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Model-Based Technical Reviews for Future Systems

GSAW, March 2023

Introduction

Devon Clark
Digital Engineering
Specialist Leader

Devon is a Systems Engineer at Deloitte with 20 years of experience in Systems Engineering, Integration, and Test supporting government agencies in (primarily) DS&J sector to solve their System of Systems problems by connecting data. He currently leads our Model-Based Systems Engineering (MBSE) capability for GPS as part of our investment into Digital Engineering and Digital Transformation.

Travis Goodwyn
Digital Engineering
Specialist Master

Travis is a Systems Engineer with 6 years of prior experience as a government civilian supporting the Missile Defense Agency Advanced Technology Program Office where he earned his Masters Degree in Systems Engineering from the Naval Postgraduate School in 2018. He has spent the last 2 years as a Deloitte Consultant focusing on Digital Engineering

Kasey Hill
Digital Engineering
Senior Consultant

Kasey is a Systems Engineer with over 7 years of experience working in the defense industry. She has proven success in leading systems engineering and test teams to solve problems and achieve operational mission success

Laying the Foundation

What is a model?

A formal representation of our understanding of a thing

- Models define key parameters of the system
- Models allow you to change those parameters to analyze relationships and effects
- Models enable you to identify key relationships before you produce a solution
- Better models lead to better solutions

What is a technical review?

A process approach by which stakeholders assess solutions against a collective set of values

- Technical reviews define key parameters for solution success
- Technical reviews assess current baselines against those parameters for success
- Technical reviews enable organizations to identify key (missing) relationships before the solution is produced
- Better technical reviews lead to better systems

Model-Based Technical Reviews produce greater understanding and better solutions

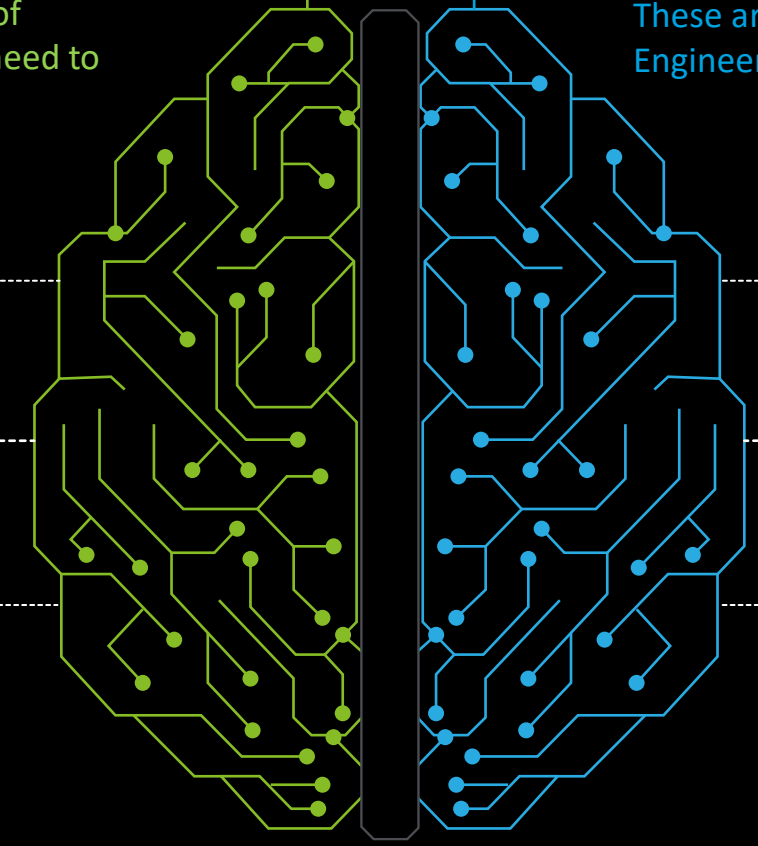
- Models provide technical content
- Technical Reviews provide understanding of technical content
- Therefore, a technical review model must balance development of content with understanding of content

Communication of Content vs. Development of Content

Communicating Content

These are the analysis questions of technical activities Stakeholders need to understand

- What are the environmental factors we need to consider?
- How do I get the best combination of performance, reliability, and cost?
- How much will the solution cost to field and maintain?



