Jeff Pilato (Sodius). *The Road to Interoperability.*

**Abstract.** Today we find ourselves at an inflection point. Development processes are beyond the point of a single design, but rather they reflect families of designs. These designs are leveraged on multiple products for multiple configurations.

Interoperability must be the ability to leverage our designs across our products including flexibility of our tooling with and across disciplines.

The road to Interoperability is a gradient from migration, exchangeability, to enterprise repository linking. Our team at Sodius-Willert have invested in navigating the path with speed, efficiency, and pragmatics. In this session, we will identify the imperatives to the levels interoperability including examples. These examples include automatic migration of models (RSA, Rhapsody, EA) to MagicDraw, integrating the ALM and PLM worlds via OSLC, and the ability to index, search, and report across linked enterprise repositories. Each represents a form of interoperability that grant capability (with some constraints) to their users. With these examples we will discuss the limits of some of existing tool technology platforms, we will define and address why Enterprise Configuration Management is critical to the success of Interoperability, and how Enterprise imperatives, such as security and scalability, must be managed to reach the holistic vision of Enterprise Interoperability.

**Track:** MBSE

[59] Douglas Genord (Boeing). *The Importance of Contextual Data for Smart Manufacturing.*

**Abstract.** During Smart Manufacturing, large amounts of data can be collected from automation equipment during process execution: “The Digital Exhaust.” In common practice, automation equipment exhausts low-level time-stamped data that is difficult to correlate to machine and process behavior. This results in a “Digital Swamp”, where the data is stored, but never utilized.

To avoid the Digital Swamp, data collected from automation processes must be rich with contextual information about the manufacturing process definition and execution so that it can be added to the Digital Thread, and become part of a “Data Lake” where it can be utilized for process improvements.

This presentation will discuss the challenges associated with collecting and mining useful data from automation equipment, along with emerging solutions to this challenge.

**Track:** CAMSC

[61] Terrence McGowan (Boeing). *Enabling a global distributed supply model for Additive Manufacturing.*

**Abstract.** Additive manufacturing of parts at industrial rates presents many challenges to large aerospace OEM’s. Capacity, Safety, ROI, Quality and IP security are only a few of the challenges being addressed but they represent some of the most important. This presentation will discuss the importance of each of these and the solutions required to meet the goal of establishing an industrialized Additive Manufacturing valuestream. Establishment of an AM global distributed supply model to provide virtual capacity without costly investment in infrastructure is an inviting AM business model. The offloading of capital investment to suppliers while maintaining value is an attractive idea that AM can unlock but not without the development and adoption of standardized definition and process standards for design and fabrication. The diversity of OEM printer manufacturers results in type specific printer drivers in order to protect their process IP. A standardized superset of process entities that encompasses all of the different print methods can be mapped to the proprietary metadata via each OEM’s adoption of the standard. Quality standards for raw material and finished parts are also needed. Additionally, I will discuss the necessity for IP protection and process controls for data provenance and print quantity control.

**Track:** CAMSC

[62] James Martin (Anark) and Stephen Collins (Anark Corp.). *Intelligent Information Management – Empowering a Connected and Collaborative Model Based Enterprise.*

**Abstract.** Successful global manufacturers are yielding substantial performance benefits by implementing effective Digital Transformation strategies built upon modern Industry 4.0, Digital Thread/Twin, IIOT, 3D MBE, and MBSE processes and technologies to empower more effective and secure data exchange and collaboration throughout engineering, manufacturing, supply-chain and field-service operations.

This session will be an interactive one to overview how industry leaders are overcoming common obstacles to effective digitalization such as interoperability limitations, rigid legacy systems, management alignment and cultural challenges, and the need to digitalize a broad array of technical data types and formats in order to come to market faster, with higher quality products, at substantially reduced costs.

Such a system must have the ability to publish ECAD, MCAD, PLM and ERP data into “fit-for-purpose” technical content and connected digital workflows that can be consumed on virtually any device, enabling users to collaborate more effectively and securely along the Digital Thread within their organizations and into their supply chain. It will highlight the power of connected, web based technical data exchange with “social-media” style visual collaboration. Industrial examples of this modern replacement for conventional ad-hoc, disconnected, legacy modes of file based data exchange and collaboration will be highlighted.

**Track:** MBD

[63] Chris Borneman (Software AG Government Solutions). *IIoT In the Factory and in the Field.*

**Abstract.** A recent Gartner survey of companies noted that 63% of CEOs perceive IoT to have a significant material business impact. Moreover, 80% of those organizations that have implemented an IoT project have realized greater value than expected. However, studies also show that nearly two thirds of IoT projects never get past the pilot phase.

Stripping away the hype of IoT, organizations found that most IoT projects focus too much on the vendor-specific IoT technology and not enough on how those technologies will be managed and integrated into an organizations existing solutions. In fact, nearly 80% of successful IoT projects relates to this integration, yet most pilots focus on the 20%.

This session will discuss successful approaches to deploying IIoT by using real-world deployments of IIoT in the factory and beyond. We will discuss actual customer use cases, performance results, and lessons learned.

