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Using Model Based Systems Engineering Technical Reviews for Complex System of Systems

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Introductions

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

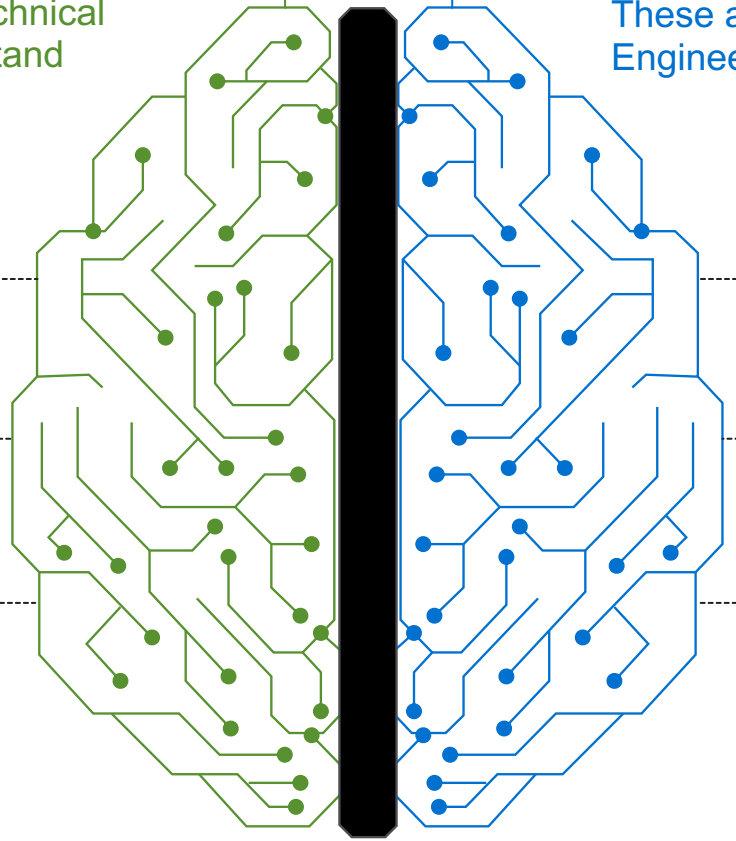
Model-Based Technical Reviews can Streamline Engineering, Increase Quality and System Design, and Increase Stakeholder Buy-in

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

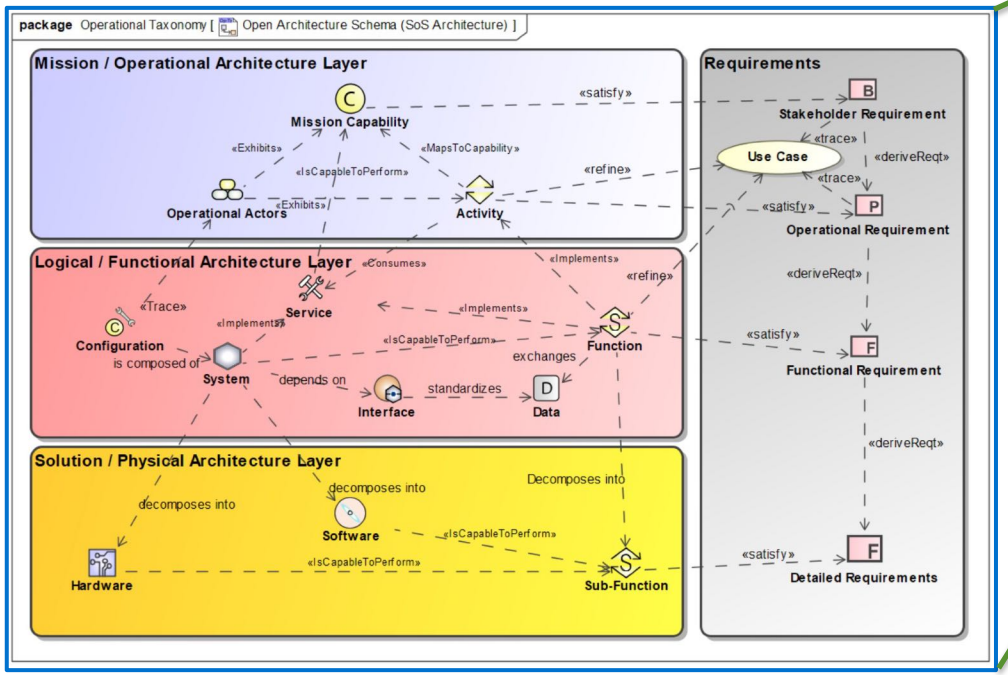
These are the technical activities Systems Engineers do in developing a system

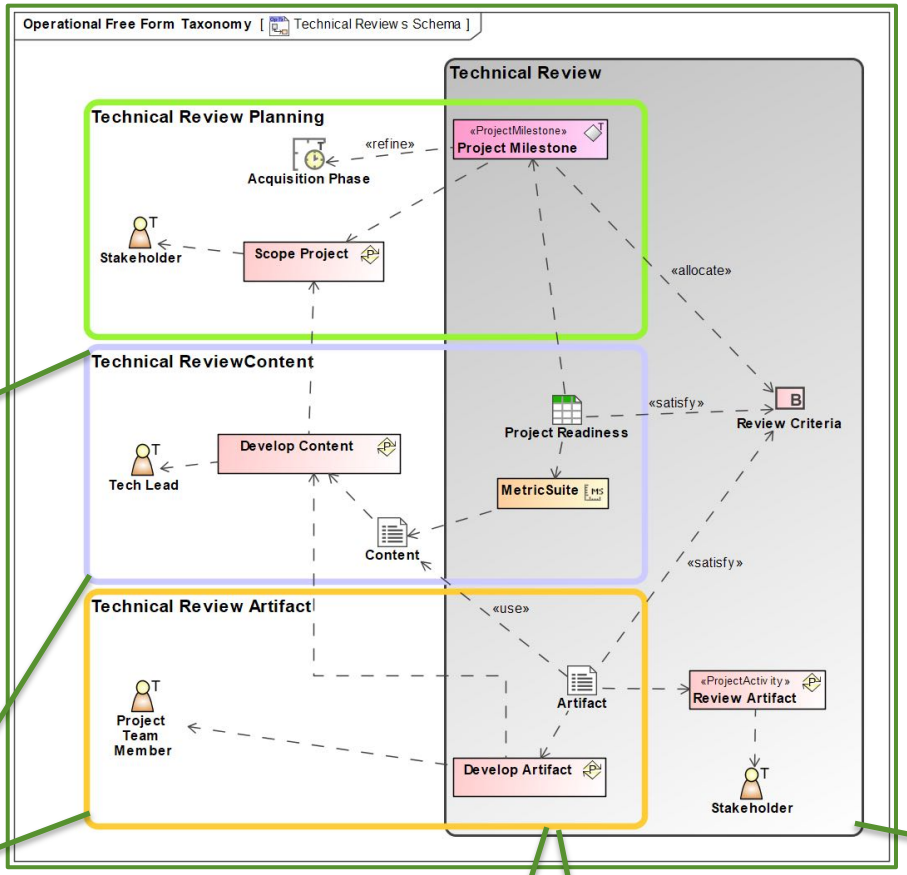
- Design Reference Mission
- Analysis of Alternatives
- Lifecycle Cost Estimate

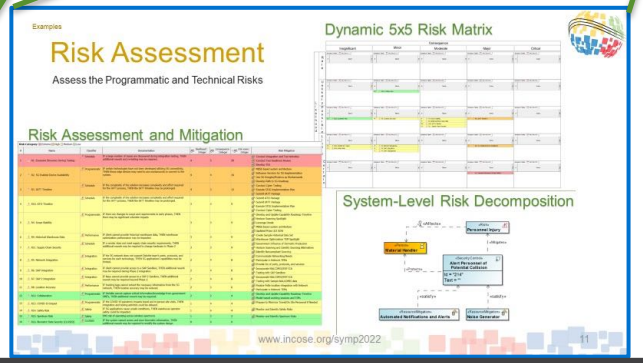
Model-Based Technical Reviews Balance Content Development with Stakeholder Understanding

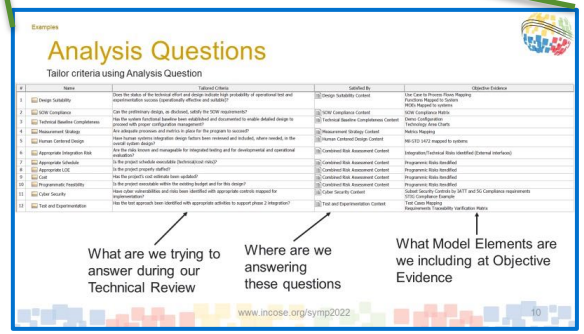
Review Schema

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**

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

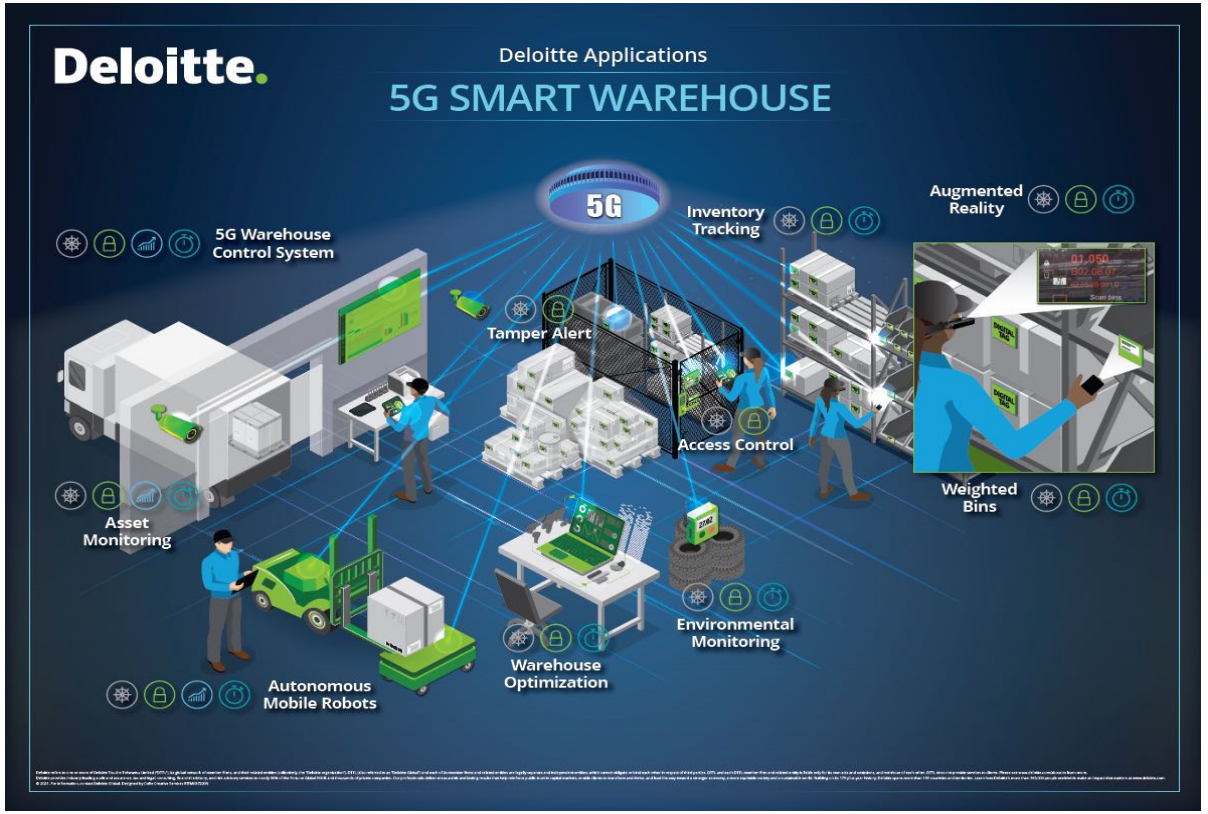
6 months from project start to PDR; 6 months from PDR to CDR

