Connecting the Dots:

Building a Cameo System Model

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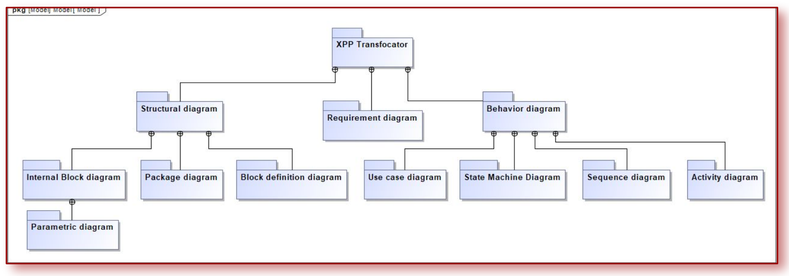
Project Overview

The objective of this project is to model an XPP Transfocator using Cameo Systems Modeling . This is a Model Based Systems Engineering (MBSE) approach, which utilizes a visual model instead of in usual documentation forms. MBSE uses visual models to organize system information instead of relying on traditional document-based methods. The main goal is to represent system context, behavior, structure, requirements, and traceability within one integrated model. Cameo supports this process by allowing different parts of the system model to be connected instead of being treated as separate pieces of information.



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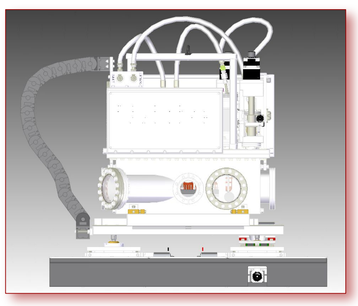
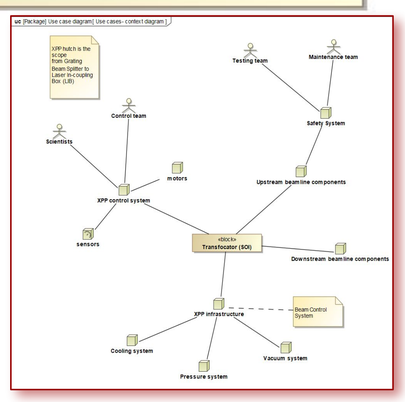
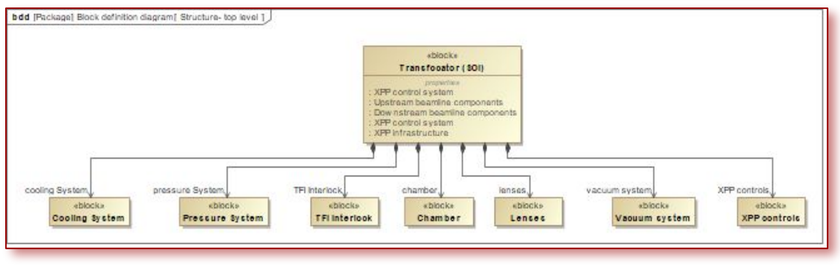
XPP Transfocator

- The XPP Transfocator is used as a beamline case study to understand how complex hardware, controls, safety logic, and interfaces can be represented in Cameo.
- Used in the XPP hutch to condition the incoming X-ray beam for experimental use by scientists.
- Inputs stacks of 1D and 2D lenses that focus and align the beam.







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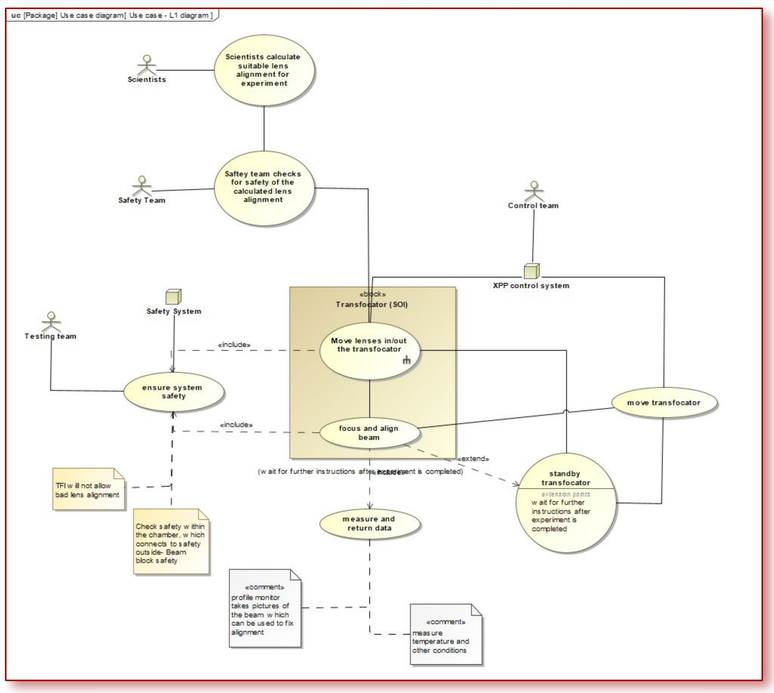
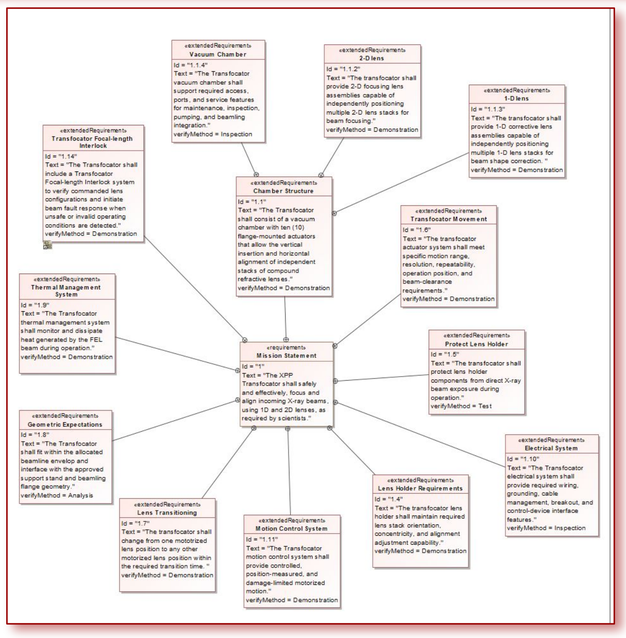
Modeling Approach in Cameo

