# A Structured Framework for Long-Term Archiving and Reuse of Simulation Models Using Modelica and LOTAR Standards

GLOBAL PRODUCT DATA

INTEROPERABILITY

SUMMIT 2025

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

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Ajaykumar MST has joined Boeing in 2024 as Systems Engineer.

Prior to joining Boeing, Ajaykumar MST gained experience in the field of Multi-Physics modeling & Simulation, working on various applications from automotive, aerospace to HAVC industries. His responsibilities included developing equation based & numerical models using Dymola (Dassault Systems), Modelon Impact and addressing to standards such as Modelica, FMU, SSP, LOTAR, etc., within the framework of Model Based Design (MBD). Ajaykumar holds a bachelor's degree in Aeronautical Engineering.

# Agenda



- Introduction
- Why LOTAR
- Preservation Benefits and Process
- LOTAR MSBE Standards Overview
- Use case of Part -500, 510, 515 & 520
- Overview of LOTAR Statement of Work
- MBSE Working Group - Next Steps
- Q&A

# Introduction



## Model-Based Systems Engineering (MBSE)

- MBSE has emerged as the standard approach for developing complex systems:
- Replacing traditional documents with descriptive and analytical model
- Integrating models across Lifecyle phases (Requirements, Design, Analysis, Verification)
- Establishing a Digital Thread

## Presentation’s Main Focus

- Introduces a framework for Long-Term Archiving & Retrieval of models.
- Emphasizes compliance, integrity and usability across lifecycle.
- Leverages capabilities from Modelica Association, LOTAR, FMI/FMI and SSP.

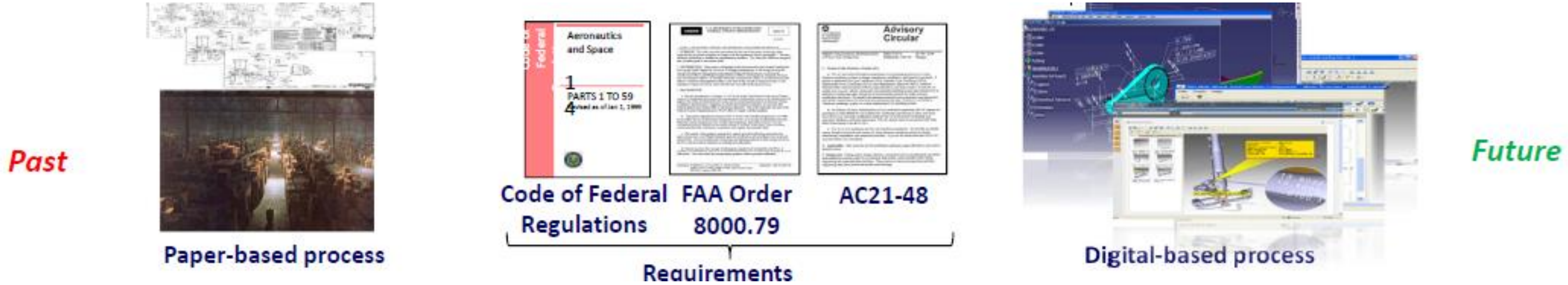
## Primary Stakeholders

- Model Requester
- Model Developer
- Model Archiver
- Model Consumer

# Why LOTAR



- **The objective of LOTAR International is to develop, test, publish and maintain standards for long-term archiving (LTA) of digital product and technical data, such as 3D CAD/CAM, PDM data & MBSE.**
- **These standards will define auditable archiving, management, and retrieval processes preserving engineering intent throughout the life-cycle of the product.**
- **The documents for the standard are published as the European Norm (EN) 9300-xxx series under ASD-STAN in Europe and, as the National Aerospace Standard (NAS) 9300-xxx in the US under the AIA.**