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

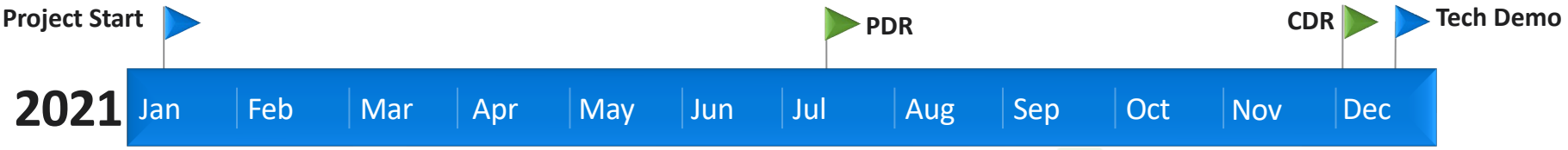
Technology agnostic model ready to incorporate new 5G technologies as they are released

Authoritative Source of Truth

Configuration control and changes captured in the model

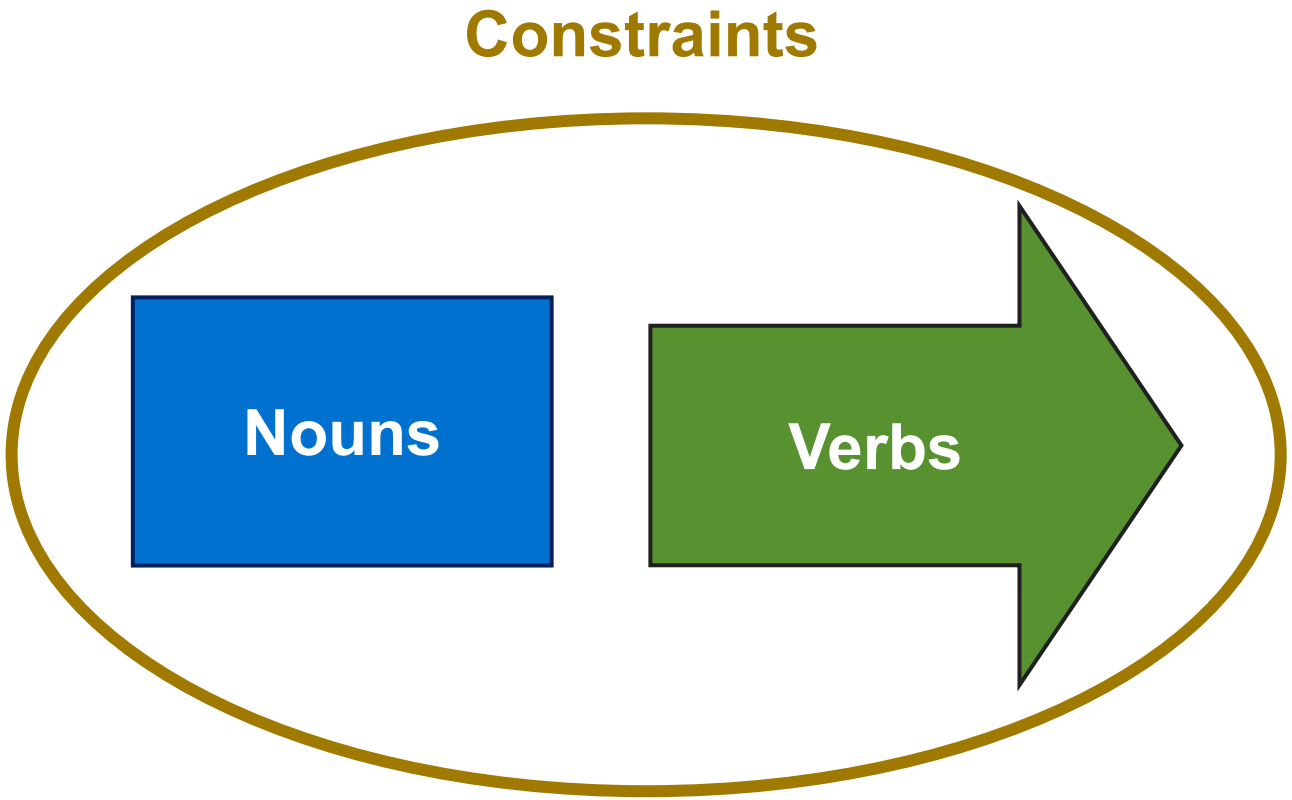
Stakeholder Confidence

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



From System Model to Technical Review Model

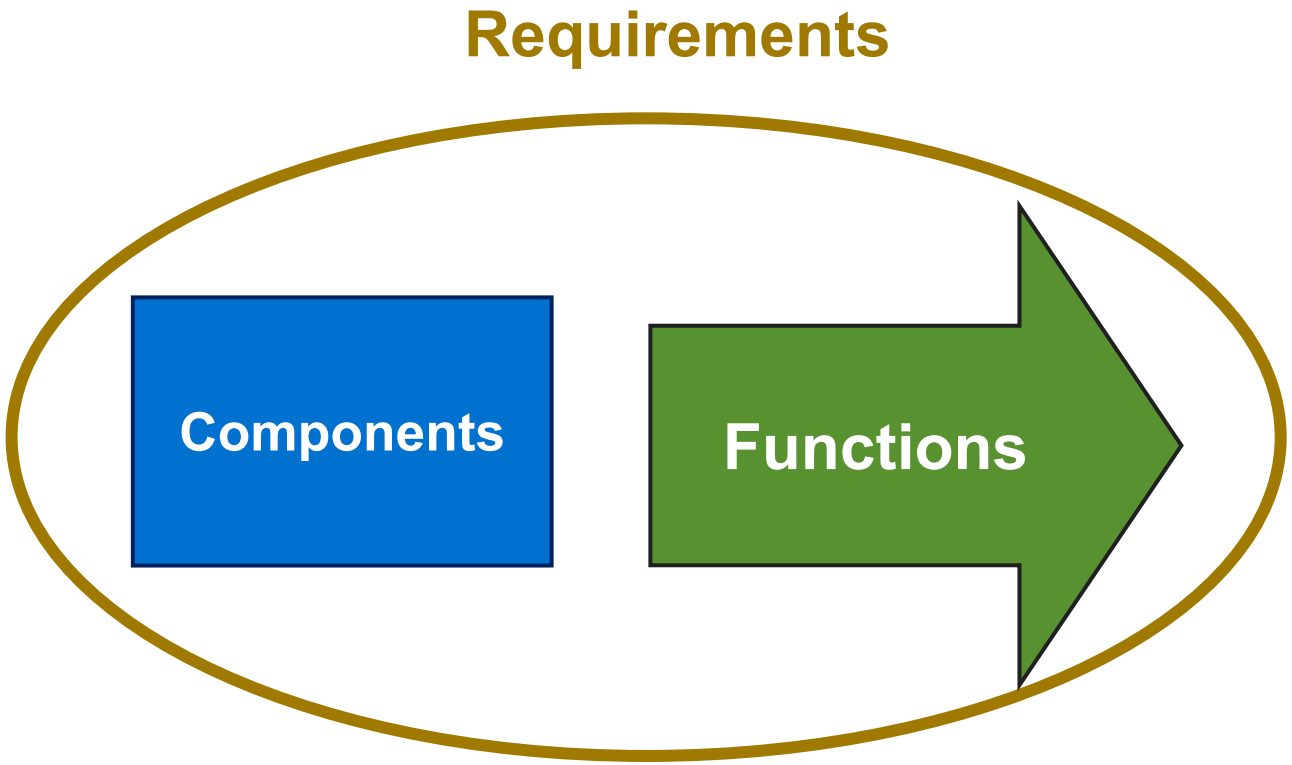
System Models in their simplest form are a collection of nouns and verbs that are wrapped in constraints



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



Applying Model-Based Approaches to System Design can Lead to Cost and Schedule Efficiencies in System Development

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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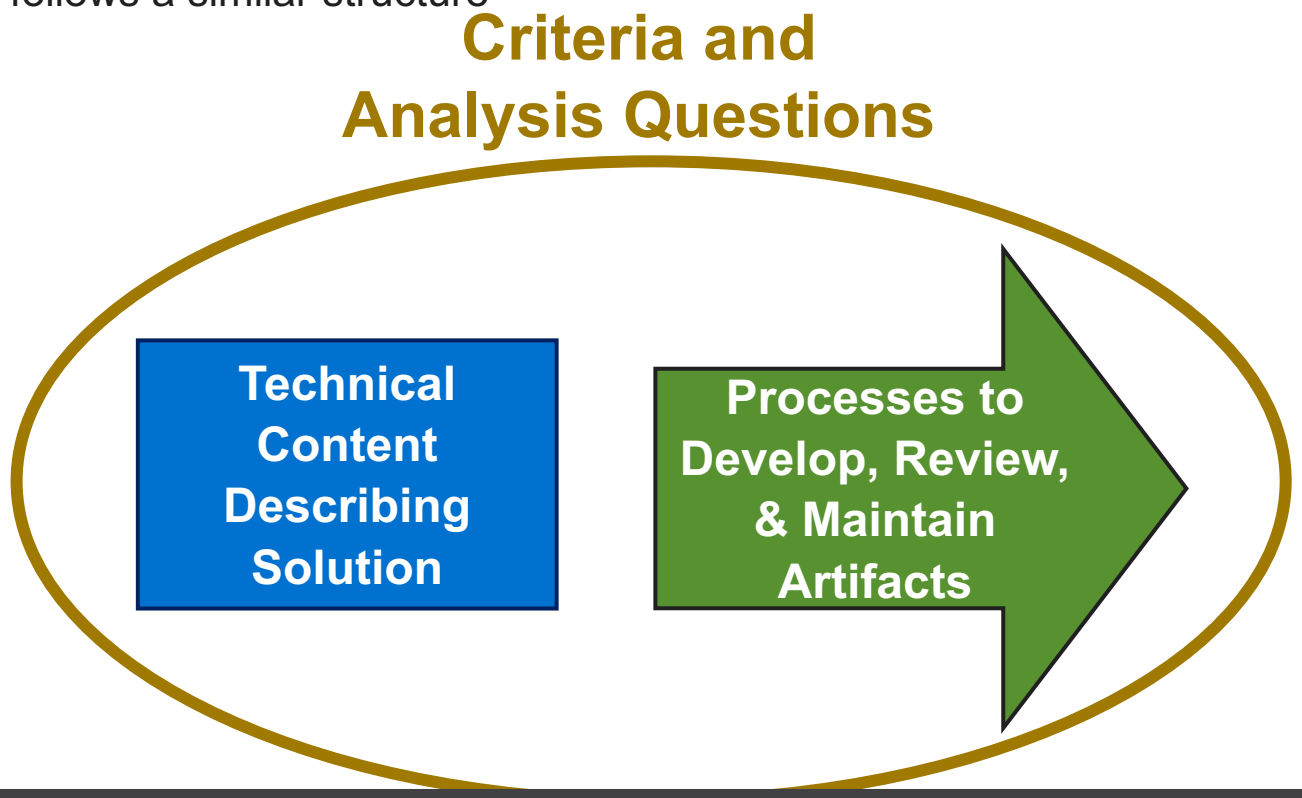
A Technical Review follows a similar structure



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

Systems Engineers can Enhance Technical Reviews by Ensuring Traceability from Artifact to Stakeholder Need in an Authoritative Source of Truth

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?