Developing Content

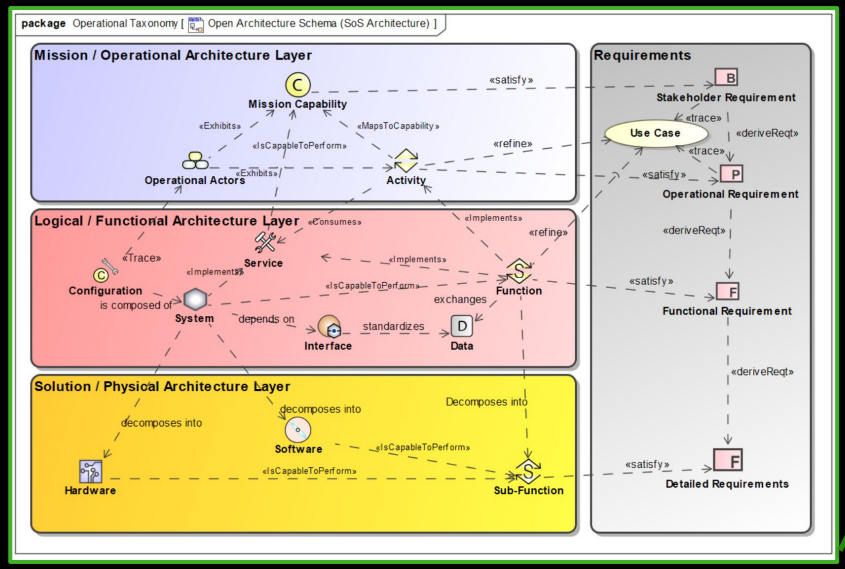
These are the technical activities Systems Engineers do in developing a system

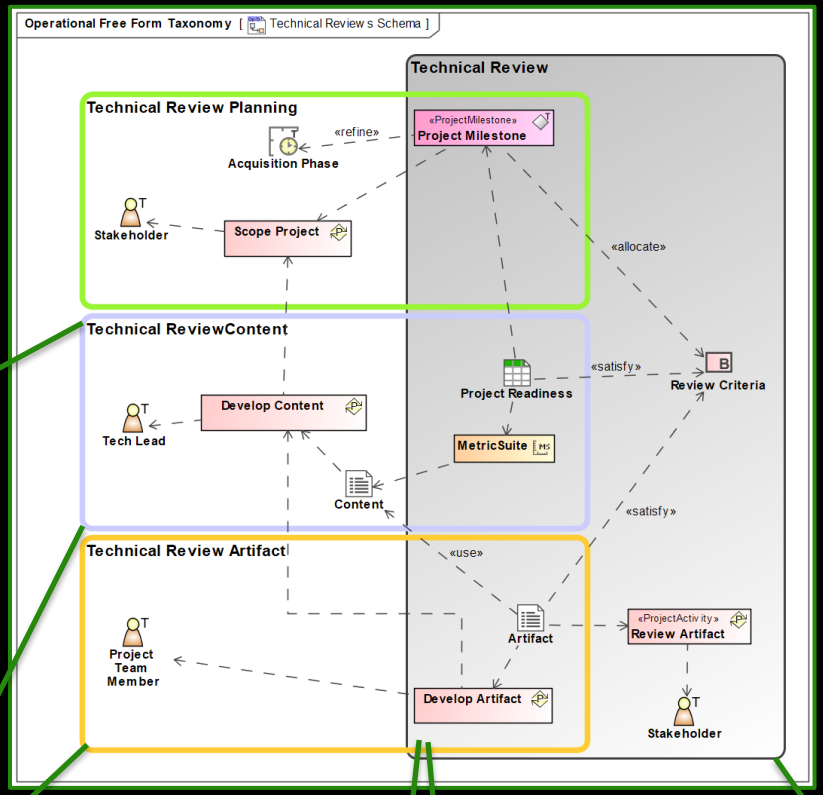
- Design Reference Mission
- Analysis of Alternatives
- Lifecycle Cost Estimate

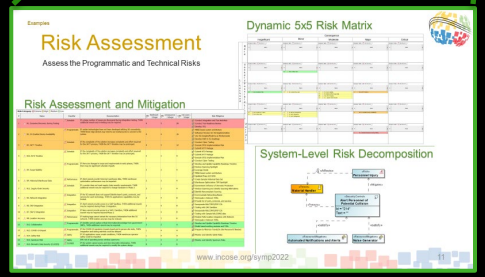
Model-Based Technical Reviews Balance Content Development with Stakeholder Understanding

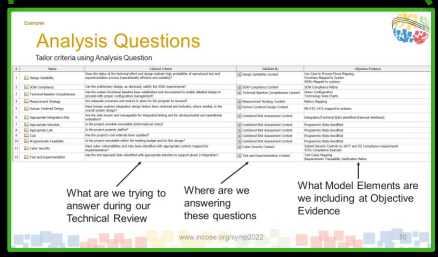
Review Schema

The Stakeholder defined Project Scope will drive **Content Development** to describe the system. The Review Criteria will drive what artifacts are used to build content to **Communicate the Content** to the Stakeholder









The System Schema Ensures a Complete System Definition

The Technical Review Schema Ensures a Complete Engineering and Communication of a System

Model Based Technical Reviews and the Future of Collaboration

Through integrated System of Systems (SoS) models and technical reviews, IPTs can achieve major gains in historically large cost drivers, such as documentation, configuration management, integration, and risk management.