**Track:** Emergent Technology

[64] Brian Nielsen (Boeing). *Integrating Semantic Quality Information with the Digital Thread.*

**Abstract.** In a traditional manufacturing process flow (even one utilizing a 3D Model-Based Definition), geometric quality requirements and results travel outside the Digital Thread in a separate paper-based system. This is inefficient, subject to synchronization errors with the design intent and hinders the relinking of quality and manufacturing data. Consequently this relinking is rarely done dynamically leaving potential process improvements unrealized.

Existing and new ways of communicating quality requirement and results using STEP and QIF standards will be discussed in this presentation. Also covered are recent demonstrations of this technology, and efforts to make quality data more easily consumed by non-human entities.

**Track:** CAMSC

[65] Martin Hardwick (ISO Digital Manufacturing (TC184/Sc4 Wg15)). *Enabling Machine Learning for Manufacturing Machines.*

**Abstract.** The shop floor is full of machines and none of them are learning! Although machine learning languages and systems can handle complex manufacturing data, they aren’t widely utilized for automated manufacturing. A missing link is a framework for sharing, learning from mistakes, and optimizing results.

ISO 23247 describes a standard for Digital Twin manufacturing. In this framework, physical manufacturing elements (PME’s) are connected to data collecting and controlling elements (DCCE’s). The physical manufacturing elements are robots and machine tools. The DCCE’s are hosted on edge computing devices. Each DCCE controls and models the results of a manufacturing process. At the end of the manufacturing, as the plane rolls off the assembly line, its Digital Twin hops onto a USB.

This presentation will discuss Digital Twin manufacturing, including:

• Managing the extremely large quantities of data of large products.

• Dealing with complexity and subtle dependencies between properties

• Data updates in real time to keep the digital twins current with the physical.

And the benefits, including:

• The ability to rapidly adapt to engineering changes, to work with many vendors, to share results, and to grow from small to large.

• Integration into systems used by the machine learning communities.

**Track:** CAMSC

[66] Conrad Leiva (iBASEt) and Mark Vrabel (iBASEt). *Where is Quality in Industry 4.0?*

**Abstract.** We don’t want to be a spoiler for the presentation, but we’ll give you a hint: you will find it in more places than you think.

Much of the talk of the digital factory of the future leaves’ quality management out of the conversation. However, we will discuss in this presentation how quality is really found in many specific aspects of the Industry 4 vision and in many of the real examples of how digital manufacturing is being realized.

We will go into more specific examples in the presentation, but the quality professional should be involved in many aspects of the digital transformation including smarter inspection equipment, integration of quality data in the digital thread, and the integration of quality management practices into the reaction loop tied to AI driven alert systems. Examples start within the plant but Industry 4.0 is about integrating processes, including quality management processes, into the entire value chain.

**Track:** MBD

[67] Dan Mittelstadt (PTC) and Kaleigh Mota (PTC). *Give your workers “Super Powers” with Augmented Reality.*

**Abstract.** Augmented Reality presents a unique new way to interact with digital information that delivers information through visual processing that is easier to comprehend. Combining the iIOT and AR, encompasses capabilities allowing users to source, contextualize, synthesize, orchestrate, and engage with data from their connected products, operations, and systems. Linking these platforms will allow for the ultimate performance for not only your employees, but your equipment as well.

PTC’s Augmented Reality technology allows the user to experience the digital information and the digital representation alongside the physical product simultaneously. This is done using digital twins and 3D overlays. AR experiences rapidly train your workforce on complex tasks with easy to follow step by step instructions. It can also improve employee retention and productivity. PTC’s IIoT platform enables companies to wrap and extend existing decision support tools, such as databases or systems, analyze them, implement applications and create unique user interfaces to manage this information all on a secure and scalable architecture.

**Track:** Emergent Technology

[68] David Odendahl (Boeing). *Industry Perspective on Manufacturing Data Exchange.*

**Abstract.** This presentation will discuss, from an industry (end user) perspective the importance of using non-proprietary data standards for manufacturing. Included will be a discussion of several use cases, and a brief history of manufacturing data standards.

The presentation will conclude with a road map to a future state of an efficient, integrated factory and supply chain, all sharing common, comprehensive, standard data.

**Track:** CAMSC

[69] David Odendahl (Boeing) and Douglas Genord (Boeing). *Computer Aided Manufacturing and Supply Chain Panel.*

**Abstract.** This session will bring together as panelists the presenters from the CAMSC track. A panel discussion pulling from a diverse set of perspectives will cover topics around the track’s presentations, data interoperability and the conference theme of Accelerating Toward a Model Based Ecosystem. Significant time will be available for you to ask your questions.