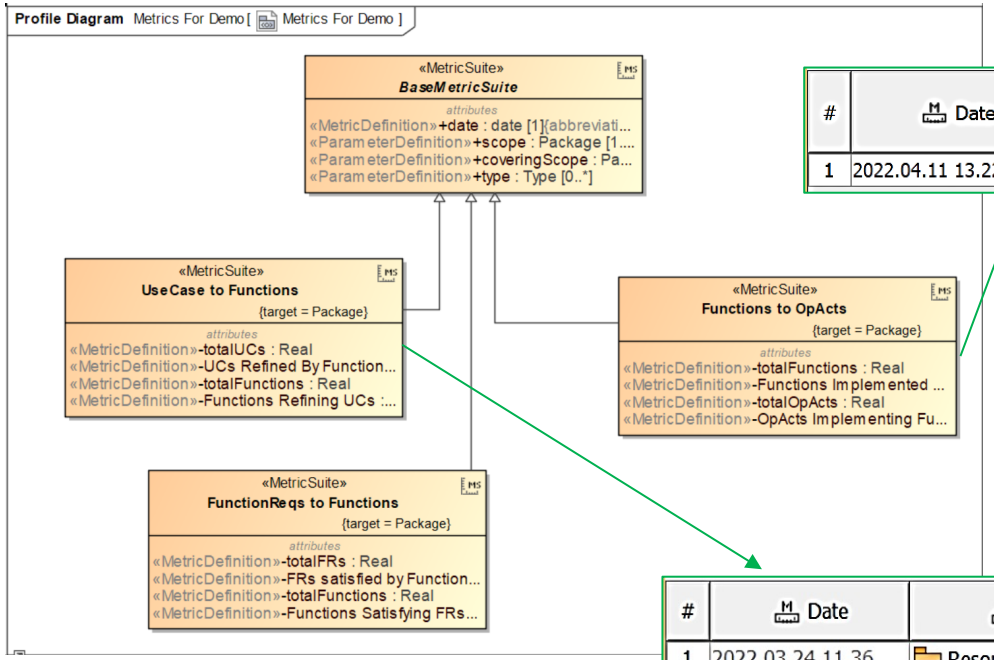
Where are we answering these questions?

What Model Elements are we including in the Objective Evidence?

A Model-Based Approach allows for Persistent Correlation Between Objective Evidence and Criteria and Communication to the Stakeholder

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	Total Op Acts	Op Acts Implemented by Functions	Avg Funcs To Op Acts	Percent Functions Implementing an Op Acts
1	2022.04.11 13.22	Template Model	198	28	48	9	3.1111	14.1414

#	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

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

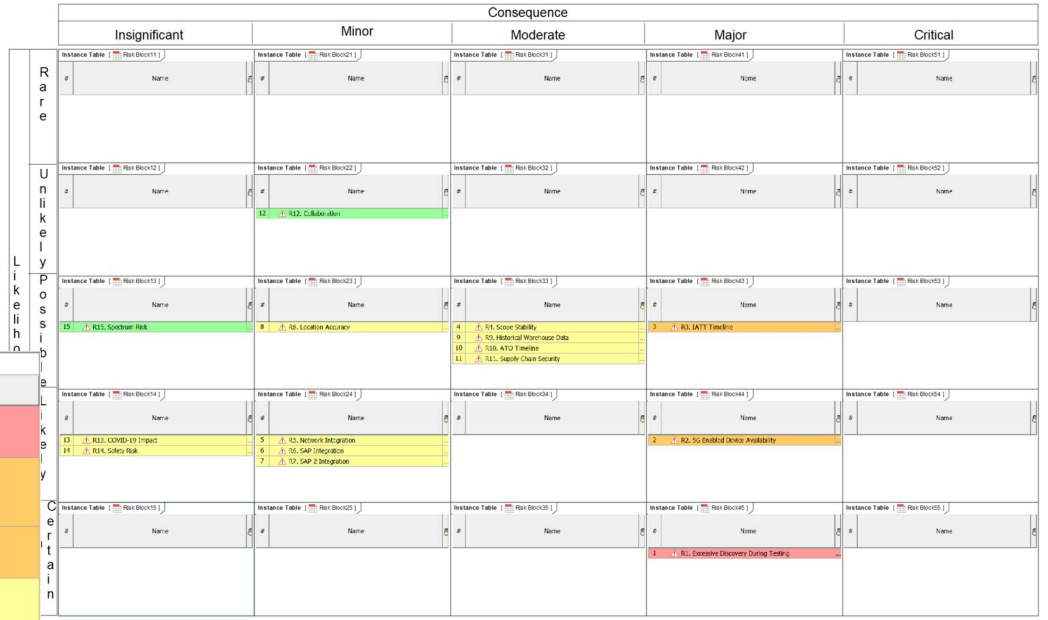
Assess the Programmatic and Technical Risks

Risk Assessment and Mitigation

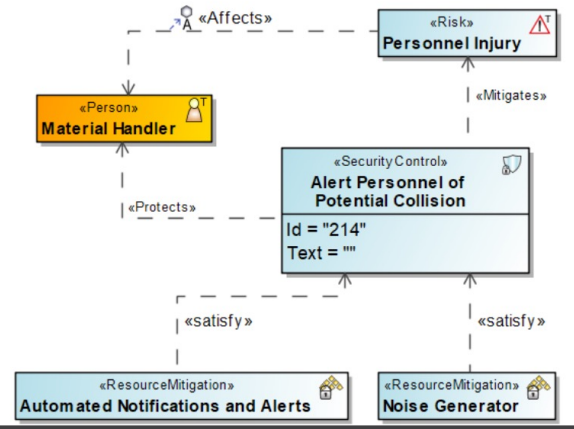
Risk Category: Extreme High Medium Low

#	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	

Dynamic 5x5 Risk Matrix



System-Level Risk Decomposition



A Model-Based Approach Integrates Risk Assessment in every Facet of System Development

Model Walkthrough

File Edit View Layout Diagrams Options Tools Analyze Collaborate Window Help

Perspective: UAF Architect | Create Diagram

_PDR Dashboard [Read-Only]

Containment

- SE Tech Review Model «Archit
  - PDR Example «Architectur
  - CDR «ArchitecturalDescrip
  - Model Example «Architect
  - Technical Review Process
  - Other
  - PDR Template «Architectu
  - SETR Profile
  - Metrics For Demo
  - SETR Exit Criteria
  - README_SE Tech Review
  - Test Procedure «ReportTe
- Project Usages
- Code Engineering Sets

Selection | Tools | Common: Note, Text Box, Anchor, Contai..., Depende..., Image S..., Diagram..., Legend, Constr..., Horizo... | Content Dia...: Content ..., Package, Create D...

Diagram name	_PDR Dashboard
Author	tgoodwyn
Creation date	8/15/21 5:07 PM
Modification date	4/13/22 11:29 AM

Deloitte.

PDR Dashboard

Briefer: Devon Clark, Deloitte

Navigation Assistant

- _PDR Dashboard
- Design Suitability Content
- SOW Compliance Content
- Technical Baseline Completeness Content
- Measurement Strategy Content
- Test and Experimentation Content
- Human Centered Design Content
- Cyber Security Content
- Combined Risk Assessment Content

Deloitte.

SETR Title Page

SETR TEMPLATE MODEL

Properties

Element | Symbol | Tags | Trace

Standard

Content Diagram

Name	_PDR Dashboard
Owner	PDR Example
Applied Stereo...	DiagramInfo
To Do	
Context	

