Human Systems Engineering and Design (IHSED2025), Vol. 198, 2025, 189–196
https://doi.org/10.54941/ahfe1006775

Benefits of Integrating Resource Management Into an Enterprise Architecture

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ABSTRACT

This paper extends previous research on the integration of model-based systems engineering (MBSE) with the Unified Architecture Framework (UAF). Building upon the author's earlier work that established the value of the UAF's Personnel and Resource domains, this study expands the implementation to include the Projects and Operational domains, creating a more comprehensive enterprise architecture (EA) model. This research demonstrates how the UAF can be applied to a manufacturing company to improve collaboration across disciplines and enable informed decision-making throughout the organization. Key outcomes include integrated viewpoints across UAF domains and aspects, automatic verification of requirements through parametric modeling, and dependency matrices that illustrate cross-domain relationships of the organization. Results show that this methodology successfully maintains traceability between enterprise domains by considering aspects such as requirements, taxonomies, structure, and processes. This work establishes a foundation for EA modeling and demonstrates the UAF's capability to bridge traditional systems engineering (SE) practices with human factors (HF) considerations. By integrating various stakeholder concerns of the enterprise, transparency across disciplines is accomplished within a model environment. Future research will explore the Services and Security domains to complete the UAF implementation.

Keywords: Enterprise architecture, Model-based systems engineering, Unified architecture framework, Resource domain, Operational domain

INTRODUCTION

This paper presents a continuation of the author's previous work regarding human-centric design (HCD) of a fictitious production line system (PLS) using model-based systems engineering (MBSE) and the Unified Architecture Framework (UAF). Initial work concluded that the *Personnel* and *Resource* domains of the framework are helpful in capturing information to analyze and improve HCD (Rudder, 2024). The subsequent study demonstrated the potential of integrating SE practices with HCD using the UAF to optimize resource allocation and improve traceability throughout the operational lifecycle (Rudder, 2025). By focusing on the *Personnel* and *Resource* domains, the research highlighted how these elements are modeled and assessed for

better alignment with requirements. The UAF produces models and views to develop an understanding of the complex relationships that exist between organizations, systems, and end users. The UAF *profile* enables practitioners to express architectural model elements and organize them in a set of viewpoints, aspects, and view specifications (OMG, 2022). The profile has a domain metamodel to guide the modeler through the processes detailed by (Martin & O'Neil, 2021). To support viability of the proposed approach for HCD, the UAF *Personnel* and *Resource* domains will be traced to *Project* and *Operational* domains leveraging cross-cutting relationships.

RESEARCH METHOD

To model the enterprise architecture (EA) of the manufacturing company that owns the PLS, a higher-level view of the organization will be constructed within the same project. This demonstrates a bottom-up approach to EA while maintaining traceability and re-usability of model elements. In this fictitious example, there is a need for project management to improve the reliability of the PLS based on insufficient output. A new project is undertaken to upgrade the facility based on current-state analysis to deploy an improved manufacturing process. To support the construction of the UAF *Project* domain, updates were made to the *Resources Information* and *Personnel Taxonomy* viewpoints. Figure 1 shows ≪ResourceInformation≫ items added to the *Resources Information* viewpoint. Figure 1 shows ≪ResourceInformation≫ items added to the *Resources Information* viewpoint.

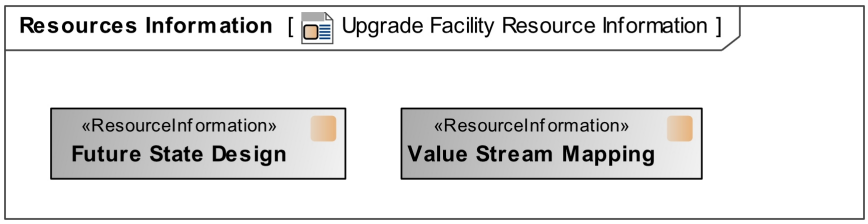

Figure 1: Resource information items.

Figure 2 shows additional ≪Post≫ elements added to the *Personnel Taxonomy* viewpoint that represent generic positions of the lean six sigma team that is tasked with increasing PLS output.

Project Domain

This UAF *Project* domain describes enterprise endeavors along with their dependencies, activities, milestones, and timelines (OMG, 2022). Enterprise projects and milestones are captured within the *Projects Structure* viewpoint. ≪ActualProject≫ and ≪ActualProjectMilestone≫ elements represent instantiations of *typical* projects and *typical* milestones as illustrated in Figure 3.