- The model was developed from a broad system organization to a more detailed architecture.

1. Create a package diagram to organize model elements.
2. Develop the context diagram with an understanding of what components have an impact on/ are impacted by the transfocator in its environment.
   - Scope of the system can be defined here.
3. Use case diagram includes the top level use cases of the transfocator as a system.
   - Shows each use case and its connections to systems and actors that work with it.
   - Use cases can be connected through association, inclusion, extension, and more.
4. Can contain Activity Diagram that shows operational workflow of each use case.



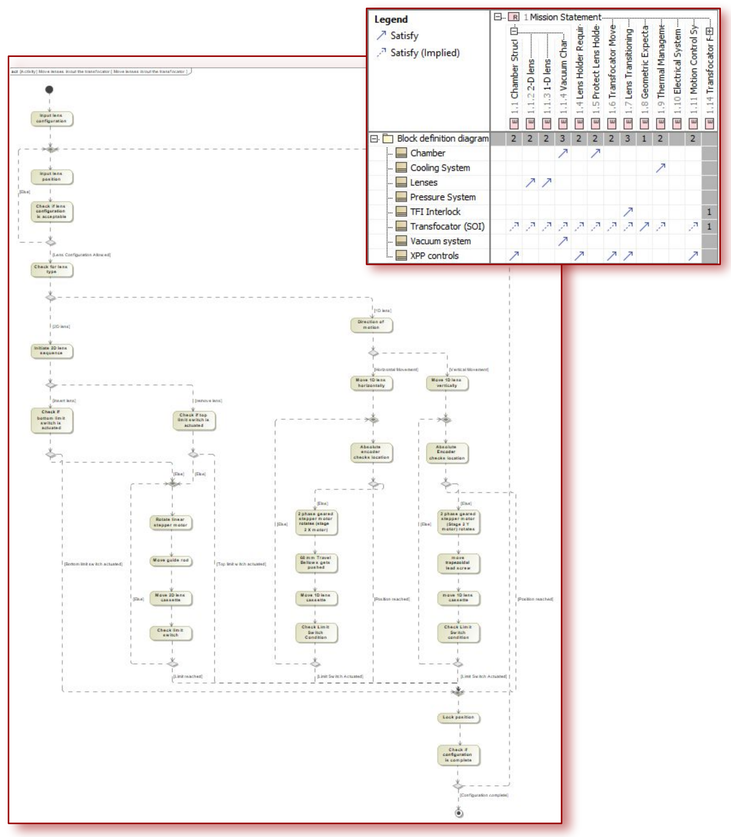


Architecture Development

Developing the model further, focused on connecting systems structure , requirements, behavior, and traceability within the Cameo model.

- The Block Definition Diagram breaks down the System of Interest, the Transfocator, into its major components.
- Requirements were organized into multiple levels, with general parent requirements containing more detailed lower-level requirements.
  - This allows requirements from different documents and subsystems to fit into one connected model.

Cameo also supports requirements tables and traceability matrices to show relationships between requirements blocks and use cases.



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Next Steps

Next steps include expanding the Cameo behavior model through state machine and sequence diagrams. The state machine diagram will show how system behavior changes across operating states, while the sequence diagram will show detailed interactions between actors, systems, and components. In the long term, this work aims to turn system information into a traceable Cameo model that improves understanding, supports future design updates, and connects requirements directly to system architecture.

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[4] SLAC National Accelerator Laboratory, LCLS-II-HE XPP Instrument Controls ESD, internal documentation.
[5] SLAC National Accelerator Laboratory, LCLS-II-HE XPP Transfocator Focal-length Interlock, internal documentation.