(Name)
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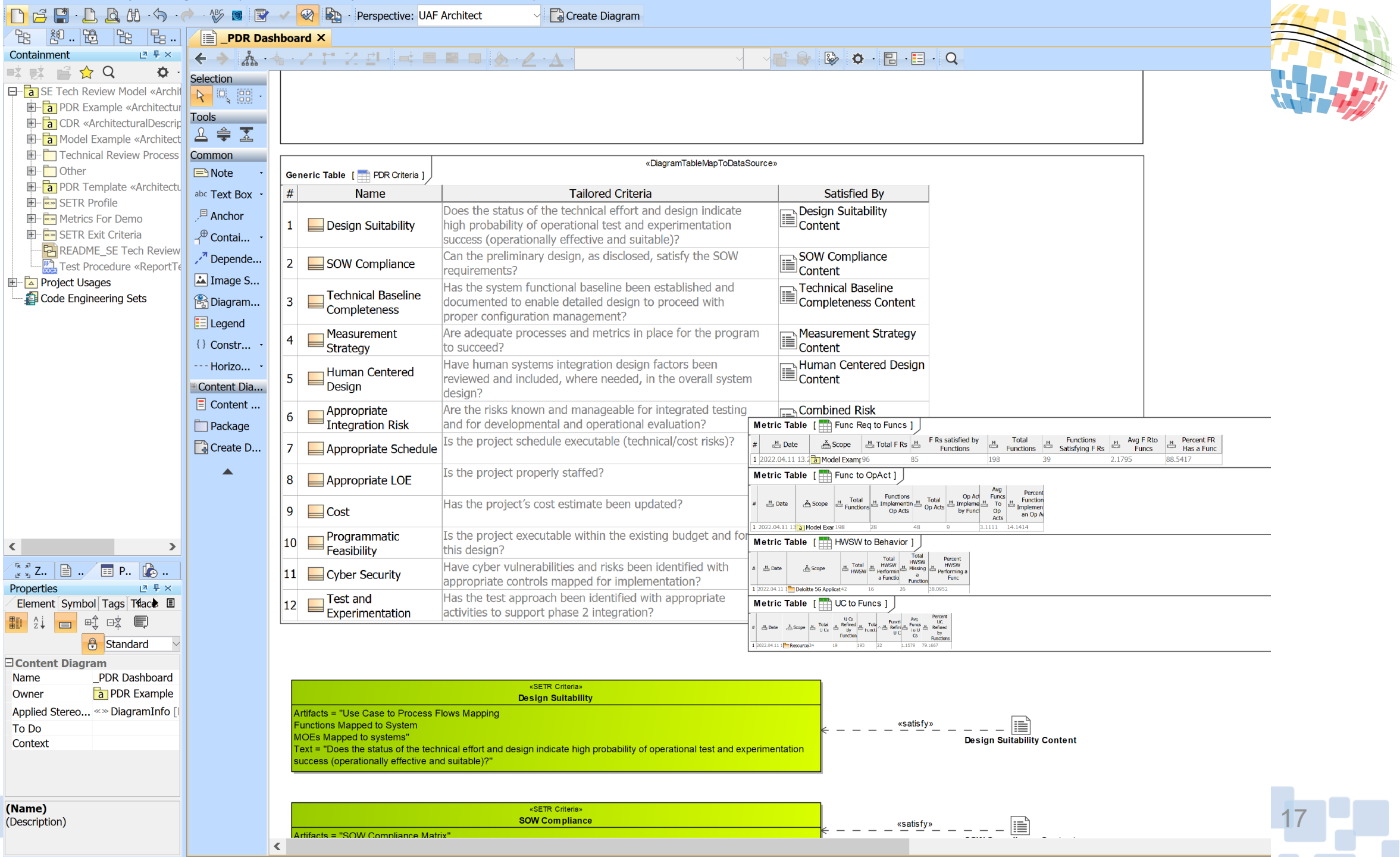
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Generic Table [PDR Criteria]
Name Tailored Criteria Satisfied By
1 Design Suitability Does the status of the technical effort and design indicate high probability of operational test and experimentation success (operationally effective and suitable)? Design Suitability Content
2 SOW Compliance Can the preliminary design, as disclosed, satisfy the SOW requirements? SOW Compliance Content
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
4 Measurement Strategy Are adequate processes and metrics in place for the program to succeed? Measurement Strategy Content
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
6 Appropriate Integration Risk Are the risks known and manageable for integrated testing and for developmental and operational evaluation? Combined Risk
7 Appropriate Schedule Is the project schedule executable (technical/cost risks)?
8 Appropriate LOE Is the project properly staffed?
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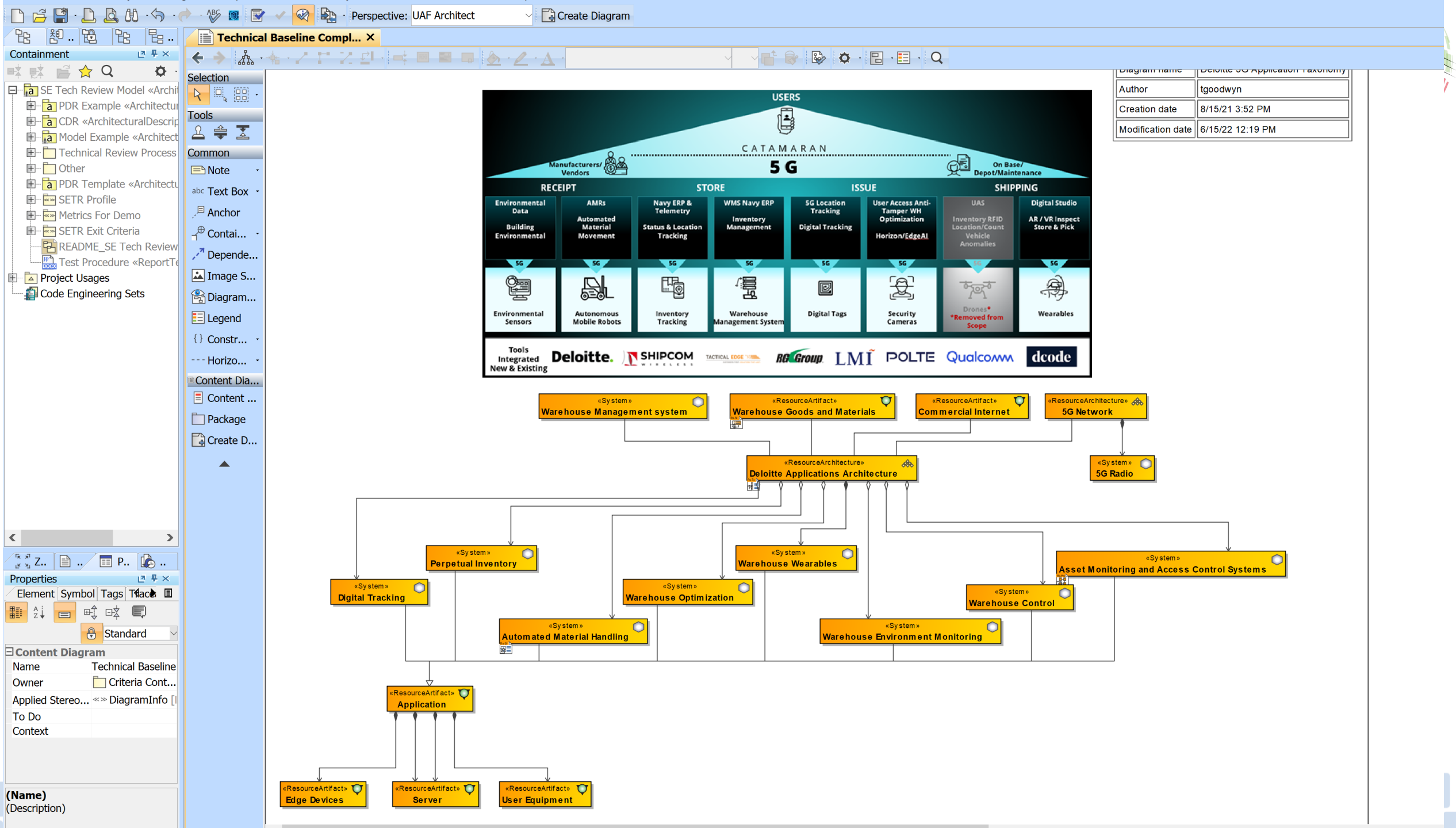
Metric Table [Func Req to Funcs]
Metric Table [Func to OpAct]
Metric Table [HWSW to Behavior]
Metric Table [UC to Funcs]
«SETR Criteria»
Design Suitability
Artifacts = "Use Case to Process Flows Mapping
Functions Mapped to System
MOEs Mapped to systems"
Text = "Does the status of the technical effort and design indicate high probability of operational test and experimentation success (operationally effective and suitable)?"
«satisfy»
Design Suitability Content
«SETR Criteria»
SOW Compliance
Artifacts = "SOW Compliance Matrix"
«satisfy»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Building Environmental
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Automated Material Movement
Navy ERP & Telemetry
Status & Location Tracking
WMS Navy ERP
Inventory Management
5G Location Tracking
Digital Tracking
User Access Anti-Tamper WH Optimization
Horizon/EdgeAI
UAS
Inventory RFID Location/Count Vehicle Anomalies
Digital Studio
AR / VR Inspect Store & Pick
Environmental Sensors
Autonomous Mobile Robots
Inventory Tracking
Warehouse Management System
Digital Tags
Security Cameras
Drones*
*Removed from Scope
Wearables
Tools Integrated New & Existing
Deloitte.
SHIPCOM
TACTICAL EDGE
RGGroup
LMI
POLTE
Qualcomm
dcode
«System» Warehouse Management system
«ResourceArtifact» Warehouse Goods and Materials
«ResourceArtifact» Commercial Internet
«ResourceArchitecture» 5G Network
«ResourceArchitecture» Deloitte Applications Architecture
«System» 5G Radio
«System» Perpetual Inventory
«System» Warehouse Wearables
«System» Asset Monitoring and Access Control Systems
«System» Digital Tracking
«System» Warehouse Optimization
«System» Warehouse Control
«System» Automated Material Handling
«System» Warehouse Environment Monitoring
«ResourceArtifact» Application
«ResourceArtifact» Edge Devices
«ResourceArtifact» Server
«ResourceArtifact» User Equipment

Perspective: UAF Architect | Create Diagram

Technical Baseline Compl...