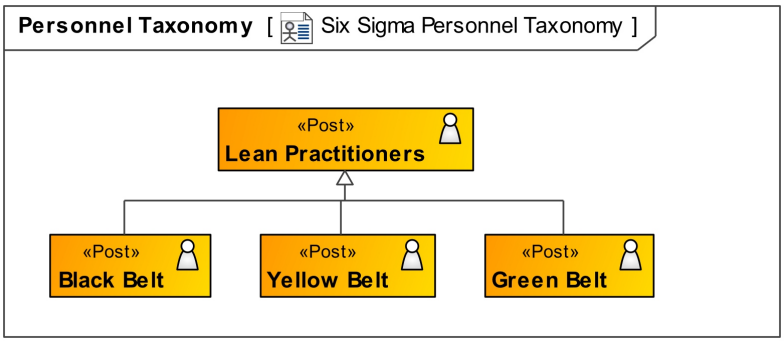

Figure 2: Six sigma personnel taxonomy.

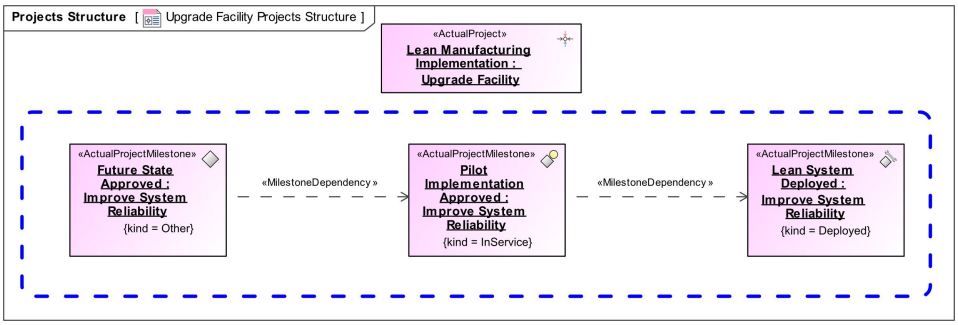

Figure 3: Projects structure diagram.

≪ProjectActivity≫ elements necessary to execute the "Lean Manufacturing Implementation" ≪ActualProject≫ are captured in the *Project Processes* viewpoint shown in Figure 4.

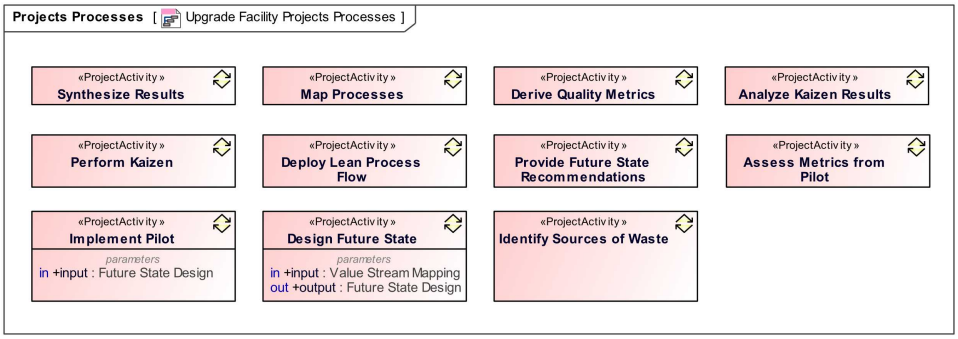

Figure 4: Projects processes diagram.

The *Project Process Flow* diagram uses ≪ProjectActivity≫ elements to type each ≪ProjectActivityAction≫ that must be executed to complete the process as illustrated in Figure 5.

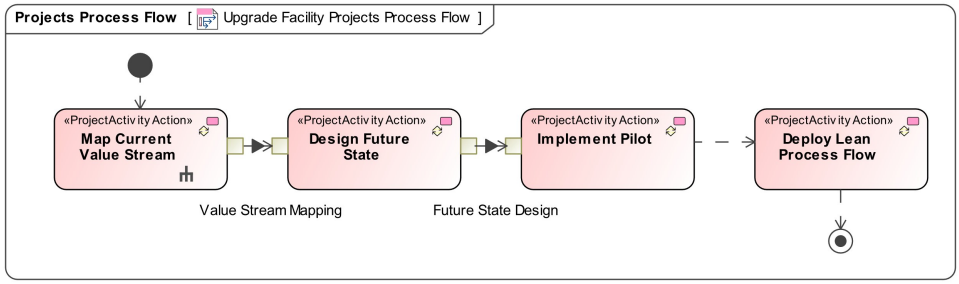

Figure 5: Projects process flow diagram.