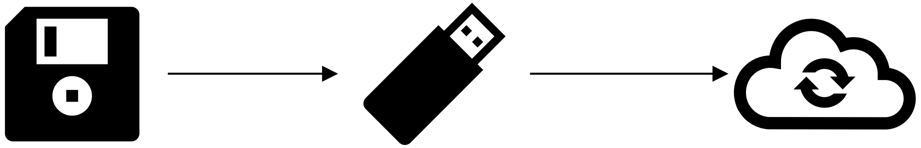


# Benefits Preservation and Process



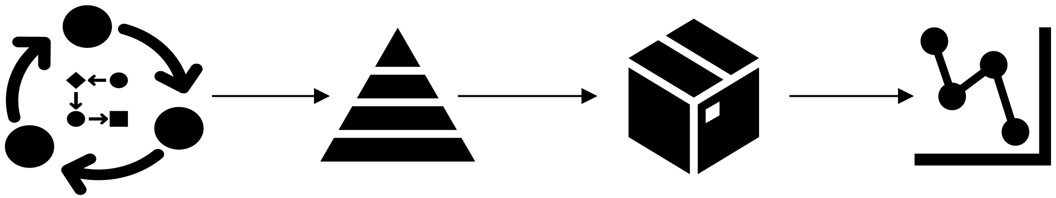
**Data preservation in engineering models is essential for:**

- Documenting design decisions
- Maintaining process management history
- Interoperability techniques, meta data capture
- Traceable links to original requirements



**Data preservation process starts with a plan identifying:**

- Model Types , Dependencies and Standards
- Archiving verified data packages at maturity milestones
- Model Manifests documenting structure and metadata
- Model Reports detailing execution and V&V evidence



# LOTAR MBSE Standard Overview



**Part 500 – Fundamentals** **Yet to be released**

- Covers basics and concepts of archiving and retrieving of MBSE information.

**Part 510 – Requirements**

- Long term archiving and retrieval of Requirement management text, graphics, tables, models, and “parameter based” information.

**Part 515 – Validation and Verification**

- Long term archiving and retrieval of Validation and Verification “text based” and “parameter based” information (expanding Part 510).

**Part 520 – Analytical & Behavior Models**

- Long term archiving and retrieval of system or component level analytical behavior models described by specification or executable code, containing differential, algebraic and discrete equations. Includes causal or acausal models not addressed by the Part 600 series.

**Part 530 – System Architecture**

- Long term archiving and retrieval of models that use system architecture descriptions and architecture description languages (ADLs) specified by ISO 42010/SAE AS5506 [9]

**Part 540 – Logical Bill of Materials (LBOM)**

- Long term archiving and retrieval of data and models specifying the Logical Bill of Materials (LBOM). Not relevant in this context