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Standard

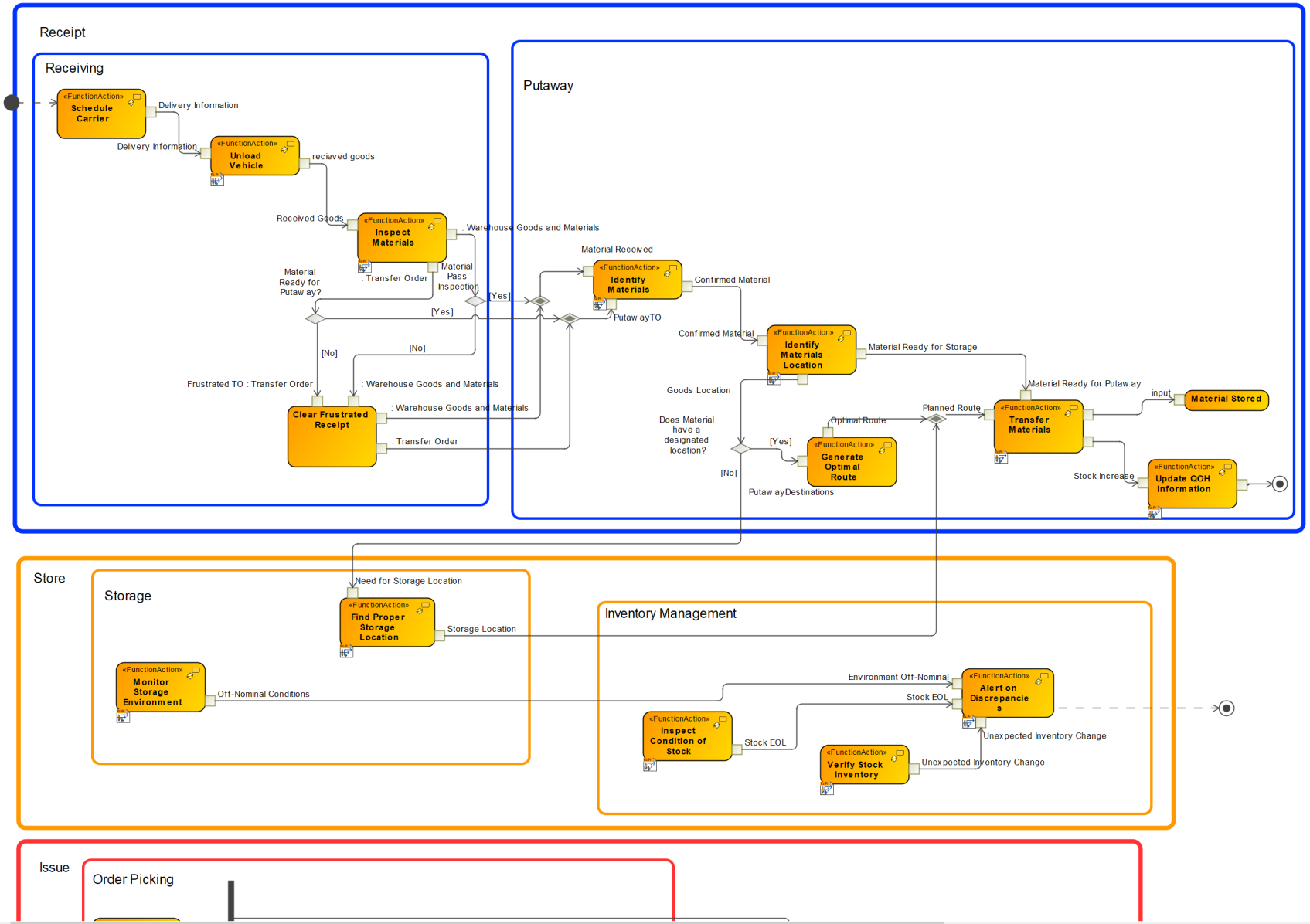
Content Diagram

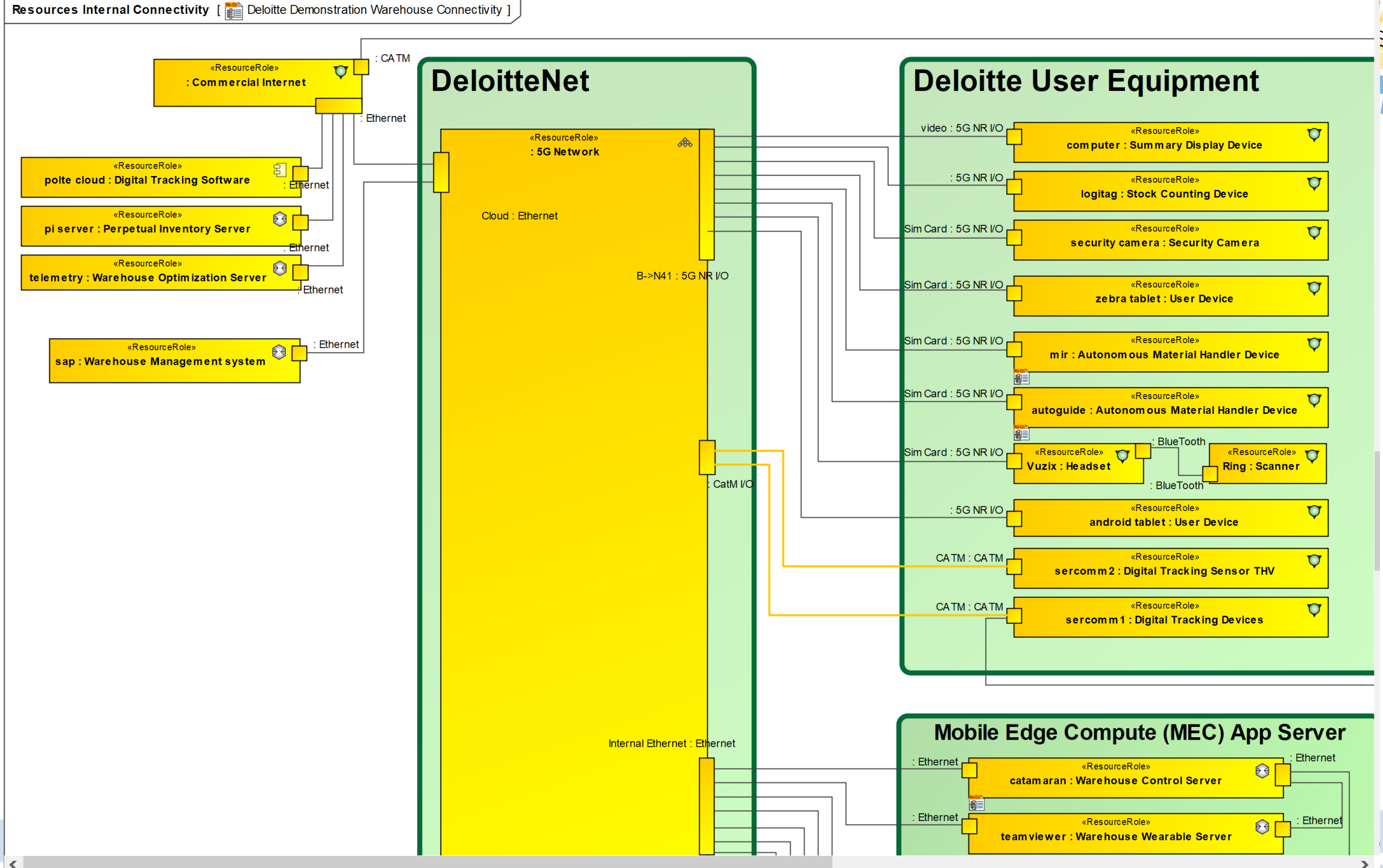
Name	Technical Baseline
Owner	Criteria Cont...
Applied Stereo...	DiagramInfo [
To Do	
Context	

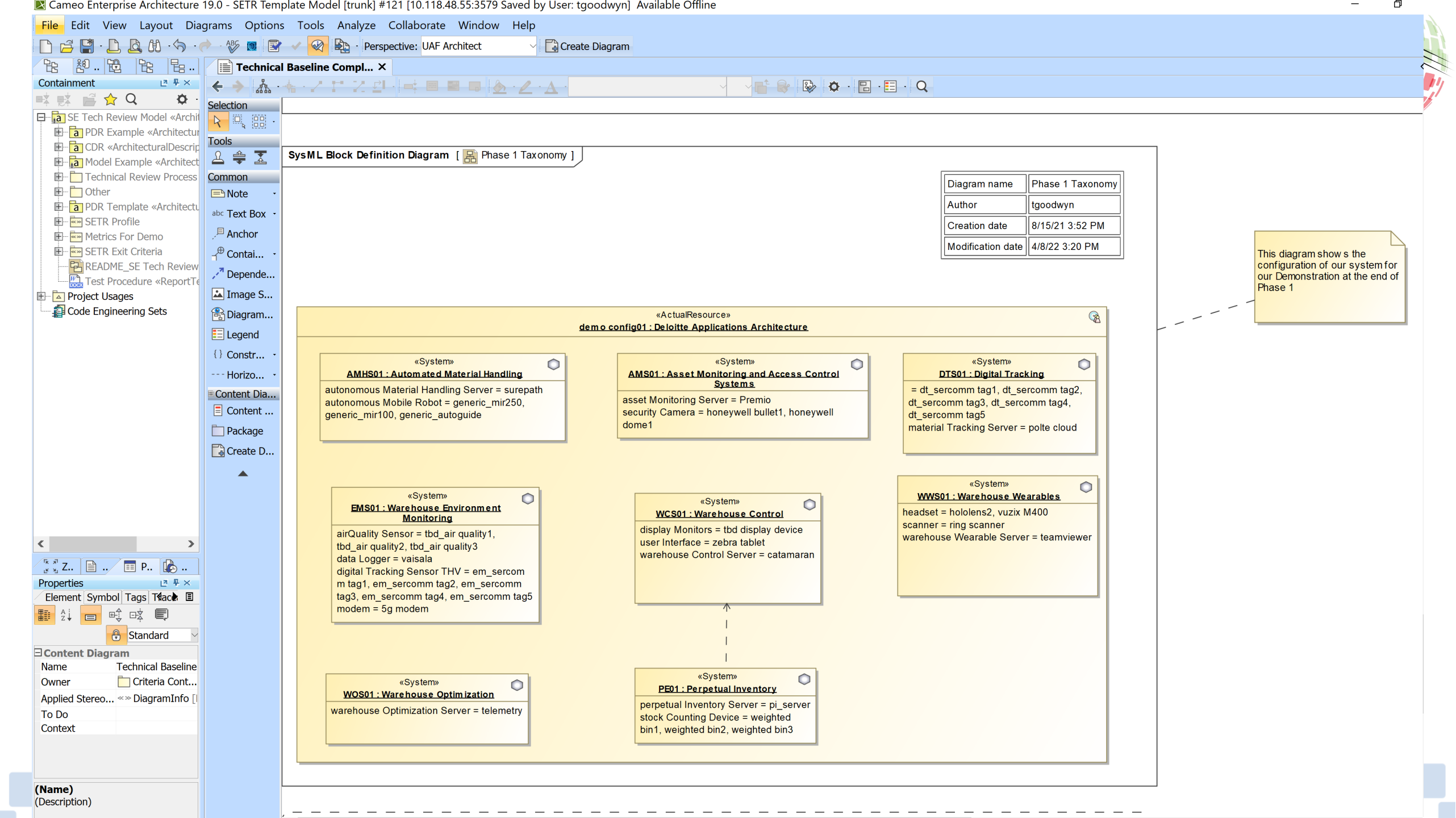
(Name)
(Description)

Resources Process Flow [Overall Functional Flow]

Diagram name	Overall Functional Flow
Author	tgoodwyn
Creation date	8/15/21 3:52 PM
Modification date	8/15/21 4:01 PM




Resources Internal Connectivity [Deloitte Demonstration Warehouse Connectivity]
«ResourceRole»
: Commercial Internet
: CATM
: Ethernet
«ResourceRole»
polte cloud : Digital Tracking Software
: Ethernet
«ResourceRole»
pi server : Perpetual Inventory Server
: Ethernet
«ResourceRole»
telemetry : Warehouse Optimization Server
: Ethernet
«ResourceRole»
sap : Warehouse Management system
: Ethernet
DeloitteNet
«ResourceRole»
: 5G Network
Cloud : Ethernet
B->N41 : 5G NR I/O
: CatM I/O
Internal Ethernet : Ethernet
Deloitte User Equipment
video : 5G NR I/O
«ResourceRole»
computer : Summary Display Device
: 5G NR I/O
«ResourceRole»
logitag : Stock Counting Device
Sim Card : 5G NR I/O
«ResourceRole»
security camera : Security Camera
Sim Card : 5G NR I/O
«ResourceRole»
zebra tablet : User Device
Sim Card : 5G NR I/O
«ResourceRole»
mir : Autonomous Material Handler Device
Sim Card : 5G NR I/O
«ResourceRole»
autoguide : Autonomous Material Handler Device
Sim Card : 5G NR I/O
«ResourceRole»
Vuzix : Headset
: BlueTooth
«ResourceRole»
Ring : Scanner
: BlueTooth
: 5G NR I/O
«ResourceRole»
android tablet : User Device
CATM : CATM
«ResourceRole»
sercomm2 : Digital Tracking Sensor THV
CATM : CATM
«ResourceRole»
sercomm1 : Digital Tracking Devices
Mobile Edge Compute (MEC) App Server
: Ethernet
«ResourceRole»
catamaran : Warehouse Control Server
: Ethernet
: Ethernet
«ResourceRole»
teamviewer : Warehouse Wearable Server
: Ethernet


