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Coordinating Program Risk Management with Model-Based System Engineering (MBSE)

An Overview of the Risk Management-System Architecting Digital Thread Research

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Session Agenda

- Session Objectives
- Digital Engineering & Digital Threads
- Research Overview
- Research Paper & Methodology
- Quick Primer on Program Risk Management
- Research Prototype & Example
- Lessons Learned
- Looking Ahead

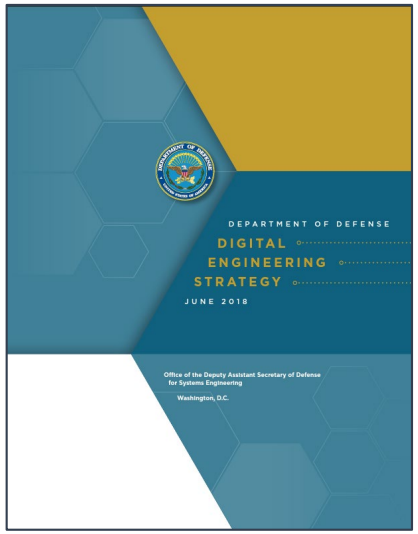
Session Objectives

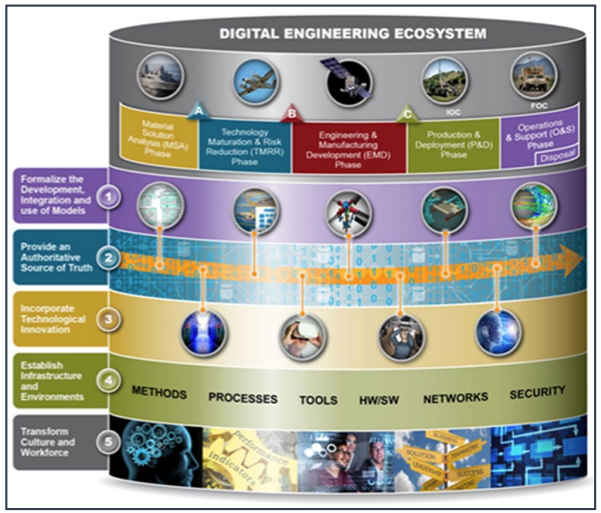
- In this session, we will learn a little bit about:
  - DoD Digital Engineering and the concept of a digital thread
  - Research conducted in the areas of risk management and systems engineering
  - A methodology for developing digital engineering requirements
  - A review of program risk management and how it can be useful to your organization
  - A prototype that demonstrates program risk management and systems architecting/MBSE working together as an example of the art-of-the-possible

- We hope that you take away the following:
  - There is more to digital engineering than the just using and integrating engineering tools
  - We can write requirements and design digital engineering like a system
  - Organizations can benefit from integrating their engineering management or project management with their technical engineering execution