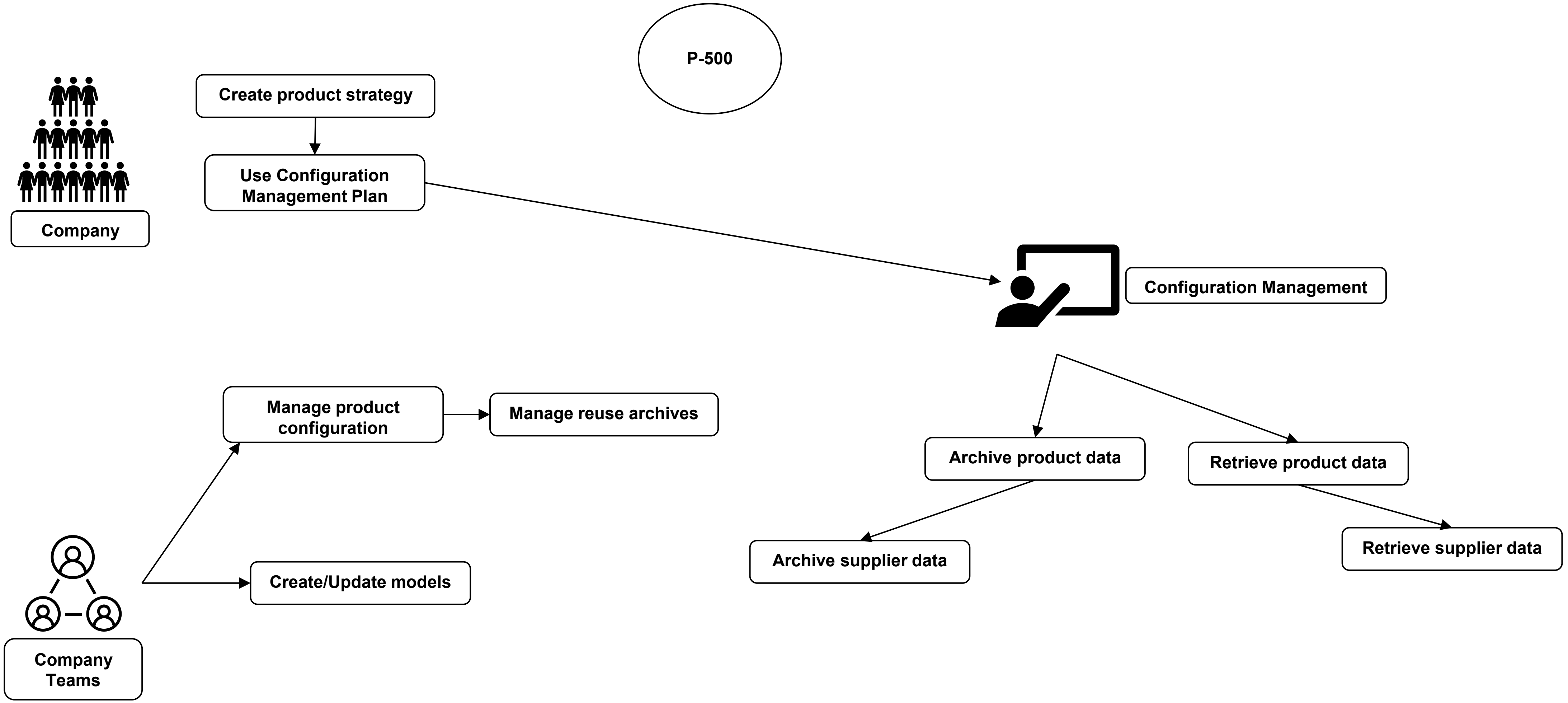
**Part 550 – Highly Integrated Models**

- Long term archiving and retrieval of Validation and Verification “text based” and “parameter based” information (expanding Part 510).