Cameo Enterprise Architecture 19.0 - SETR Template Model [trunk] #121 [10.118.48.55:3579 Saved by User: tgoodwyn] Available Offline
File Edit View Layout Diagrams Options Tools Analyze Collaborate Window Help
Perspective: UAF Architect
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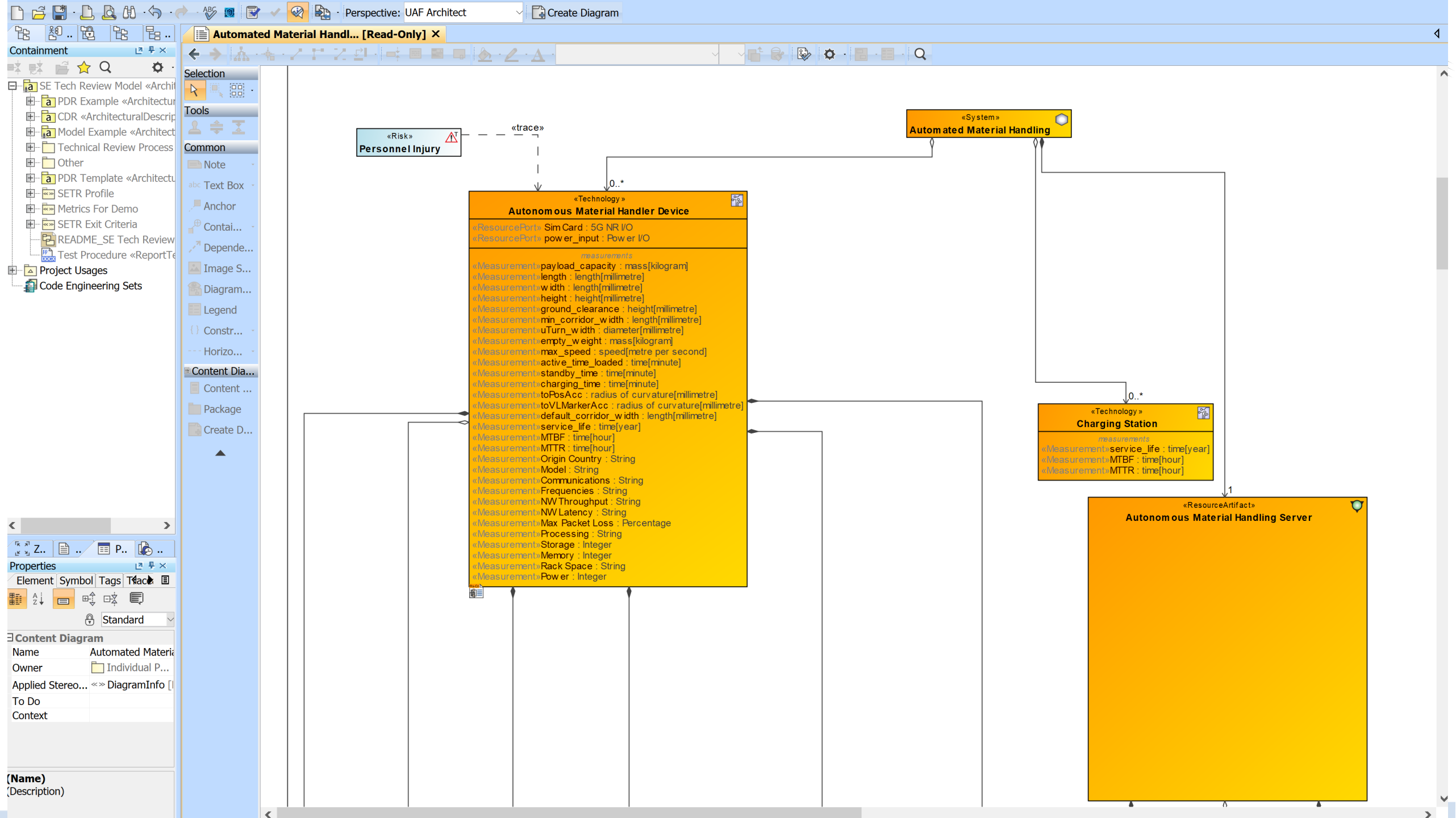
SysML Block Definition Diagram [Phase 1 Taxonomy]
Diagram name Phase 1 Taxonomy
Author tgoodwyn
Creation date 8/15/21 3:52 PM
Modification date 4/8/22 3:20 PM
This diagram show s the configuration of our system for our Demonstration at the end of Phase 1
«ActualResource»
demo config01 : Deloitte Applications Architecture
«System»
AMHS01 : Automated Material Handling
autonomous Material Handling Server = surepath
autonomous Mobile Robot = generic_mir250, generic_mir100, generic_autoguide
«System»
AMS01 : Asset Monitoring and Access Control Systems
asset Monitoring Server = Premio
security Camera = honeywell bullet1, honeywell dome1
«System»
DTS01 : Digital Tracking
= dt_sercomm tag1, dt_sercomm tag2, dt_sercomm tag3, dt_sercomm tag4, dt_sercomm tag5
material Tracking Server = polte cloud
«System»
EMS01 : Warehouse Environment Monitoring
airQuality Sensor = tbd_air quality1, tbd_air quality2, tbd_air quality3
data Logger = vaisala
digital Tracking Sensor THV = em_sercom m tag1, em_sercomm tag2, em_sercomm tag3, em_sercomm tag4, em_sercomm tag5
modem = 5g modem
«System»
WCS01 : Warehouse Control
display Monitors = tbd display device
user Interface = zebra tablet
warehouse Control Server = catamaran
«System»
WWS01 : Warehouse Wearables
headset = hololens2, vuzix M400
scanner = ring scanner
warehouse Wearable Server = teamviewer
«System»
WOS01 : Warehouse Optimization
warehouse Optimization Server = telemetry
«System»
PE01 : Perpetual Inventory
perpetual Inventory Server = pi_server
stock Counting Device = weighted bin1, weighted bin2, weighted bin3
Properties
Element Symbol Tags Trace
Standard
Content Diagram
Name Technical Baseline
Owner Criteria Cont...
Applied Stereo... DiagramInfo
To Do
Context
(Name)
(Description)