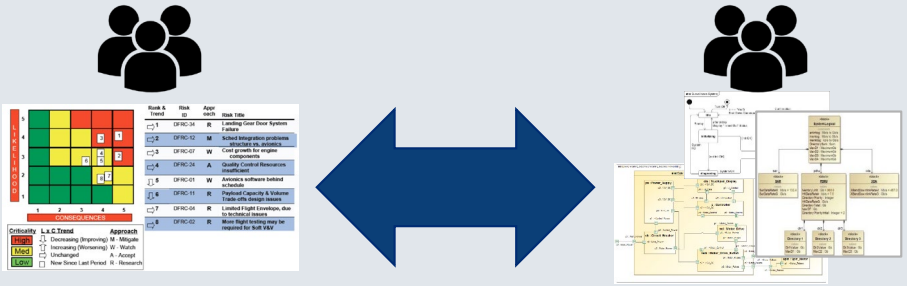
Digital Engineering & Digital Threads

- The United States Department of Defense (DoD) introduced digital engineering in its Digital Engineering Strategy in 2018:
  - Digital engineering is the *"integrated digital approach that uses authoritative sources of systems' data and models as a continuum across disciplines to support lifecycle activities from concept through disposal."* (DoD Digital Engineering Strategy, 2018)
- One key concept of digital engineering is a digital thread:
  - A digital thread is *"an extensible, configurable and component enterprise-level analytical framework that **seamlessly expedites** the controlled **interplay of authoritative … information …** by providing the capability to access, integrate and **transform disparate data into actionable information**"* (Defense Acquisition University Glossary, 2022)
- A digital thread can be understood as:
  - The coordination between disciplines …
    - ("***interplay of authoritative information***")
  - … executed in a seamless way …
    - ("***seamlessly expedites***")
  - … to take action upon.
    - ("***transform disparate data into actionable information***")