**Track:** CAMSC

[70] Sky Matthews (IBM) and Uranie Browne-Armstrong (IBM). *Applications of Artificial Intelligence in Engineering, Manufacturing and Operations and Maintenance of Complex Systems.*

**Abstract.** AI is impacting almost every field and industry and it has some compelling value propositions to improve efficiency in both engineering and operations of aerospace/defense systems. We will discuss current applications of AI in various aspects of operations, including scheduling and pricing, weather prediction, equipment maintenance and repair. In addition, new AI applications for engineering are helping engineers deal with the enormous amount of data created in the design and development process to make better design decisions. We will cover applications of AI in Engineering, give practical examples in use today, and provide advice on overcoming the challenges and risks to start getting the benefits of AI.

**Track:** Emergent Technology

[71] Leon McGinnis (Georgia Institute of Technology). *Bringing MBSE to the Design of Aircraft Production Systems.*

**Abstract.** SysML supported MBSE is transforming the design of aerospace and defense systems, by providing a federated “source of current truth” to all the relevant engineering design disciplines, along with high quality integrated system analyses. The project described in this presentation explores the potential for a similar transformation in the design of the factories and supply chains that produce these systems. Focusing on the production of large composite parts, the project used SysML to create integrated models of products, production processes, and production resources. Using the capabilities of MagicDraw™ the team demonstrated that information can be extracted from the SysML-based production system model, and used both in model validation and in analyses to support factory design decision making; the case of autoclaves and mandrels was examined in detail.

**Track:** CAMSC

[72] Kenneth Swope (The Boeing Company). *Smart Manufacturing Strategy and Plan at ISO.*

**Abstract.** Ever wondered how standards are developed? It all starts with that great idea that gets refined through the consensus process by experts over periods of time that ultimately becomes a standard. Indeed, there are many standards that deliver on their promises, yet, when evaluated from a perspective of their position in the product lifecycle value stream, many issues surface. In the industrial setting, standards from various organizations are expected to executed relative to each other and fail miserably. Interoperability is not just about IT applications, it applies to the standard as well.

The International Organization of Standardization (ISO) has been taking proactive steps in this area with the formation of the Smart Manufacturing Coordination Committee and the establishment of a partnership between ISO and the International Electrotechnical Commission (IEC) on the development of a Smart Manufacturing Reference Model that both organizations can use for relating the many different perspectives of modern manufacturing data architectures to the standards developed within each organization. This talk will focus on the efforts of ISO and what ISO committees are doing to embrace the concepts of Smart Manufacturing and the steps being taken to enable a new level of standards development across the value stream.

**Track:** CAMSC

[73] Christopher Ramirez (Rescale). *Machine-Learning Augmented HPC Workflow for Physics-based Analysis in Cloud.*

**Abstract.** The goal of engineering communities has been to accelerate innovation by leveraging advancements in High Performance Computing (HPC) and Machine Learning (ML) algorithms. Computer Aided Engineering (CAE) software, which leverage HPC, are used for design analysis in a wide-variety of industries such as aerospace and defense, automotive design, oil and gas, etc . However, the design of experiments and optimization workflows used with these softwares today are tedious and involves running many compute-intensive CAE simulations. They also require manual tweaking of design parameters to come up with a design which is ready for manufacturing.

In this presentation, we will demonstrate using an industry example on how Rescale provides a single HPC environment to:

- Harvest all the simulation input data using a DOE framework necessary to train deep learning algorithms

- Train models using Tensorflow and Keras API

- Perform model inference, deploy to the enterprise and execute it anywhere on-premise or in the cloud with consistency

Using Rescale’s ML-based HPC workflow, engineers can cut down design time cycles and accelerate time-to-market

**Track:** Emergent Technology

[74] Dinesh Arora (NGC). *Migration and upgrade of Teamcenter Enterprise from Solaris to Linux.*

**Abstract.** Teamcenter Enterprise (TcEnt) on Solaris servers continues to be used by many Programs at NGC and other companies with no immediate plans to migrate to Teamcenter Unified (TcU).

Solaris servers have reached their end of life. Solaris hardware and OS though still supported by Oracle are on phase out path. To ensure continuous support of this critical application, we decided to re-host it to Linux and also upgrade the version from TcEnt 8 to TcEnt 9 at the same time.

This presentation deals with migrating NGC customizations, choice of Linux vs Windows, interfaces (SAP, MES, CITIS, etc.), integration with TcU 10 used for CAD Model Management, virtual vs. physical servers.

**Track:** PDSTV

[75] Shashank Narayan (AGI) and Jeff Gorham (AGI). *Extending digital engineering from the component to the mission level.*

**Abstract.** Within the digital engineering enterprise, mission problems are broken down into executable pieces: component development, sub-system integration, and system integration. In use, these complex systems come together in a system-of-systems architecture and must operate in a coordinated way across multiple domains in order to achieve the intended mission outcomes.

Digital engineering connects all the digital models from components to the system-of-systems architecture and evaluates outcomes against mission objectives – the true measure of success.

Digital mission engineering connects the design of components, sub-systems, and systems to operational outcomes by extending emerging digital engineering/MBSE technologies, standards, and practices to the mission level.

This presentation will explore the value of using computer-based modeling, simulation, and analysis tools to evaluate operational outcomes.

**Track:** MBD