Perspective: UAF Architect
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Automated Material Handl... [Read-Only]
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Element
Symbol
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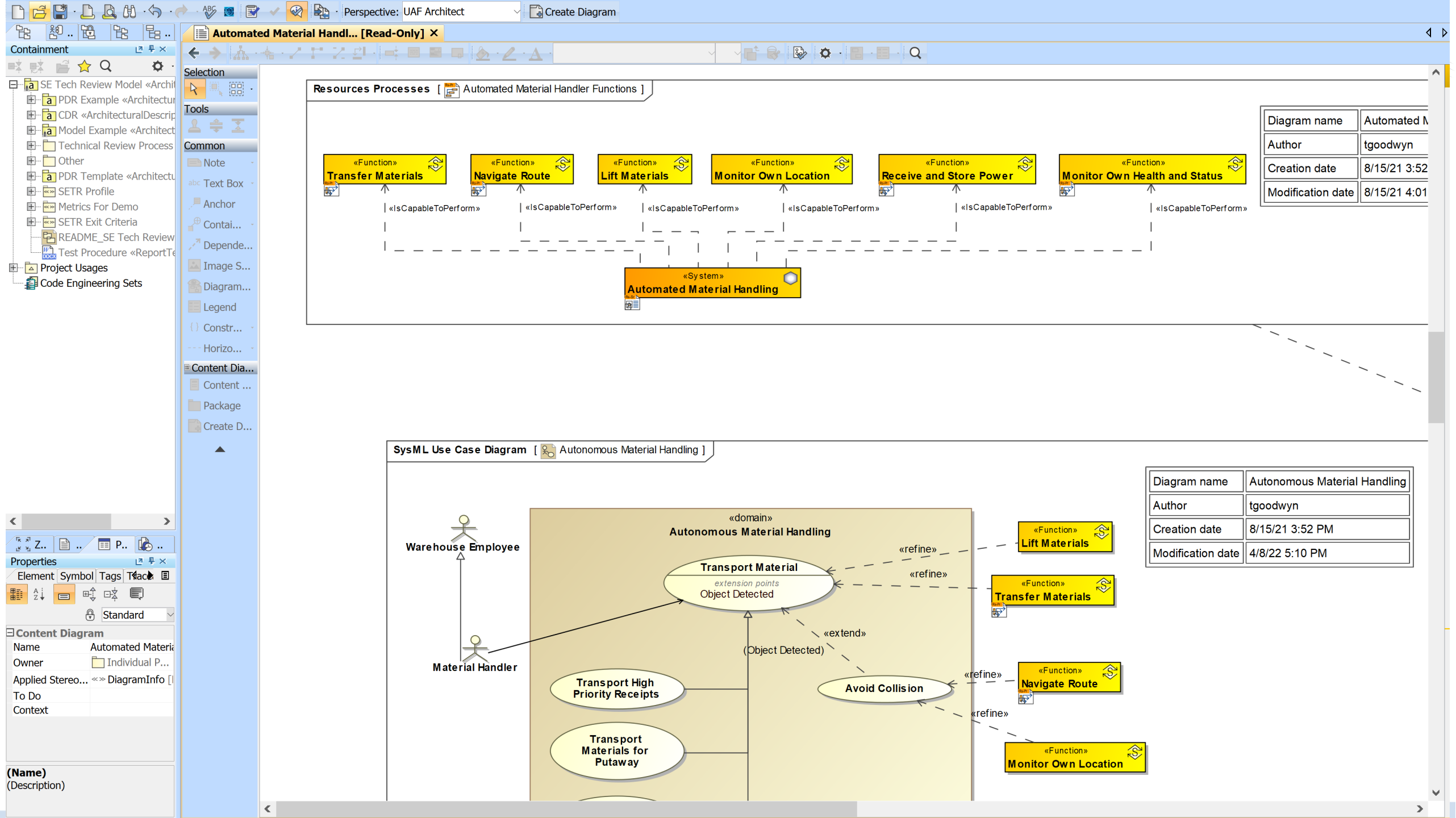
Standard
Content Diagram
Name
Automated Materia
Owner
Individual P...
Applied Stereo...
DiagramInfo
To Do
Context
(Name)
(Description)
«Risk»
Personnel Injury
«trace»
«System»
Automated Material Handling
0..*
«Technology»
Autonomous Material Handler Device
«ResourcePort» Sim Card : 5G NR I/O
«ResourcePort» power_input : Power I/O
measurements
«Measurement»payload_capacity : mass[kilogram]
«Measurement»length : length[millimetre]
«Measurement»width : length[millimetre]
«Measurement»height : height[millimetre]
«Measurement»ground_clearance : height[millimetre]
«Measurement»min_corridor_width : length[millimetre]
«Measurement»uTurn_width : diameter[millimetre]
«Measurement»empty_weight : mass[kilogram]
«Measurement»max_speed : speed[metre per second]
«Measurement»active_time_loaded : time[minute]
«Measurement»standby_time : time[minute]
«Measurement»charging_time : time[minute]
«Measurement»toPosAcc : radius of curvature[millimetre]
«Measurement»toVLMarkerAcc : radius of curvature[millimetre]
«Measurement»default_corridor_width : length[millimetre]
«Measurement»service_life : time[year]
«Measurement»MTBF : time[hour]
«Measurement»MTTR : time[hour]
«Measurement»Origin Country : String
«Measurement»Model : String
«Measurement»Communications : String
«Measurement»Frequencies : String
«Measurement»NW Throughput : String
«Measurement»NW Latency : String
«Measurement»Max Packet Loss : Percentage
«Measurement»Processing : String
«Measurement»Storage : Integer
«Measurement»Memory : Integer
«Measurement»Rack Space : String
«Measurement»Power : Integer
0..*
«Technology»
Charging Station
measurements
«Measurement»service_life : time[year]
«Measurement»MTBF : time[hour]
«Measurement»MTTR : time[hour]
1
«ResourceArtifact»
Autonomous Material Handling Server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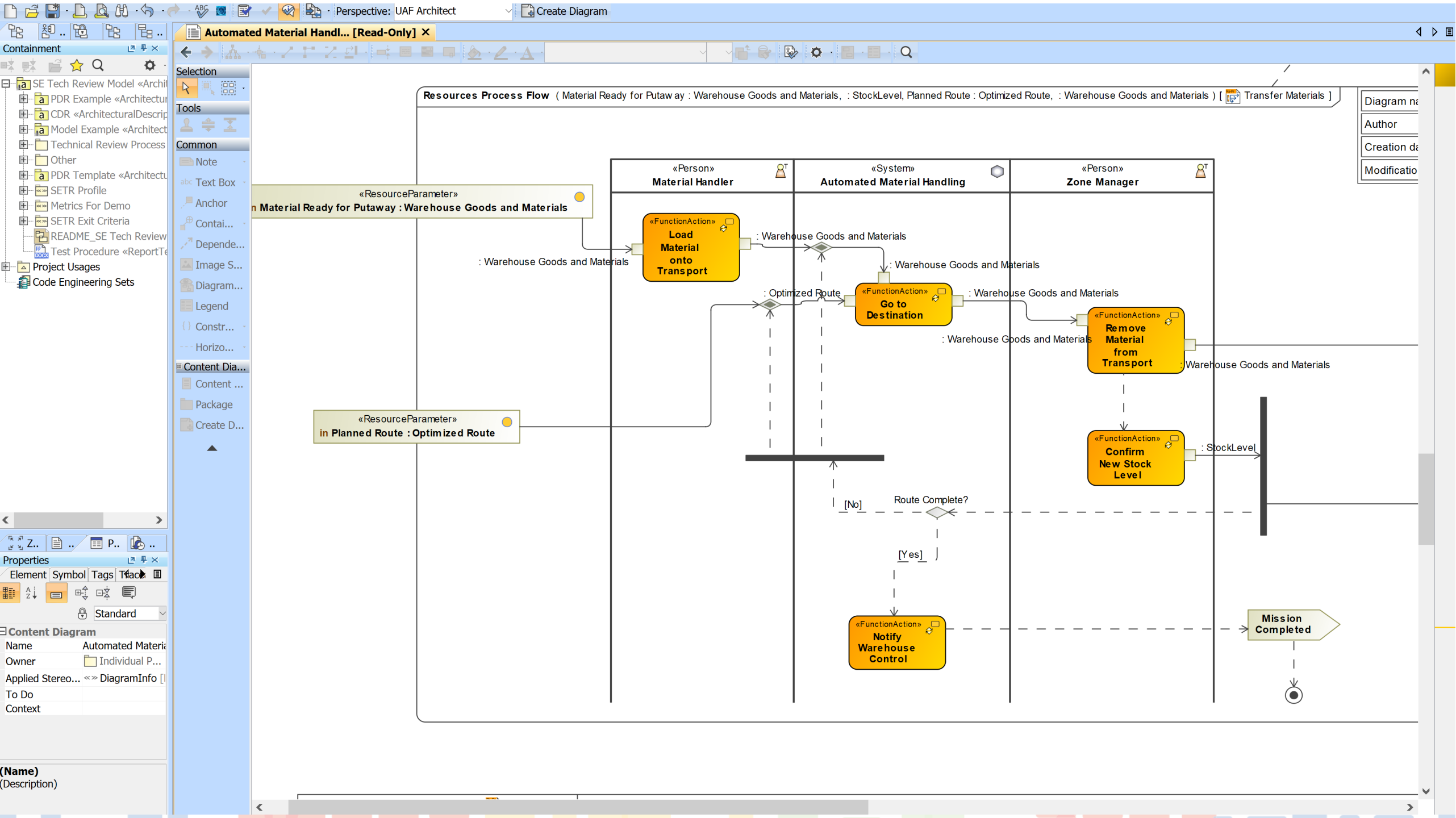
Create D...
Properties
Element
Symbol
Tags
Trace
Standard
Content Diagram
Name
Automated Materia
Owner
Individual P...
Applied Stereo...
DiagramInfo [
To Do
Context
(Name)
(Description)
Resources Processes [Automated Material Handler Functions]
«Function»
Transfer Materials
«Function»
Navigate Route
«Function»
Lift Materials
«Function»
Monitor Own Location
«Function»
Receive and Store Power
«Function»
Monitor Own Health and Status
«IsCapableToPerform»
«System»
Automated Material Handling
Diagram name
Automated M
Author
tgoodwyn
Creation date
8/15/21 3:52
Modification date
8/15/21 4:01
SysML Use Case Diagram [Autonomous Material Handling]
Warehouse Employee
Material Handler
«domain»
Autonomous Material Handling
Transport Material
extension points
Object Detected
Transport High Priority Receipts
Transport Materials for Putaway
«refine»
«extend»
(Object Detected)
Avoid Collision
«Function»
Lift Materials
«Function»
Transfer Materials
«Function»
Navigate Route
«Function»
Monitor Own Location
Diagram name
Autonomous Material Handling
Author
tgoodwyn
Creation date
8/15/21 3:52 PM
Modification date
4/8/22 5:10 PM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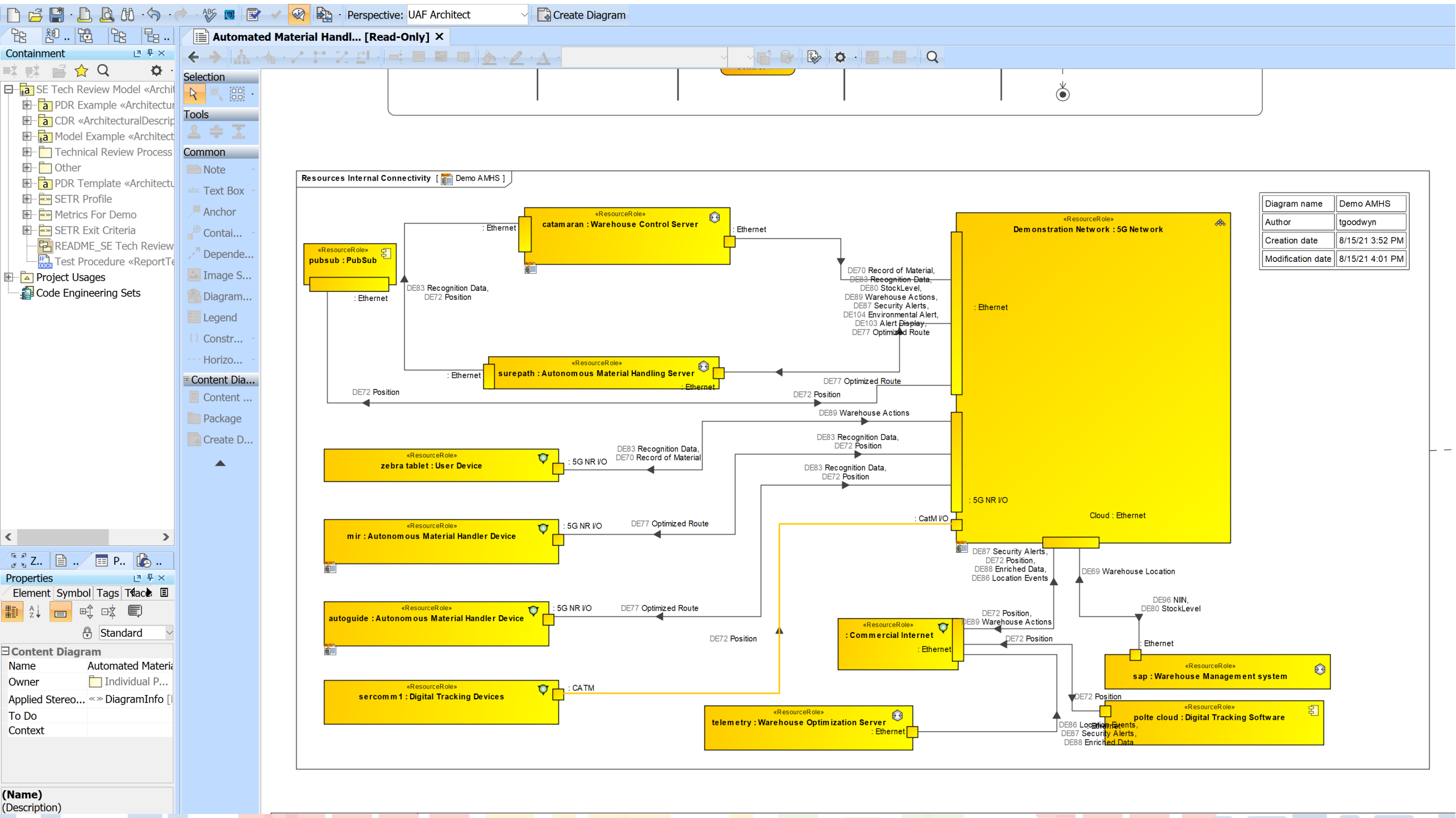
Automated Materia
Owner
Individual P...
Applied Stereo...
DiagramInfo
To Do
Context
(Name)
(Description)
Resources Process Flow (Material Ready for Putaway : Warehouse Goods and Materials, : StockLevel, Planned Route : Optimized Route, : Warehouse Goods and Materials) [Transfer Materials]
Diagram na
Author
Creation da
Modificatio
«Person»
Material Handler
«System»
Automated Material Handling
«Person»
Zone Manager
«ResourceParameter»
in Material Ready for Putaway : Warehouse Goods and Materials
«FunctionAction»
Load Material onto Transport
: Warehouse Goods and Materials
: Warehouse Goods and Materials
: Warehouse Goods and Materials
: Optimized Route
«FunctionAction»
Go to Destination
: Warehouse Goods and Materials
«FunctionAction»
Remove Material from Transport
: Warehouse Goods and Materials
: Warehouse Goods and Materials
«ResourceParameter»
in Planned Route : Optimized Route
«FunctionAction»
Confirm New Stock Level
: StockLevel
[No]
Route Complete?
[Yes]
«FunctionAction»
Notify Warehouse Control
Mission Completed


Perspective: UAF Architect
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Applied Stereo...
DiagramInfo
To Do
Context
(Name)
(Description)
Resources Internal Connectivity [Demo AMHS]
Diagram name
Demo AMHS
Author
tgoodwyn
Creation date
8/15/21 3:52 PM
Modification date
8/15/21 4:01 PM
«ResourceRole»
pubsub : PubSub
: Ethernet
«ResourceRole»
catamaran : Warehouse Control Server
: Ethernet
«ResourceRole»
Demonstration Network : 5G Network
: Ethernet
DE83 Recognition Data,
DE72 Position
DE70 Record of Material,
DE83 Recognition Data,
DE80 StockLevel,
DE89 Warehouse Actions,
DE87 Security Alerts,
DE104 Environmental Alert,
DE103 Alert Display,
DE77 Optimized Route
«ResourceRole»
surepath : Autonomous Material Handling Server
: Ethernet
DE77 Optimized Route
DE72 Position
DE72 Position
DE89 Warehouse Actions
«ResourceRole»
zebra tablet : User Device
: 5G NR I/O
DE83 Recognition Data,
DE70 Record of Material
DE83 Recognition Data,
DE72 Position
DE83 Recognition Data,
DE72 Position
: 5G NR I/O
«ResourceRole»
mir : Autonomous Material Handler Device
: 5G NR I/O
DE77 Optimized Route
: CatM I/O
Cloud : Ethernet
DE87 Security Alerts,
DE72 Position,
DE88 Enriched Data,
DE86 Location Events
DE69 Warehouse Location
DE96 NIIN,
DE80 StockLevel
«ResourceRole»
autoguide : Autonomous Material Handler Device
: 5G NR I/O
DE77 Optimized Route
DE72 Position
DE72 Position,
DE89 Warehouse Actions
«ResourceRole»
: Commercial Internet
: Ethernet
DE72 Position
: Ethernet
«ResourceRole»
sap : Warehouse Management system
«ResourceRole»
sercomm1 : Digital Tracking Devices
: CATM
DE72 Position
«ResourceRole»
telemetry : Warehouse Optimization Server
: Ethernet
DE86 Location Events,
DE87 Security Alerts,
DE88 Enriched Data
«ResourceRole»
polte cloud : Digital Tracking Software