Opportunities

Digital traceability provides **greater decision support**

Model navigation enables **greater communications and collaboration**

Greater modularity and system openness through **model integration**

Greater **risk visibility and Mapping**

Challenges

Legacy process requirements can lead to need to **re-document content**

Lack of model fluency in stakeholders can make reviewing content difficult

Separation of model environments (IP) requires **periodic manual updates**

Risk definitions (in UAF) require **customizations**

Proof Point

5G Smart Warehouse

By implementing an MBSE approach and model-based technical reviews, Deloitte developed a 5G smart warehouse prototype in under 12 months, culminating in a live client demonstration.

Time Savings

Accelerated Design Process

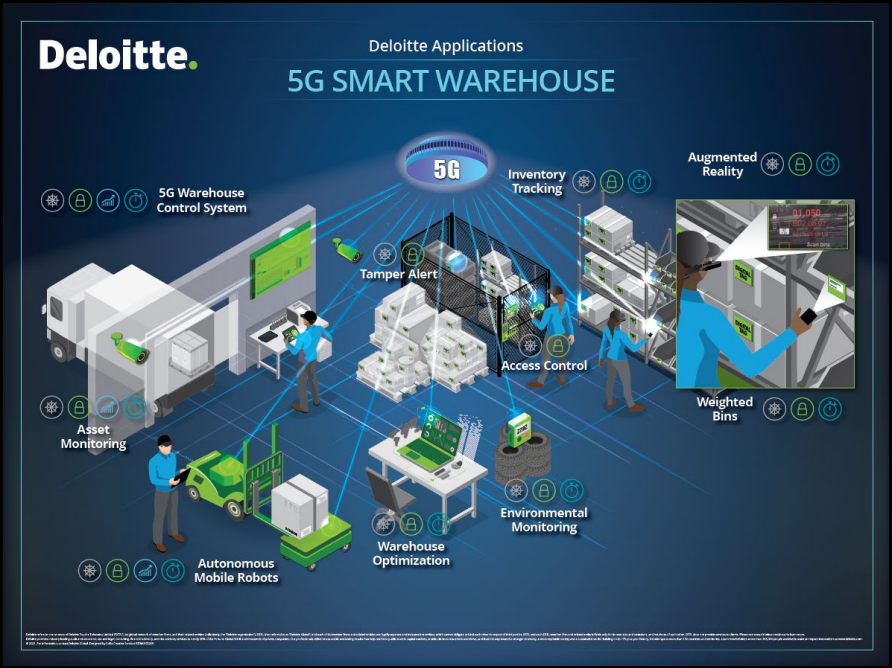
6 months from project start to PDR; 6 months from PDR to CDR

Rapid Integration and Test

<1 year from project start to integrated technology demo

Minimized Documentation Time

Model-Based technical reviews enabled more time for design, integration, and test



Model Confidence

Agile and Flexible Model

Technology agnostic model ready to incorporate new 5G technologies as they are released

Authoritative Source of Truth

Configuration control and changes captured in the model

Stakeholder Confidence

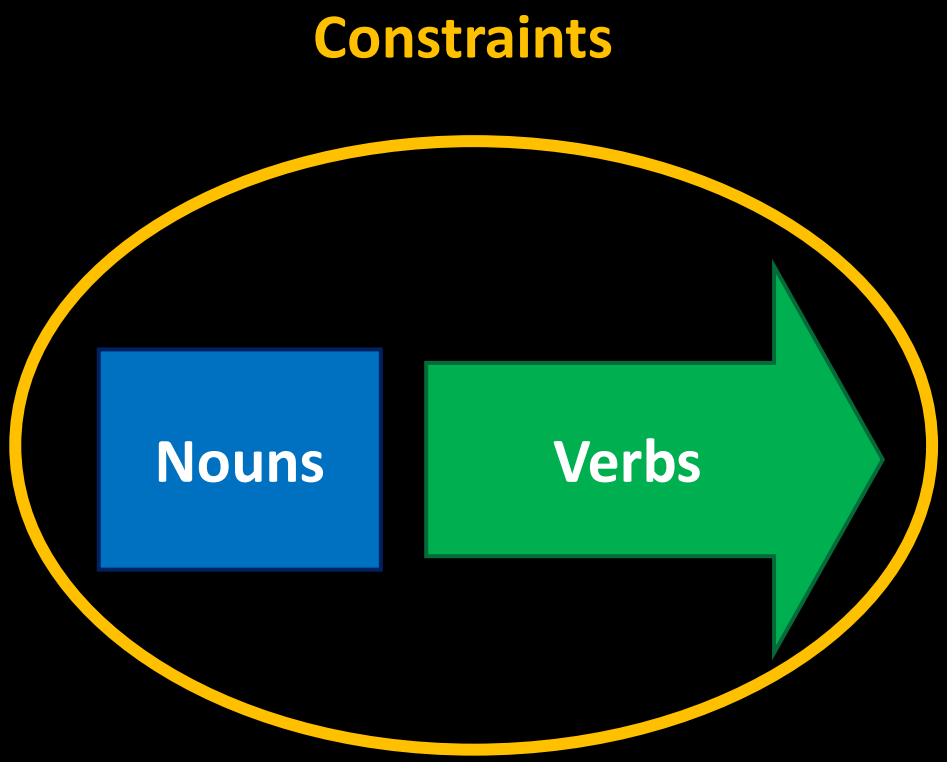
During technical reviews, questions were answered on-the-spot by navigating in the model

