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
Context

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.

Context

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
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.

**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

**Time Savings**

**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

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**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.
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.
Approach

From System Model to Technical Review Model

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These equate to System Components and Functions wrapped in requirements.
Approach

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.

These equate to System Components and Functions wrapped in requirements.

A Technical Review follows a similar structure.

Criteria and Analysis
Questions

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

Objective of the Model-Based 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
## Analysis Questions

Tailor criteria using Analysis Question

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

**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**
Examples

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

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

Metrics allow for Automation and Tracking of Readiness for a Technical Review
### Risk Assessment

**Assess the Programmatic and Technical Risks**

#### Examples

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Risk Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programmatic</td>
<td>Assess the Programmatic and Technical Risks.</td>
</tr>
<tr>
<td>Technical</td>
<td></td>
</tr>
</tbody>
</table>

#### Risk Assessment and Mitigation

<table>
<thead>
<tr>
<th>Risk</th>
<th>Data Type</th>
<th>Description</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Risk Score</th>
<th>Risk Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Schedule</td>
<td>Excessive Discovery During Testing</td>
<td>5</td>
<td>20</td>
<td></td>
<td>Conduct Integration and Test Initiative</td>
</tr>
<tr>
<td>2</td>
<td>Program</td>
<td>5G-Enabled Device Availability</td>
<td>5</td>
<td>15</td>
<td></td>
<td>Develop 5G Network Architecture</td>
</tr>
<tr>
<td>3</td>
<td>Schedule</td>
<td>IATT Timeline</td>
<td>3</td>
<td>12</td>
<td></td>
<td>Execute STG Implementation Plan</td>
</tr>
<tr>
<td>4</td>
<td>Program</td>
<td>ATO Timeline</td>
<td>3</td>
<td>9</td>
<td></td>
<td>Submit ATO Package</td>
</tr>
<tr>
<td>5</td>
<td>Program</td>
<td>Scope Stability</td>
<td>3</td>
<td>9</td>
<td></td>
<td>Develop and Update Capability Roadmap Timeline</td>
</tr>
<tr>
<td>6</td>
<td>Performance</td>
<td>Historical Warehouse Data</td>
<td>3</td>
<td>9</td>
<td></td>
<td>Create Sample-Historical Data Set</td>
</tr>
<tr>
<td>7</td>
<td>Schedule</td>
<td>Supply Chain Security</td>
<td>3</td>
<td>9</td>
<td></td>
<td>Create Sample-Historical Data Set</td>
</tr>
<tr>
<td>8</td>
<td>Integration</td>
<td>Network Integration</td>
<td>2</td>
<td>8</td>
<td></td>
<td>Communicate Networking Needs</td>
</tr>
<tr>
<td>9</td>
<td>Integration</td>
<td>SAP Integration</td>
<td>2</td>
<td>8</td>
<td></td>
<td>Participate in Network TDRs</td>
</tr>
<tr>
<td>10</td>
<td>Integration</td>
<td>SAP-2 Integration</td>
<td>2</td>
<td>8</td>
<td></td>
<td>Incorporate NAC/HPsmart ICA</td>
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<tr>
<td>11</td>
<td>Performance</td>
<td>Location Accuracy</td>
<td>2</td>
<td>6</td>
<td></td>
<td>Incorporate NAC/HPsmart ICA</td>
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<tr>
<td>12</td>
<td>Program</td>
<td>Collaboration</td>
<td>2</td>
<td>4</td>
<td></td>
<td>Develop and Update Capability Roadmap Timeline</td>
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<tr>
<td>13</td>
<td>Program</td>
<td>COVID-19 Impact</td>
<td>2</td>
<td>4</td>
<td></td>
<td>Develop and Update Capability Roadmap Timeline</td>
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<td>14</td>
<td>Safety</td>
<td>Safety Risk</td>
<td>1</td>
<td>4</td>
<td></td>
<td>Monitor and Identify Safety Risks</td>
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<tr>
<td>15</td>
<td>Safety</td>
<td>Spectrum Risk</td>
<td>1</td>
<td>4</td>
<td></td>
<td>Monitor and Identify Safety Risks</td>
</tr>
<tr>
<td>16</td>
<td>Security</td>
<td>Biometric Data Security</td>
<td>0</td>
<td>0</td>
<td></td>
<td>Monitor and Identify Spectrum Risks</td>
</tr>
</tbody>
</table>

#### Dynamic 5x5 Risk Matrix

<table>
<thead>
<tr>
<th>System-Level Risk Decomposition</th>
<th>Personnel Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security Controls</td>
<td>Alert Personnel of Potential Collision</td>
</tr>
</tbody>
</table>

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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.

Rapid Integration & Capability Deployment

Risk Identification & Mitigation

Cost Analysis and Oversight Efficiency

Transparent Communication

Configuration Control

Maintains Schedule Efficiency

Model-Based Technical Reviews promote a Holistic Single-Source of Truth

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.
Thank you.

Lee Wilbur
Managing Director, Deloitte Consulting LLP
Contact: lewilbur@deloitte.com

Travis Goodwyn
Specialist Senior, Deloitte Consulting LLP
Contact: tgoodwyn@deloitte.com

Devon Clark
Specialist Leader, Deloitte Consulting LLP
Contact: devclark@deloitte.com

Kasey Hill
Senior Consultant, Deloitte Consulting LLP
Contact: kashill@deloitte.com

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