# Use case of Part - 500



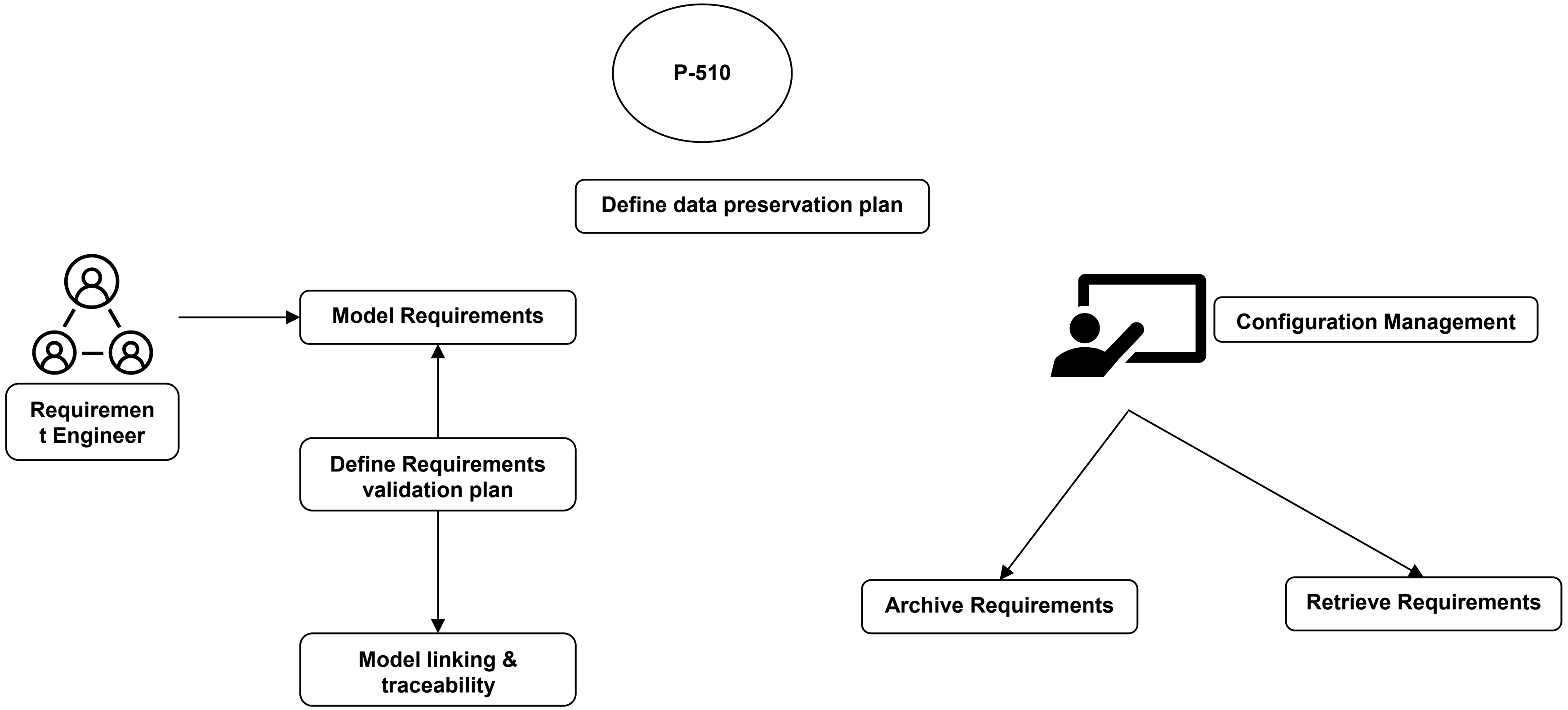
## From Company Viewpoint



# Use case of Part - 510

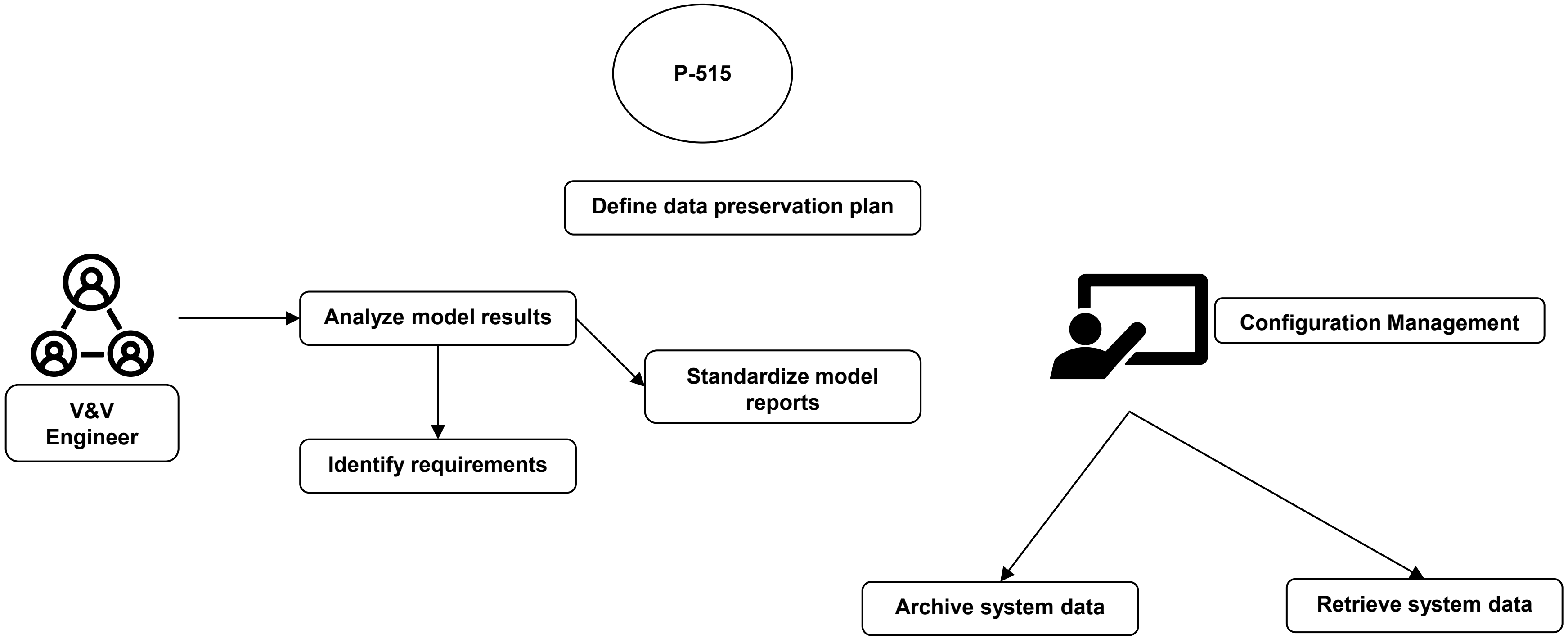