Project Start — **PDR** — **CDR** — **Tech Demo**

2021 Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec **2022**

From System Model to Technical Review Model

System Models in their simplest form are a collection of nouns and verbs that are wrapped in constraints



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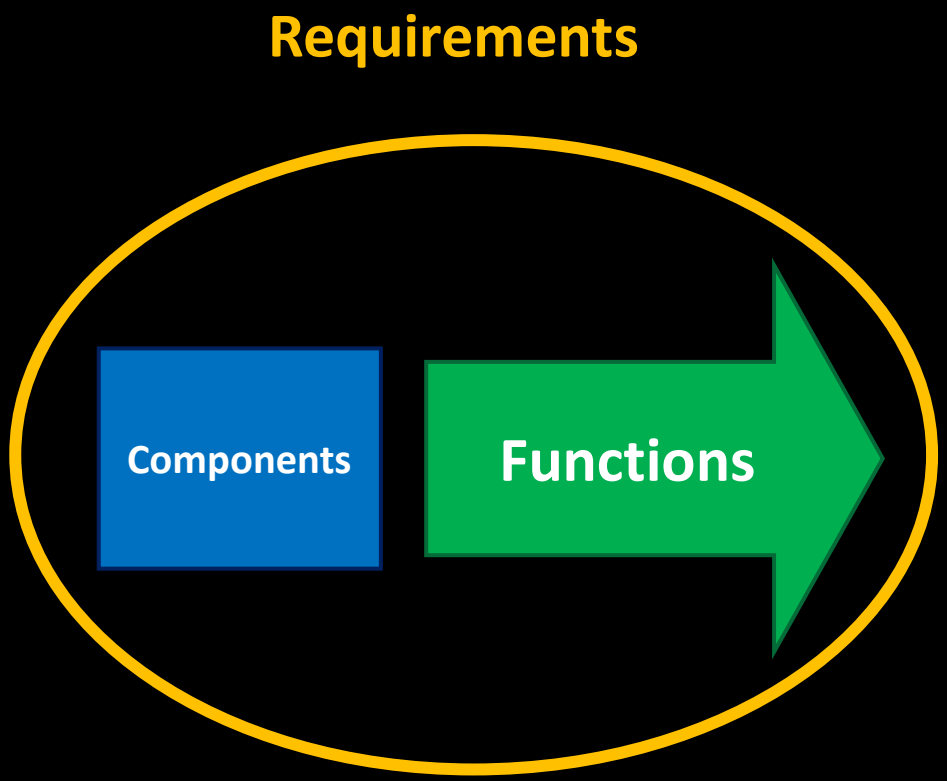
System Models in their simplest form are a collection of nouns and verbs that are wrapped in constraints

These equate to System Components and Functions wrapped in requirements



From System Model to Technical Review Model

System Models in their simplest form are a collection of nouns and verbs that are wrapped in constraints

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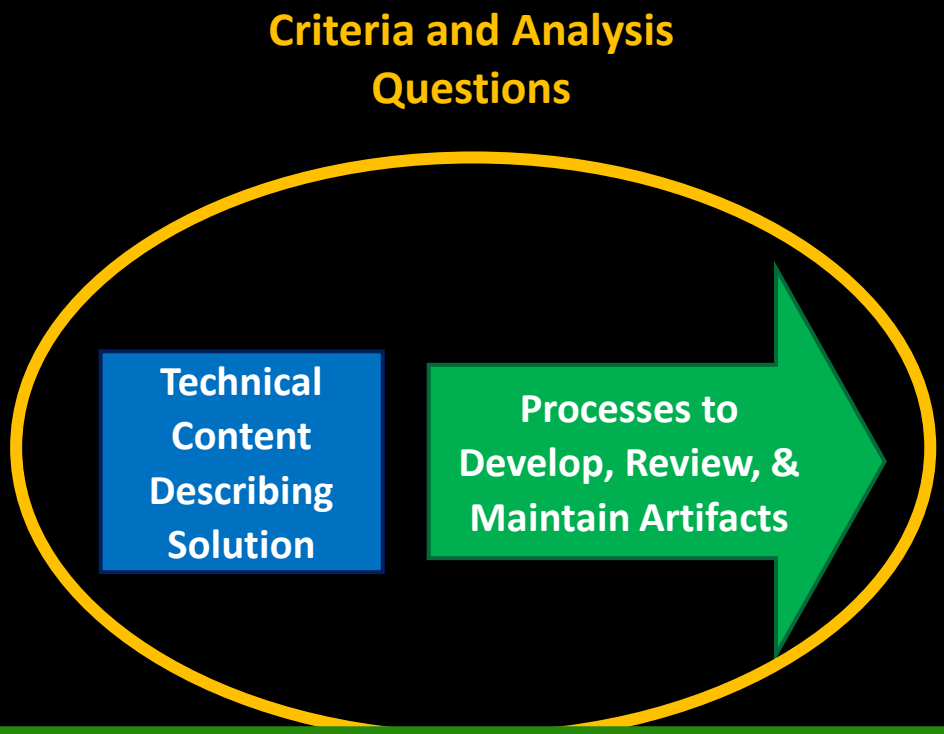
A Technical Review follows a similar structure