Figure 5 shows a sequential process that supports each ≪ActualProjectMilestone≫ and demonstrates the connectivity between the *Projects* and *Resources* domains. The "Value Stream Mapping" and "Future State Design" ≪ResourceInformation≫ items from Figure 1 are shown being exchanged in this view, connecting the *Projects* and *Resources* domains. Each ≪ProjectActivityAction≫ shown in Figure 5 can be further elaborated to specify each responsible ≪Post≫ with additional process flow diagrams. Figure 6 shows a white-box view of the "Map Current Value Stream" ≪ProjectActivityAction≫ with a specific ≪Post≫ allocated to each partition, indicating responsibility for the tasks.

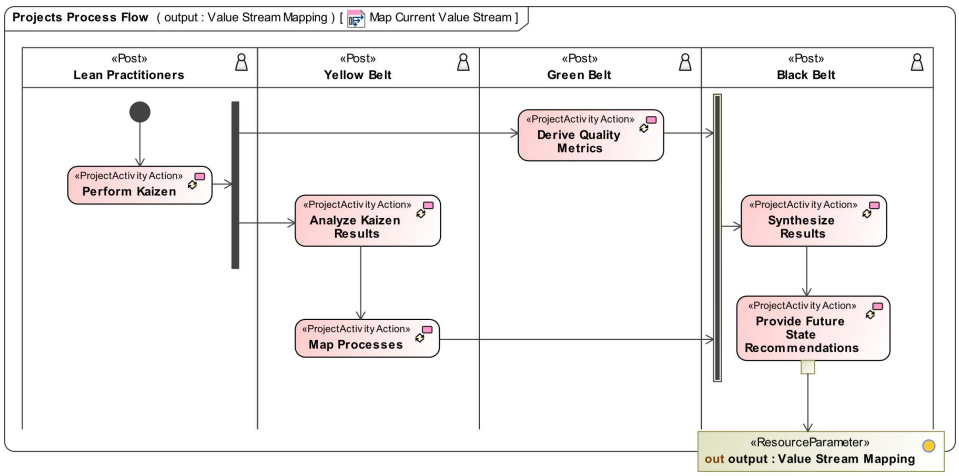

Figure 6: Projects process flow of value stream mapping.

The output "Value Stream Mapping" ≪ResourceParameter≫ directly aligns with the ≪ResourceInformation≫ item from the "Map Current Value Stream" ≪ProjectActivityAction≫ in Figure 5.

Figure 7 shows an example of a dependency matrix constructed to show activities in the *Project* domain that have been allocated to *Personnel* elements. Visualizing the cross-domain relationships within the EA aids in identifying potential gaps between all UAF aspects.

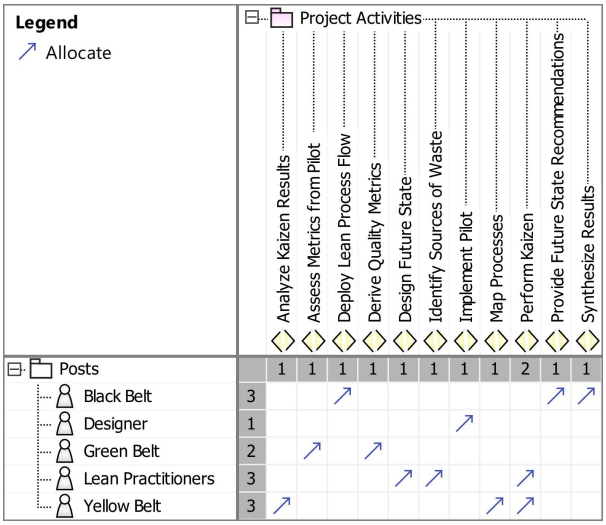

Figure 7: Projects process flow of value stream mapping.