Coordinated Risk Management & System Architecting

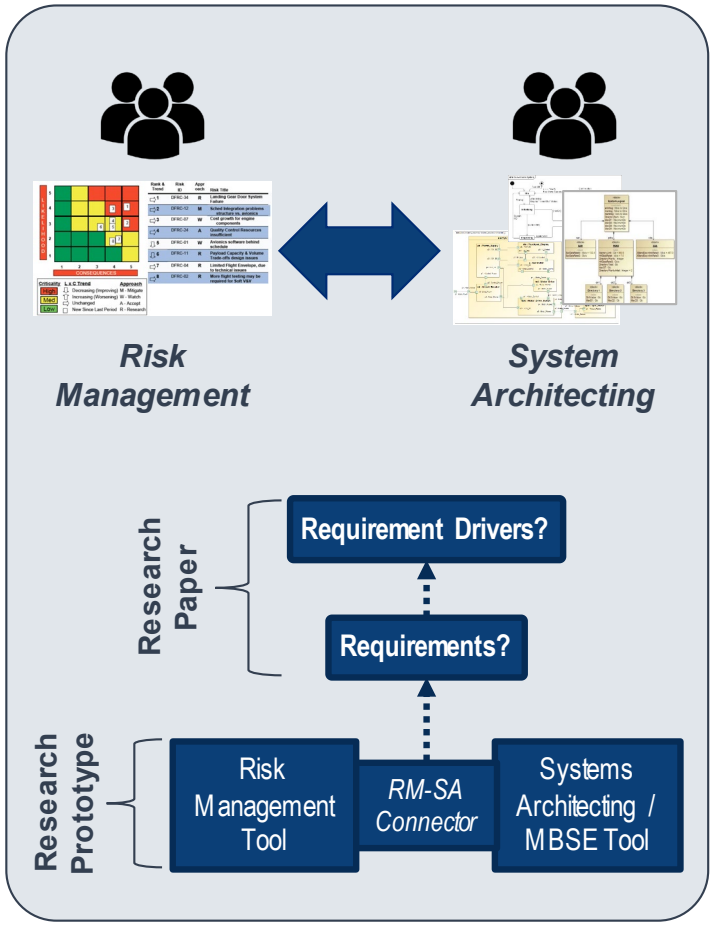


Risk Management

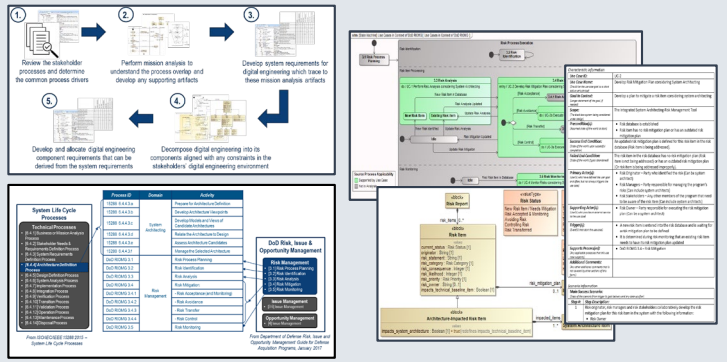
System Architecting

Research Overview

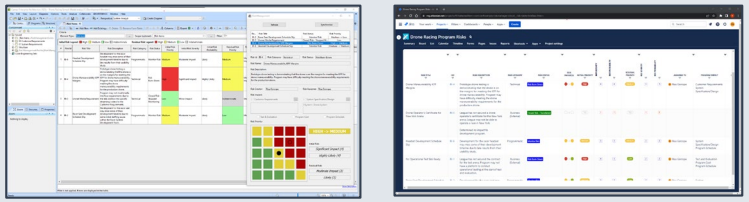
- Our research explores the digital thread between risk management and system architecting
- Research Paper:
  - Developed a methodology that:
    - Extracts the common domain needs from risk management and system architecting processes
    - Uses those needs to develop the implementable requirements for the corresponding tools to coordinate with each other
- Research Prototype:
  - Demonstrates an example of this digital thread concept using Cameo, Jira and other custom software



Research Paper (Methodology):
"Architecting Digital Engineering Requirements for Risk Management & Systems Architecting"
(2023 INCOSE International Symposium)

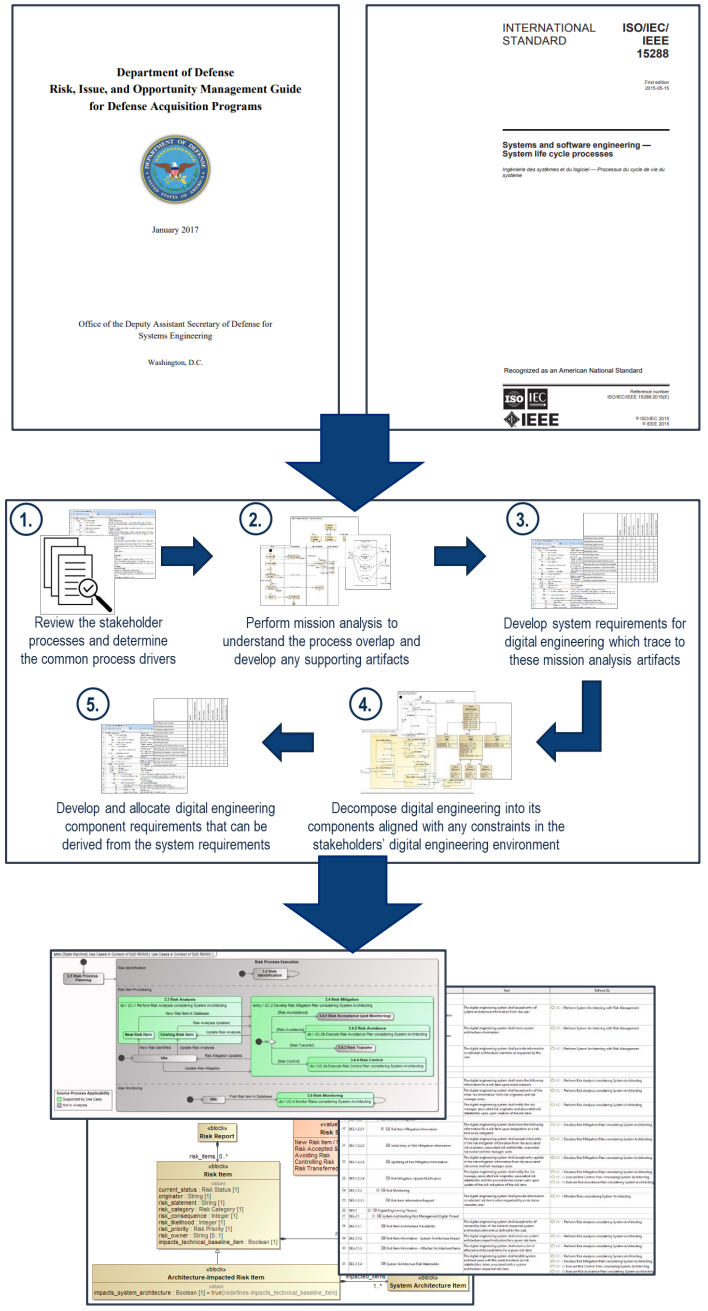


Research Prototype (Example Implementation):
"Understanding the Digital Thread between MBSE and Program Risk Management" (Vitech Integrate23)