Applying Similar Model-Based Approaches to Technical Reviews can Lead to Cost and Schedule Efficiencies in Systems Engineering Lifecycle

Objective of the Model-Based Technical Review

Communication of the Architecture, System (or System of Systems) Design, Risks, Analysis and Progress are critical parts of a Technical Review.

1 **Tailor Criteria to Stakeholder Objectives**

- Start from a Common Definition of Technical Review Objectives and refine objectives to a specific project
- Establish analysis questions (e.g. Technical Review Criteria) that will address each Objective
- Focus on development of specific model that answers each question

2 **Automate Assessment and Monitoring of Readiness**

- Maintain an Event-Driven Technical Review
- Show value-added metrics that establish readiness or completeness of content that answers each Review Criteria
- Show progress of those metrics to give confidence to Stakeholders that the team is ready to execute a successful review

3 **Identify and Track Risk**

- What are the critical risks to the program?
- What are the impacts, trade-offs, and mitigations of each risk?
- Using a model as the objective evidence provides opportunity to deep dive on content in real-time

Examples

Analysis Questions

Tailor criteria using Analysis Question

#	Name	Tailored Criteria	Satisfied By	Objective Evidence
1	Design Suitability	Does the status of the technical effort and design indicate high probability of operational test and experimentation success (operationally effective and suitable)?	Design Suitability Content	Use Case to Process Flows Mapping Functions Mapped to System MOEs Mapped to systems
2	SOW Compliance	Can the preliminary design, as disclosed, satisfy the SOW requirements?	SOW Compliance Content	SOW Compliance Matrix
3	Technical Baseline Completeness	Has the system functional baseline been established and documented to enable detailed design to proceed with proper configuration management?	Technical Baseline Completeness Content	Demo Configuration Technology Area Charts
4	Measurement Strategy	Are adequate processes and metrics in place for the program to succeed?	Measurement Strategy Content	Metrics Mapping
5	Human Centered Design	Have human systems integration design factors been reviewed and included, where needed, in the overall system design?	Human Centered Design Content	Mil-STD 1472 mapped to systems
6	Appropriate Integration Risk	Are the risks known and manageable for integrated testing and for developmental and operational evaluation?	Combined Risk Assessment Content	Integration/Technical Risks identified (External interfaces)
7	Appropriate Schedule	Is the project schedule executable (technical/cost risks)?	Combined Risk Assessment Content	Programmic Risks itendified
8	Appropriate LOE	Is the project properly staffed?	Combined Risk Assessment Content	Programmic Risks itendified
9	Cost	Has the project's cost estimate been updated?	Combined Risk Assessment Content	Programmic Risks itendified
10	Programmatic Feasibility	Is the project executable within the existing budget and for this design?	Combined Risk Assessment Content	Programmic Risks itendified
11	Cyber Security	Have cyber vulnerabilities and risks been identified with appropriate controls mapped for implementation?	Cyber Security Content	Subset Security Controls by IATT and 5G Compliance requirements STIG Compliance Example
12	Test and Experimentation	Has the test approach been identified with appropriate activities to support phase 2 integration?	Test and Experimentation Content	Test Cases Mapping Requirements Traceability Varification Matrix