## From Requirements Engineer Viewpoint



# Use case of Part - 515

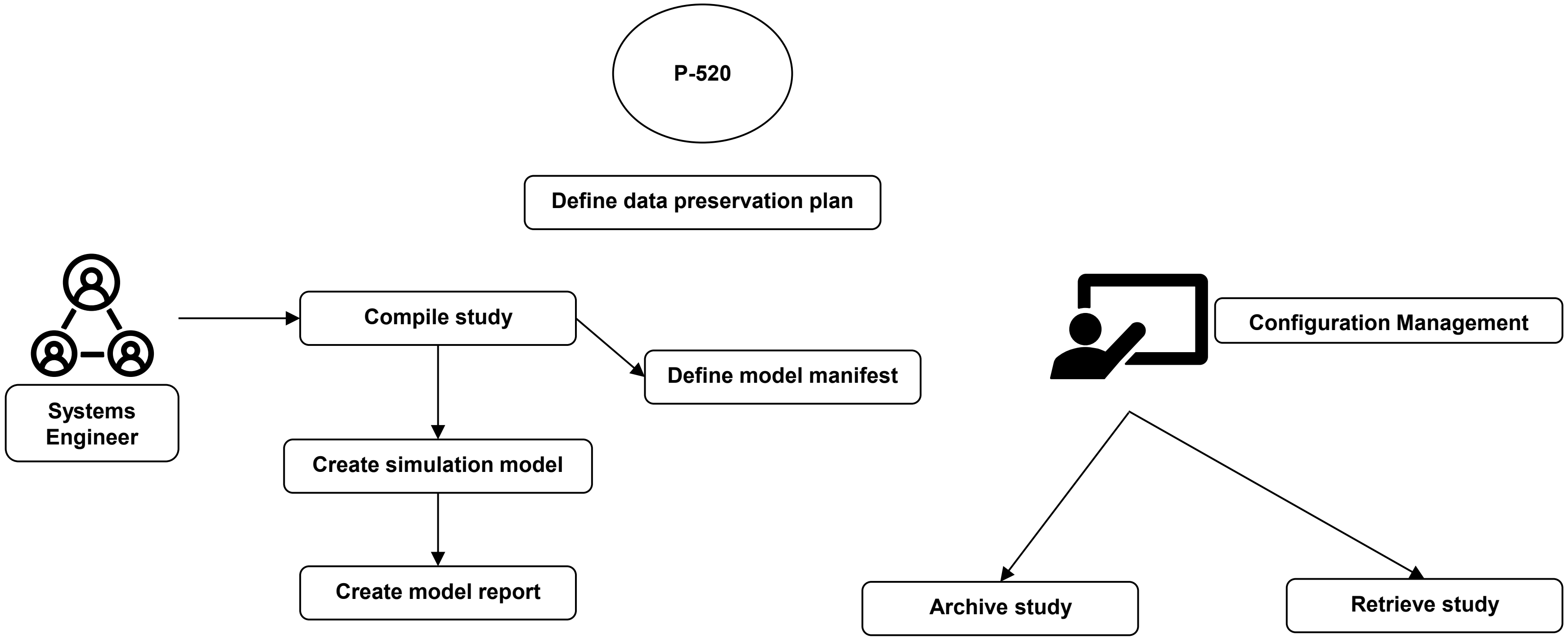
## From Verification & Validation Engineer Viewpoint