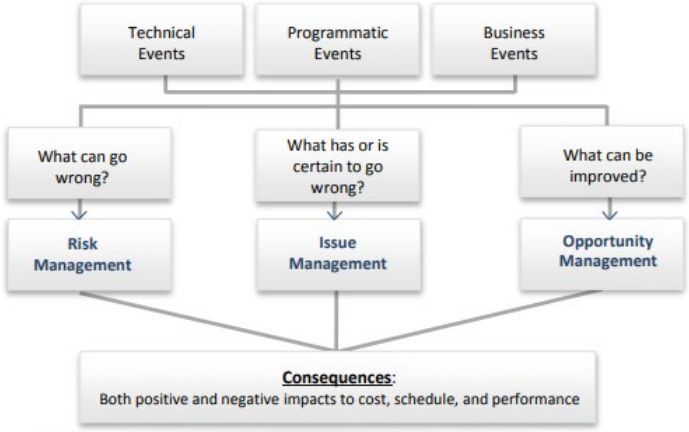
Research Paper & Methodology

- In the research paper, we developed a systems engineering methodology that takes process definitions and methodically develops design artifacts that trace down to implementable digital engineering requirements
- We applied this methodology to risk management and system architecting, developed appropriate artifacts and the requirements, and documented the execution observations
  - For the risk management source process:
    - United States Department of Defense Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs January 2017 (DoD RIOMG)
  - For the systems architecting source process:
    - ISO/IEC/IEEE 15288:2015
- These systems engineering artifacts and requirements became the basis for the research prototype
- For a deep dive, please review the INCOSE IS2023 paper: “Architecting Digital Engineering Requirements for Risk Management & Systems Architecting”