Operational Domain

The UAF *Operational* domain describes the solution-independent logical architecture by capturing operational requirements (OR), behavior, structure, and exchanges that support strategic capabilities of the enterprise (OMG, 2022). Figure 8 shows two (2) ORs with arbitrary bounds meant to demonstrate the concept of automatic validation within the system model.

#	△ Name	Text
1	R OR-1 Defect Rate	The defect rate shall be less than 0.0023.
2	R OR-2 MTBF	MTBF shall be less than 0.4.

Figure 8: PLS operational requirements.

Figure 9 shows the ≪satisfy≫ relationship created between the "Workstation" ≪KnownResource≫ value properties and the ORs that must be met in the production environment.

Figure 10 shows "Workstation" ≪KnownResource≫ constraints and the associated parameters that correlate to each variable in the constraint expression.

Figure 11 illustrates the "Defect Rate" and "MTBF" ≪constraint≫ calculations.

Figure 12 shows four (4) "Workstation" ≪KnownResource≫ instances in the *Operational Structure* viewpoint and exemplifies the usage of *Resource* model elements within the *Operational* domain.

The traceability between UAF domains within an enterprise project allows for ORs to be automatically verified as shown in Figure 13.

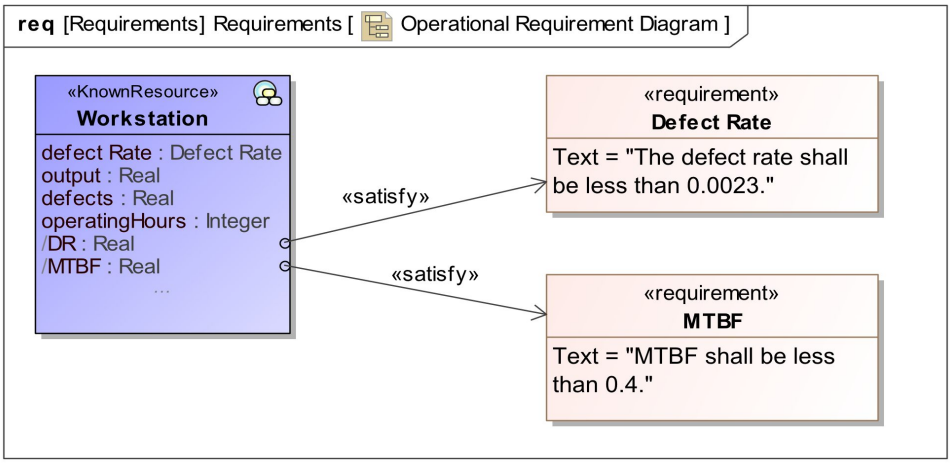

Figure 9: OR diagram.

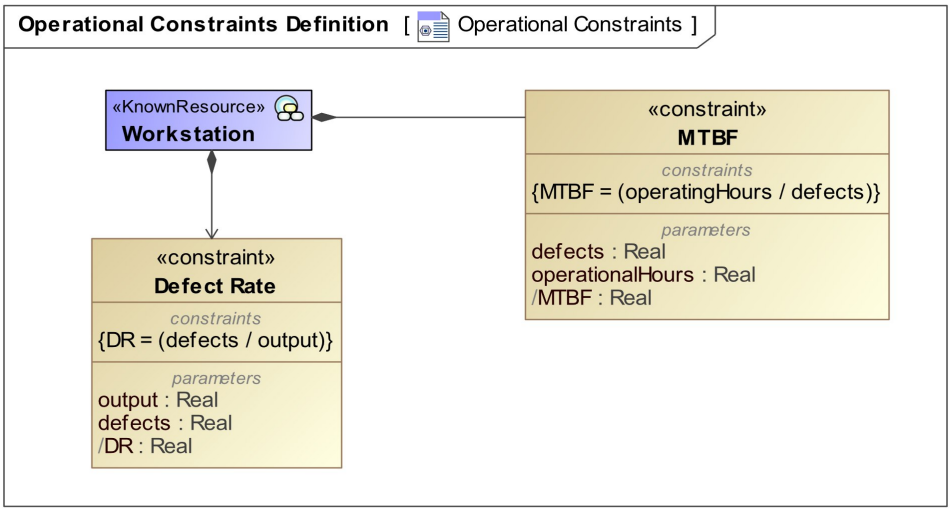

Figure 10: Operational constraints definition diagram.