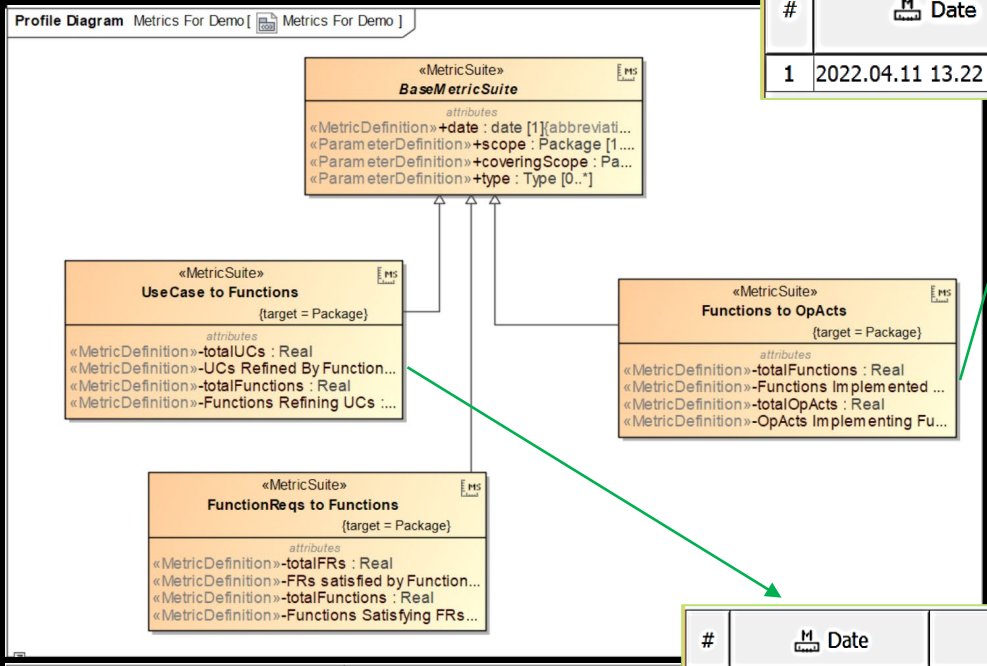
What are we trying to answer during our Technical Review

Where are we answering these questions

What Model Elements are we including at Objective Evidence

Automated Assessment and Monitoring of Readiness

Build Metrics into the model that can track progress toward the SETR and provide a reason for known modeling gaps

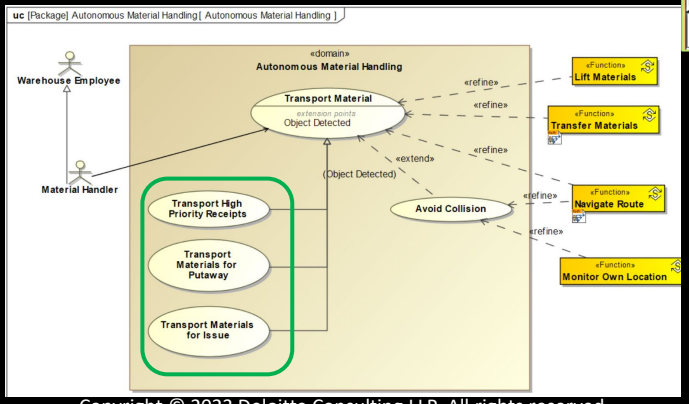


#	Date	Scope	Total Functions	Functions Implementing Op Acts
1	2022.04.11 13.22	Template Model	198	28

Total Op Acts	Op Acts Implemented by Functions	Avg Funcs To Op Acts	Percent Functions Implementing an Op Acts
48	9	3.1111	14.1414

Note: not every metric needs to be at 100% to show readiness for a Review, but the design team should be able to explain any gaps that allow Stakeholders to assess maturity of the System Baseline

#	Date	Scope	Total U Cs	U Cs Refined By Functions	Total Functions	Functions Refining U Cs
1	2022.03.24 11.36	Resources	24	19	193	22



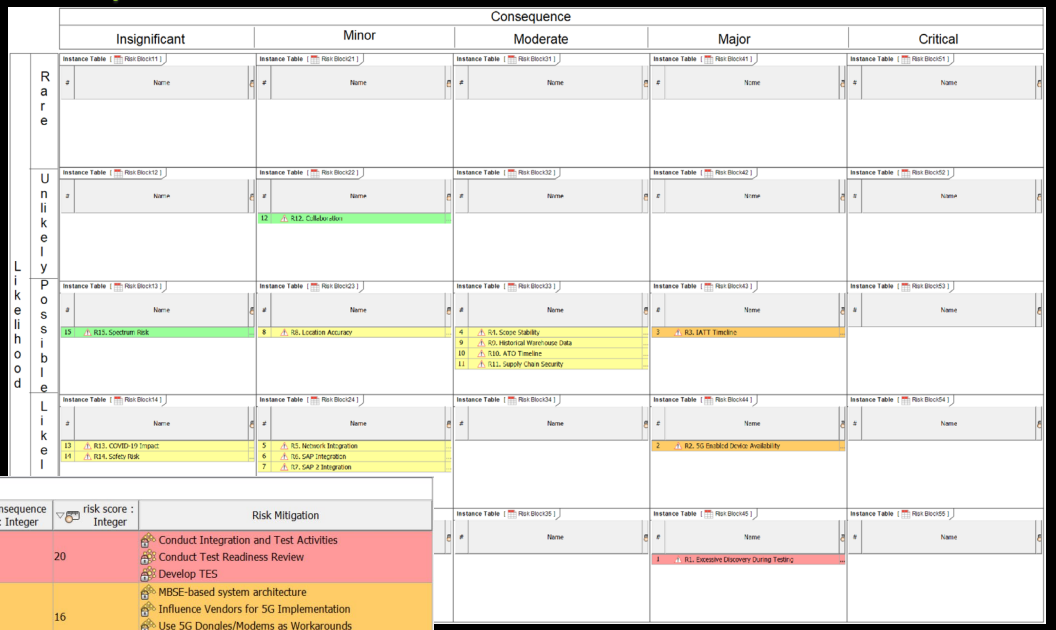
Metrics allow for Automation and Tracking of Readiness for a Technical Review