# Use case of Part - 520



## From Systems Engineer Viewpoint

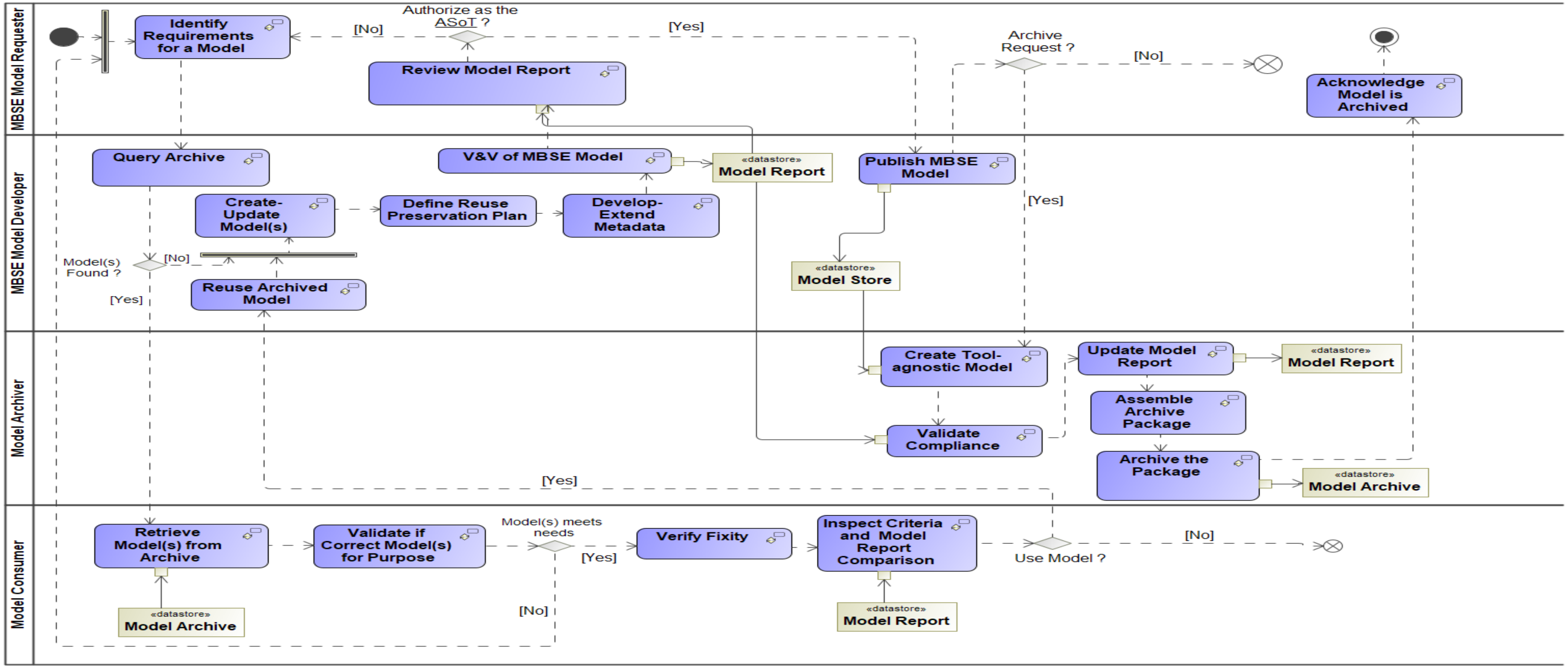


# Overview of LOTAR Statement of Work



LOTAR

## LOTAR sow focus over Part 520 – Archiving & Retrieval of Analytical & Behavior Models



# Overview of LOTAR Statement of Work

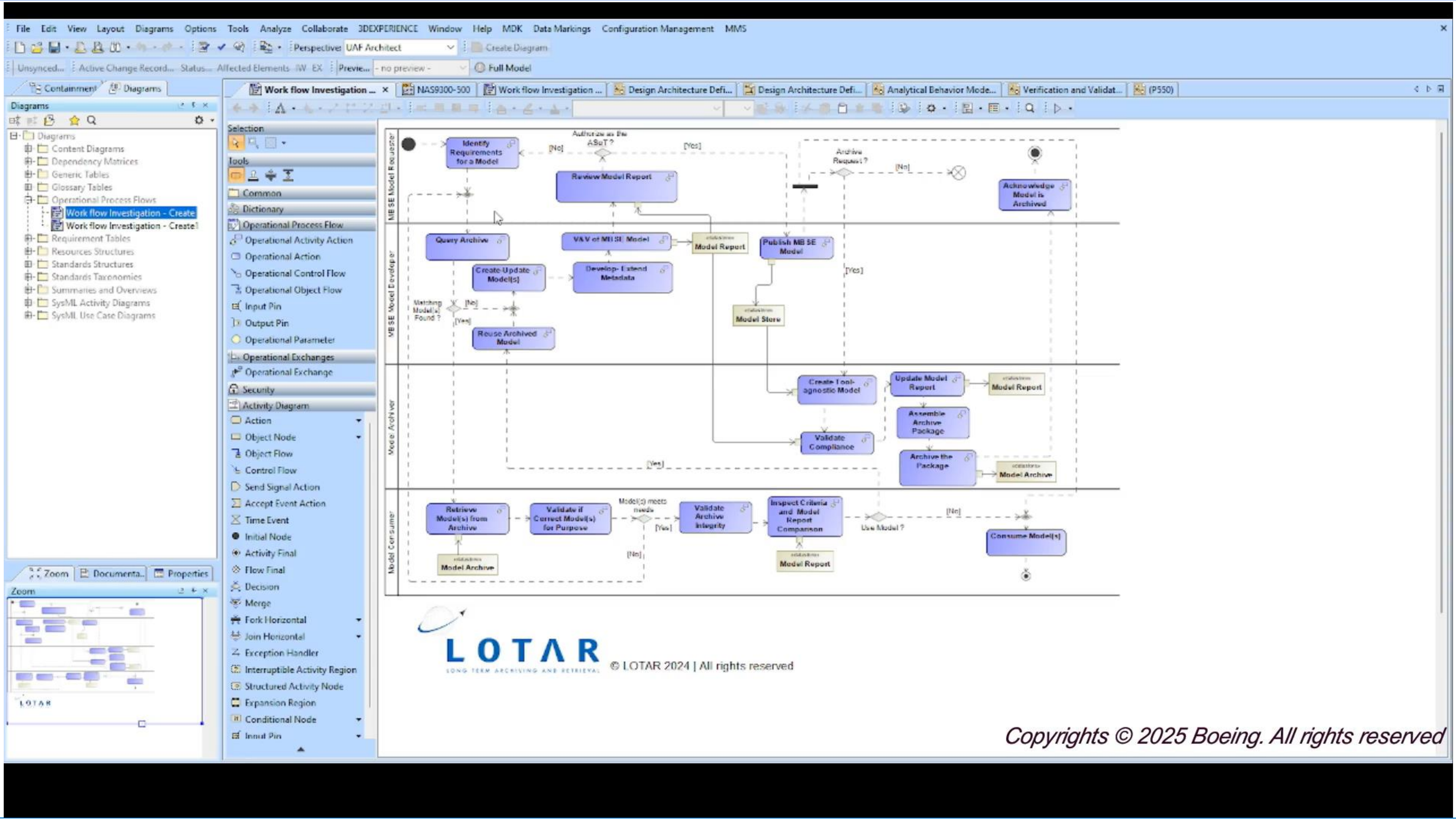


- **Developed behavioral and numerical models using the Modelica language in Modelon Impact.**
- **These models were then exported as FMUs and packaged into an SSP.**
- **Implemented a Python-based framework for the archival and retrieval workflow, addressing various components in accordance with standards such as P515, P520, and others.**

**Demonstration of the Archival and Retrieval Workflow**

# Demonstration of the Archival and Retrieval Workflow





# MBSE Working Group - Next Steps



- **Building a dedicated executable application to handle archival and retrieval workflows instead of using Jupyter notebooks.**
- **Integrating the archival & retrieval workflow into the LOVO tool to improve its capabilities and user experience.**
- **Plan in draft to archive the Architecture Definition Framework (ADF) in compliance with ISO 42010.**

- **If you are interested in participating, submit your information through the LOTAR website here https://lotar-international.org/why-lotar/joining-lotar/**

LOTAR

LONG TERM ARCHIVING AND RETRIEVAL

# Thank You

## Any Questions/Feedbacks/Comments ?