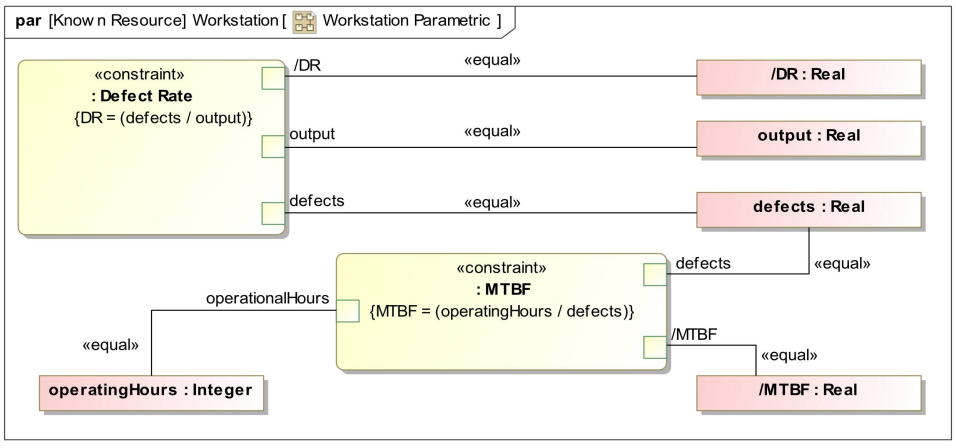

Figure 11: Parametric evaluation of workstations.

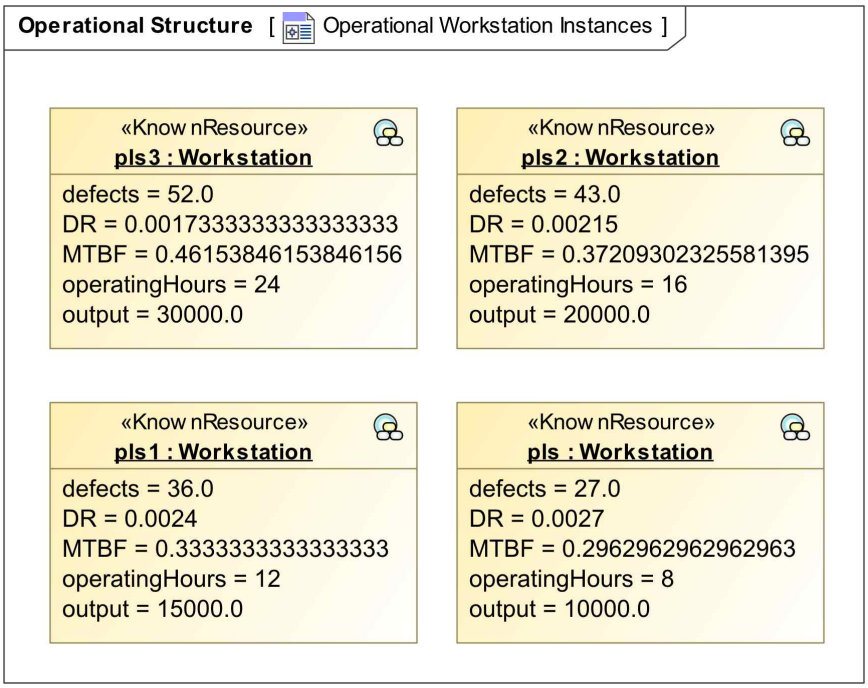

Figure 12: Operational structure of workstation instances.

Verification Status: Pass Fail

#	Name	output : Real	defects : Real	operatingHours : Integer	DR : Real	MTBF : Real
1	pls	10000	27	8	0.0027	0.2963
2	pls1	15000	36	12	0.0024	0.3333
3	pls2	20000	43	16	0.0022	0.3721
4	pls3	30000	52	24	0.0017	0.4615

Figure 13: Workstation OR verification.

CONCLUSION

Implementing a framework when architecting an enterprise assists typical project management activities. This fictitious performance improvement scenario of a manufacturing PLS exemplifies UAF capabilities regarding the *Projects* and *Operational* domains. By leveraging information previously captured within the model, traceability is maintained across stakeholder views to increase transparency and collaboration between disciplines. Future work will continue to build the EA by investigating the *Services* and *Security* stakeholder concerns.

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