«DiagramTableMapToDataSource»

Instance Table [AMR HW/SW]

#	Name	Classifier	payl mas	leng	leng	heig	grou heig	min_ leng	u diam	emp mas	max spee per	activ :	stan time	char time	toPc curv	to curv	cam_3d : 3D Camera	default_corri : length[mi	PC : PC	PC.c Sy Op S	PLC : PLC
1	generic_autogu	Autog	1000																ag_p	linux	allen bradl
2	generic_mir100	MiR10	100	890	580	352					1.5			120	50	10	intel_Rea		nuc	linux	mir_plc : P
3	generic_mir250	MiR25	250	800	580	300	25	1000	1500	83	2	17.4	22	70	20	3	intel_Rea	1350	nuc	linux	mir_plc : P
4	generic_mir500	MiR50	500	1350	910	320	40	2100		226	2	15	26	60	20	3	intel_Rea	2200	nuc	linux	mir_plc : P
5	generic_mir100	MiR10	1000	1350	910	320	40			231	1.2	15	26	60			intel_Rea	2100	nuc	linux	mir_plc : P

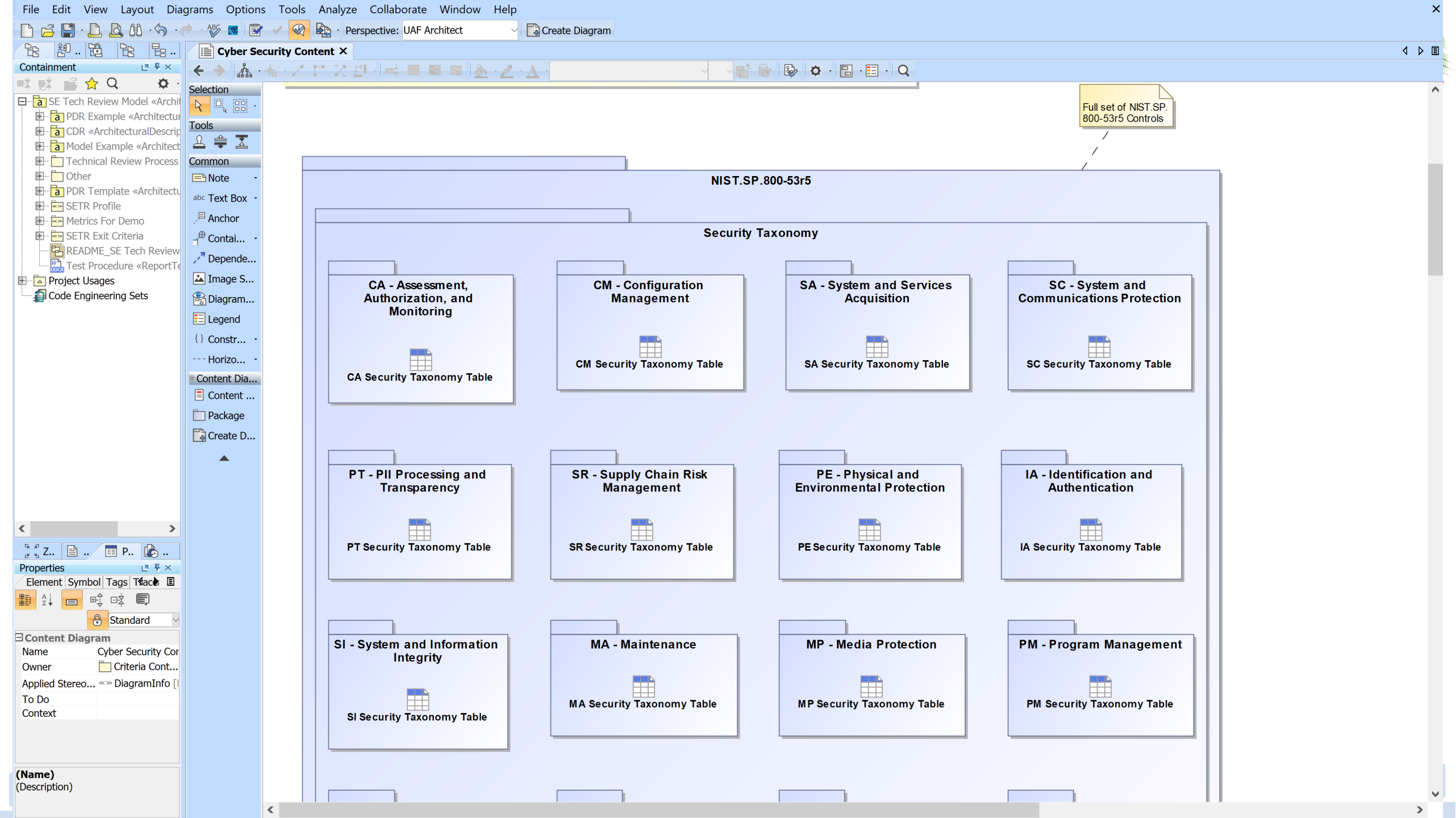
Instance Table [AMH Server]

#	Name	AMHS Software : AMHS Software	Stor : Inte	Mem : Inte	AMHS Software.ve : String
1	surepath	surepath SW : AM	500	16	1.2.1.8

Next Topic

Presented By:

Digital Tracking System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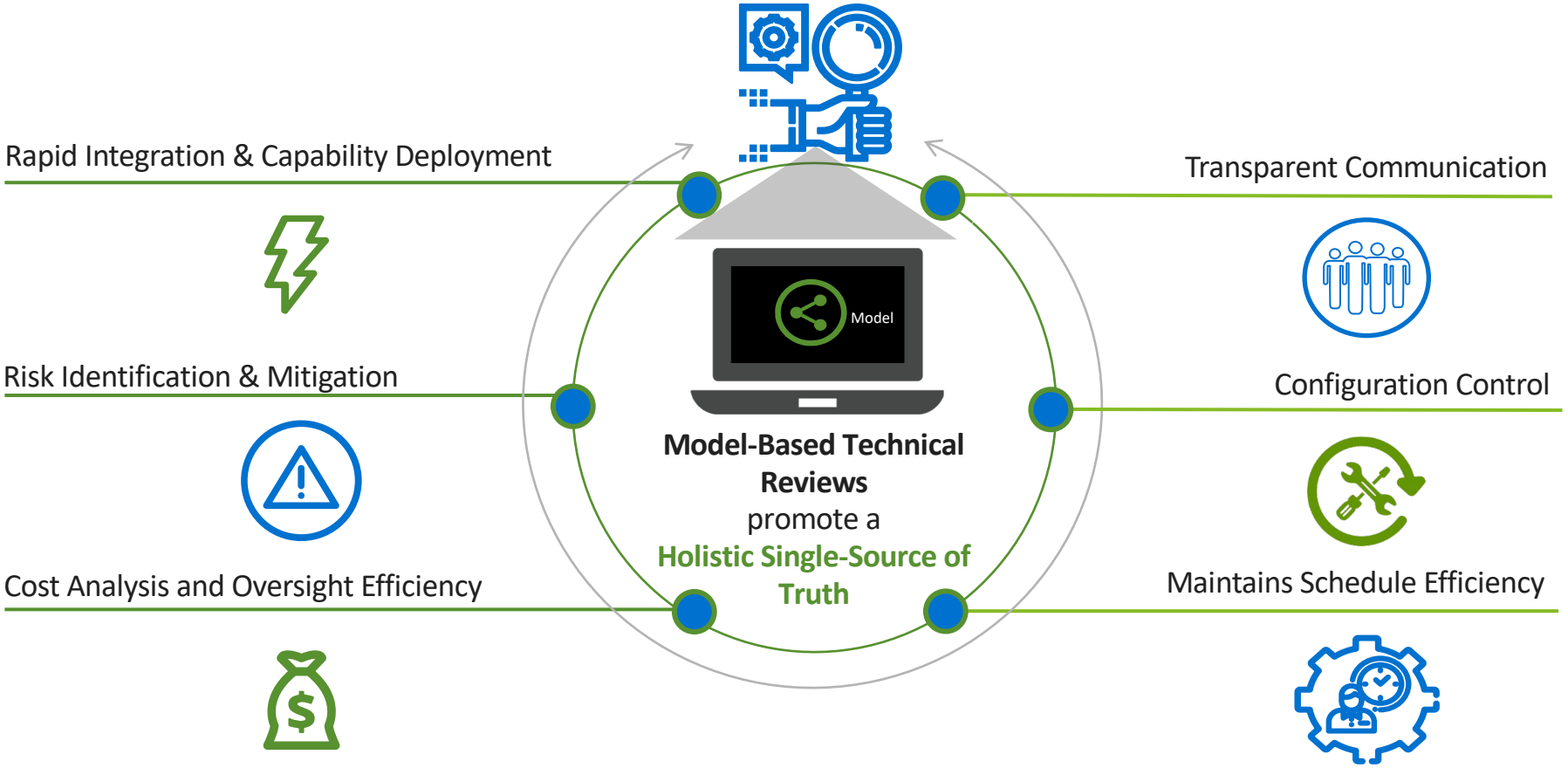
Full set of NIST.SP. 800-53r5 Controls
NIST.SP.800-53r5
Security Taxonomy
CA - Assessment, Authorization, and Monitoring
CA Security Taxonomy Table
CM - Configuration Management
CM Security Taxonomy Table
SA - System and Services Acquisition
SA Security Taxonomy Table
SC - System and Communications Protection
SC Security Taxonomy Table
PT - PII Processing and Transparency
PT Security Taxonomy Table
SR - Supply Chain Risk Management
SR Security Taxonomy Table
PE - Physical and Environmental Protection
PE Security Taxonomy Table
IA - Identification and Authentication
IA Security Taxonomy Table
SI - System and Information Integrity
SI Security Taxonomy Table
MA - Maintenance
MA Security Taxonomy Table
MP - Media Protection
MP Security Taxonomy Table
PM - Program Management
PM Security Taxonomy Table

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	IT IS A PROCESS	SYSTEM MODEL VS TECHNICAL REVIEW MODEL	VALUE TO THE STAKEHOLDER
Model development is about representing a system and its performance while the Technical Reviews should be about communicating that system design effectively	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	These models have the same structure but with a distinct focus for different purposes	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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Specialist Leader

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Digital Engineering
Senior Consultant

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32nd Annual INCOSE international symposium

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June 25 - 30, 2022

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