Bridging the Gap Between Systems Engineers' Architecture Models and Model-Based Design

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Principal Product Manager
Key Takeaways

Unified environment with no data duplication enabling:

- Optimization through analysis and simulation
- Communication with various stakeholders using focused views
- Responding to changes through the digital thread
System Engineering Workflow

Stakeholder Needs

Requirements & Use Cases

Architecture: Structure & Behavior

- Respond to changes

Optimize

Communicate

System Characteristics

Multiple Viewpoints

Highly Iterative
Highly Collaborative

Deliverables:
- Specifications
- ICDs
- Reports
- Code
- More….

size
power
weight
performance
cost
reliability
etc.
Mapping the problems users report with their current tooling

Stakeholder Needs

Requirements & Use Cases

Architecture: Structure & Behavior

- Not Synchronized
- Not Analyzable
- Not Executable
- Steep learning curve
- Hard to use
- Difficulty responding to change

System Characteristics

Multiple Viewpoints

Deliverables:
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Typical (simplified) System Engineering Workflow

- Stakeholder Needs
- Requirements
- Architecture: Structure & Behavior
- System Characteristics
- Multiple Viewpoints
How does this common approach of System Engineering work

- Stakeholder Needs
- Requirements
- Architecture: Structure & Behavior
- System Characteristics
- Multiple Viewpoints
Start with a basic set of Stakeholder Needs

- **Requirements**
- **Architecture: Structure & Behavior**
- **System Characteristics**
- **Multiple Viewpoints**

It needs to track a target for at least 4 min

It needs to fit in a laptop bag
Requirements define what the system shall do

#6: Target Color
The target shall be a ball that is green in color.

#8: Mission Duration
The system shall be capable of persistent target tracking for greater than or equal to 4 minutes.

#9: System Size
The aircraft with attached payload shall fit inside a 15cm x 30cm x 8cm container.
Identify WHAT the System should do and HOW the system is built

Stakeholder Needs

Requirements

Architecture: Structure & Behavior

System Characteristics

Multiple Viewpoints

- **Ground Control Station**
  - #9: System Size
  - The aircraft with attached payload shall fit inside a 15cm x 30cm x 8cm container.

- **Quadcopter**
  - #6: Target Color
  - The target shall be a ball that is green in color

- **Target**
Perform Trade Study to Compare Different System Components

- Stakeholder Needs
- Requirements
- Architecture: Structure & Behavior
- System Characteristics
- Multiple Viewpoints

DIY Mini Drone

Tello

Parrot Mambo
Views are used to simplify complexity

Stakeholder Needs

Requirements

Architecture: Structure & Behavior

System Characteristics

Multiple Viewpoints

Ground Control Station

Quadcopter

Target
Views are used to simplify complexity

- Architecture models can be complex
- Spaghetti models are just as problematic as spaghetti code
Views are used to simplify complexity

- Architecture models can be complex
- An Architecture View can simplify the diagram to contain only the relevant parts
Views are used to highlight specific concerns

Stakeholder Needs

Requirements

Architecture: Structure & Behavior

System Characteristics

Multiple Viewpoints

Ground Control Station

Quadcopter

Target
Views are used to highlight specific concerns

- Stakeholder Needs
- Requirements
- Architecture: Structure & Behavior
- System Characteristics

Multiple Viewpoints

Software View

- GUI
- Video Processing
- On Board Processor
Views are used to highlight specific concerns

Stakeholder Needs

Requirements

Architecture: Structure & Behavior

System Characteristics

Multiple Viewpoints

Mechanical View

Camera

Payload

Camera Power Switch

On Board Processor

Battery
Views are used to highlight specific concerns

- Stakeholder Needs
- Requirements
- Architecture: Structure & Behavior
- System Characteristics

**Multiple Viewpoints**

**Software View**
- GUI
- Video Processing
- On Board Processor

**Mechanical View**
- Camera
- Payload
- Camera Power Switch
- On Board Processor
- Battery

**Ground Control Station**

**Quadcopter**

**Target**
Design and Implement the System

Stakeholder Needs

Requirements

Architecture: Structure & Behavior

System Characteristics

Multiple Viewpoints

OUTPUT: Mode
1 = WaitForComms
2 = Init
3 = Calibration
4 = ReadyForTO
5 = TrackAlt
6 = Track3D
7 = LostBall
8 = Land
9 = Crash

MATLAB EXPO
Unified Environment for MBSE and Model-Based Design

- Stakeholder Needs
- Is Intuitive
- Facilitates Analysis and Execution
- Creates Digital Thread
- Enables Implementation
- Simplifies Complexity
- Highly Iterative
- Highly Collaborative

Deliverables:
- Specifications
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- Reports
- Code
- More….
Now let’s see it in action
Requirements Engineering
Architecture Modeling
Requirements Allocation
Creating and Applying Interfaces – Top Down
Creating and Applying Interfaces – Bottom Up
Capture System Characteristics & Properties
Facilitate Analysis & Trade Studies

![Analysis Viewer](image-url)

MATLAB EXPO
Facilitate Analysis & Trade Studies
Simplifies Complexity: Live Views for Design Trades
Simplifies Complexity: Communicate Effectively with Stakeholders
Enables Implementation: Environment for Architecture and Design
Simulation & Verification

![MATLAB Simulation & Verification](image)
# Digital Thread - Navigation

## Code Generation Report for 'ModeLogic'

### Model Information

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<td>Author</td>
<td>marthony</td>
</tr>
<tr>
<td>Last Modified By</td>
<td>marthony</td>
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<tr>
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### Code Information

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### Additional Information

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Digital Thread – Responding to change
Summary: Unified Environment for MBSE and Model-Based Design

- **Stakeholder Needs**
- **System Characteristics**
- **Multiple Viewpoints**
- **Respond to changes**
- **No data duplication**
- **Optimize**
- **Communicate**
- **Highly Iterative**
- **Highly Collaborative**

**Deliverables:**
- Specifications
- ICDs
- Reports
- Code
- More...