Examples

Risk Assessment

Assess the Programmatic and Technical Risks

Dynamic 5x5 Risk Matrix

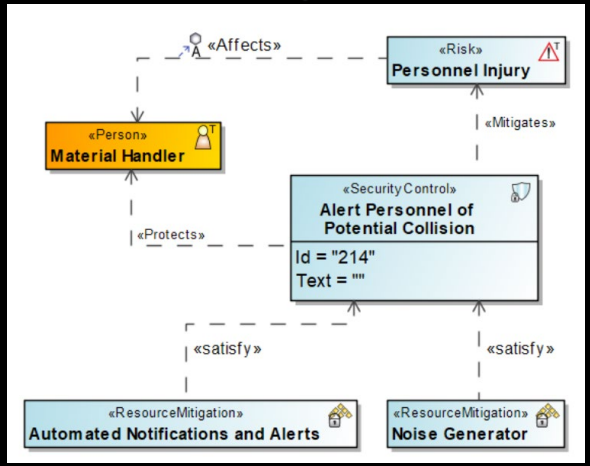


Risk Assessment and Mitigation

Risk Category: Extreme High Medium Low

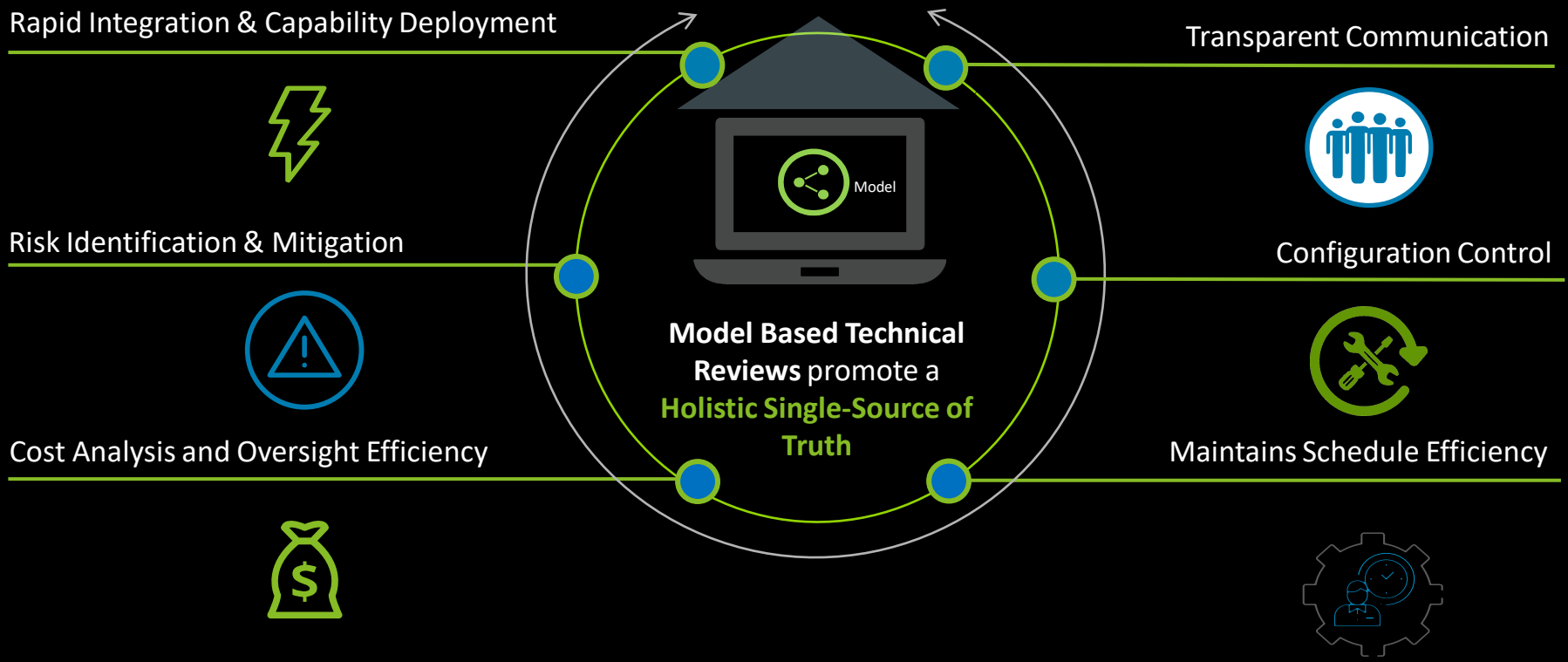
#	Name	Classifier	Documentation	likelihood : Integer	consequence : Integer	risk score : Integer	Risk Mitigation
1	R1. Excessive Discovery During Testing	Schedule	IF a large number of issues are discovered during integration testing, THEN additional rework and re-testing may be required.	4	5	20	Conduct Integration and Test Activities Conduct Test Readiness Review Develop TES
2	R2. 5G Enabled Device Availability	Programmatic	IF certain technologies have not been developed utilizing 5G connectivity, THEN those edge devices may need to use workarounds to connect to the system.	4	4	16	MBSE-based system architecture Influence Vendors for 5G Implementation Use 5G Dongles/Modems as Workarounds Develop Path to 5G Roadmap
3	R3. IATT Timeline	Schedule	IF the complexity of the solution increases complexity and effort required for the IATT process, THEN the IATT timeline may be prolonged.	4	3	12	Conduct Cyber Testing Execute STIG Implementation Plan Submit IATT Package
4	R10. ATO Timeline	Schedule	IF the complexity of the solution increases complexity and effort required for the IATT process, THEN the IATT timeline may be prolonged.	3	3	9	Submit ATO Package Submit IATT Package Execute STIG Implementation Plan Conduct Cyber Testing
5	R4. Scope Stability	Programmatic	IF there are changes to scope and requirements in early phases, THEN there may be significant schedule impacts	3	3	9	Develop and Update Capability Roadmap Timeline Horizon Scanning Spotlight Leverage Dcode MBSE-based system architecture Updated Phase 2/3 SOW
6	R9. Historical Warehouse Data	Performance	IF client cannot provide historical warehouse data, THEN warehouse optimization performance may be impacted.	3	3	9	Create Sample Historical Data Set Warehouse Optimization TEM Spotlight
7	R11. Supply Chain Security	Schedule	IF a vendor does not meet supply chain security requirements, THEN additional rework may be required to change hardware in Phase 2	3	3	9	Government Influence of Domestic Production Horizon Scanning and Identify Sourcing Alternatives Identify Noncompliant Sourcing
8	R5. Network Integration	Integration	IF the 5G network does not support Deloitte team's ports, protocols, and services for each technology, THEN 5G applications' capabilities may be limited.	2	4	8	Communicate Networking Needs Participate in Network TEMs Provide list of ports, protocols, and services
9	R6. SAP Integration	Integration	IF client cannot provide access to a SAP Sandbox, THEN additional rework may be required during Phase 2 integration.	2	4	8	Incorporate NALCOMIS/ERP ICA Testing with SAP Sandbox
10	R7. SAP 2 Integration	Integration	IF Navy cannot provide access to a SAP 2 Sandbox, THEN additional rework may be required beyond Phase 2.	2	4	8	Incorporate NALCOMIS/ERP ICA Testing with Sample NALCOMIS data
11	R8. Location Accuracy	Performance	IF tracking tags cannot extract the necessary information from the 5G network, THEN location accuracy may be reduced.	2	3	6	Finalize Polte location integration with Network Participate in Network TEMs
12	R12. Collaboration	Programmatic	IF Deloitte cannot capture critical information/knowledge from government SME's, THEN additional rework may be required.	2	2	4	Develop and Update Capability Roadmap Timeline Model-based working sessions and TIMs
13	R13. COVID-19 Impact	Programmatic	IF the COVID-19 pandemic impacts travel and in-person site visits, THEN integration and testing activities could be delayed.	1	4	4	Prepare to Minimize Travel/On Site Personnel if Needed
14	R14. Safety Risk	Safety	IF 5G applications cause unsafe conditions, THEN warehouse operator safety could be impacted.	1	4	4	Monitor and Identify Safety Risks
15	R15. Spectrum Risk	Safety	EMI risk of operating across wireless spectrums	1	3	3	Monitor and Identify Spectrum Risks
16	R16. Biometric Data Security (CLOSED)	CLOSED	IF the system cannot access and store biometric information, THEN additional rework may be required to modify the system design.	0	0	0	

System-Level Risk Decomposition



Providing Stakeholders with Visibility into Key Activities

By delivering Technical Reviews digitally, the team can answer questions in real time by navigating within the model, which helps to reduce actions and establishes Stakeholder confidence that answers can be found in the model.



Model-Based Technical Reviews Increase Overall Quality while Ensuring Consistency and Repeatability

Summary

COMMUNICATION VS DEVELOPMENT

Model development is about representing a system and its performance while the Technical Reviews should be about communicating that system design effectively

IT IS A PROCESS

The challenges to executing a Technical Review with a Model-Based Approach are not trivial, but the opportunities have greater value across the system lifecycle

SYSTEM MODEL VS TECHNICAL REVIEW MODEL

These models have the same structure but with a distinct focus for different purposes

VALUE TO THE STAKEHOLDER

Using an MBSE approach to the system design as well as technical reviews saves resources by reviewing, and updating content directly from the authoritative source of truth

Deloitte.

Thank you.

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