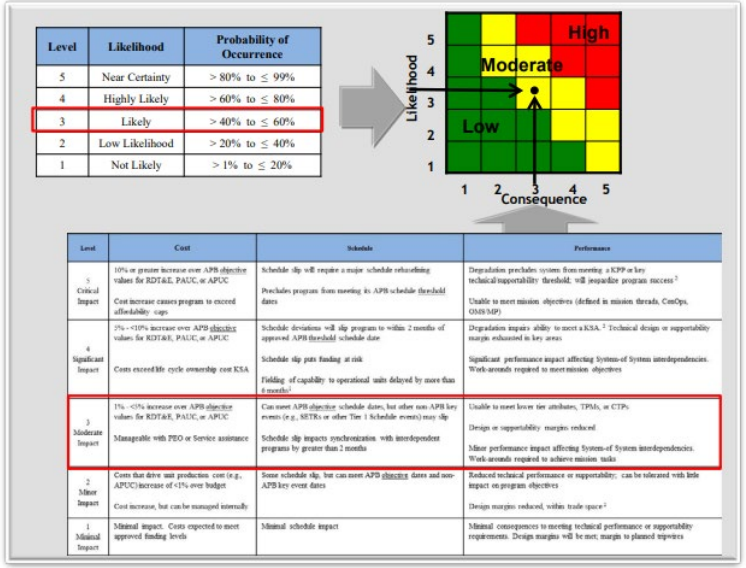
Quick Primer on Program Risk Management

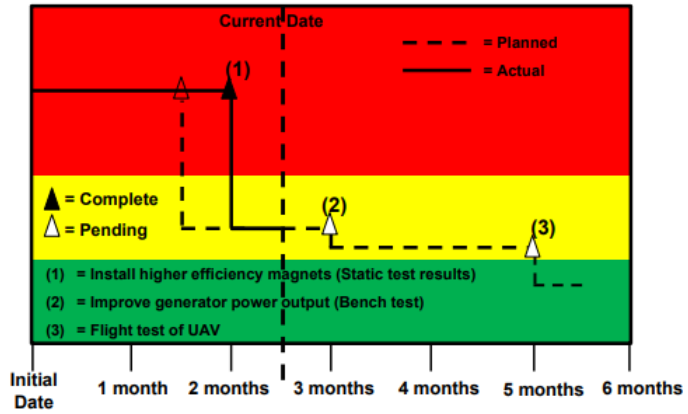
- Program risk management is the management of "potential future events or conditions that may have a negative effect on achieving program objectives" (DoD RIOMG)
  - In the US Department of Defense, program risk management is defined in the DoD Risk, Issue, and Opportunity Management Guide (DoD RIOMG, 2017) and in various different policy documents (e.g., DoDI 5000.85)
- The program risk management process has a different focus from other risk management processes
  - Other processes are often focused on managing specific kinds of system risk to mitigate adverse effects of a system
    - e.g., medical system safety risk management (ISO 14971)
  - Program risk management is focused on managing any risks that may derail a system's development program
    - This includes non-technical risks such as schedule and cost risks
- A risk has a probabilistic future component
  - If a risk has happened or a risk will happen with 100% confidence, then it is no longer a risk and it is considered an issue



Quick Primer on Program Risk Management

- Risk items:
  - represent singular units of risk
  - are maintained in a risk database called a risk register
  - defined with some measure of likelihood and consequence
- The likelihood and consequence measures for a risk item are rolled up into a measure of a risk's priority
  - This is defined in a program's risk reporting matrix and is often color coded for quick identification
  - In the DoD, it is up to the program to determine its own risk reporting matrix and criteria
- Higher priority risk items are often selected to be mitigated (i.e., "risk control") to try to reduce their priority
- The goal is NOT to mitigate every risk item in a program
  - The goal is for the program to be actively aware of its risks and to prioritize the risk items that need the most attention

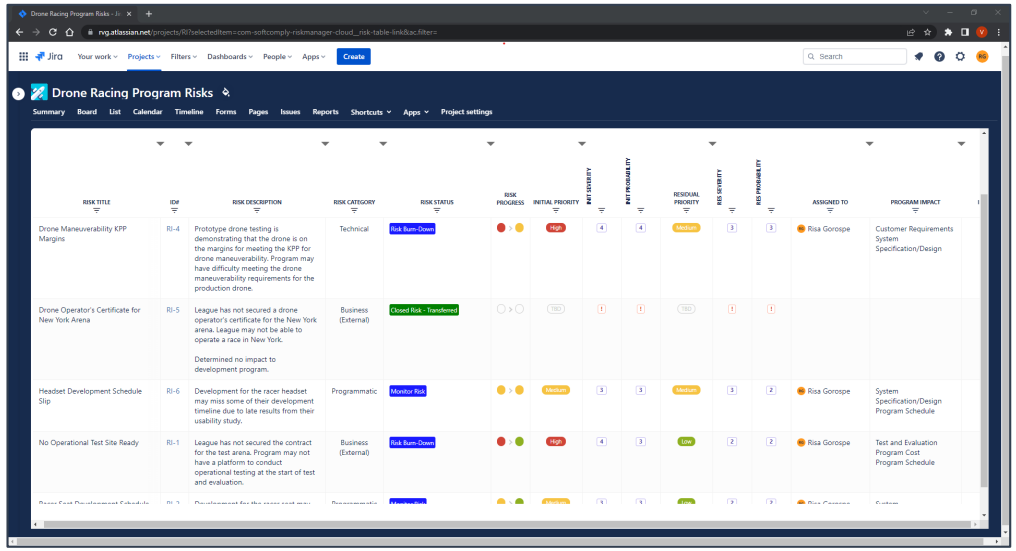


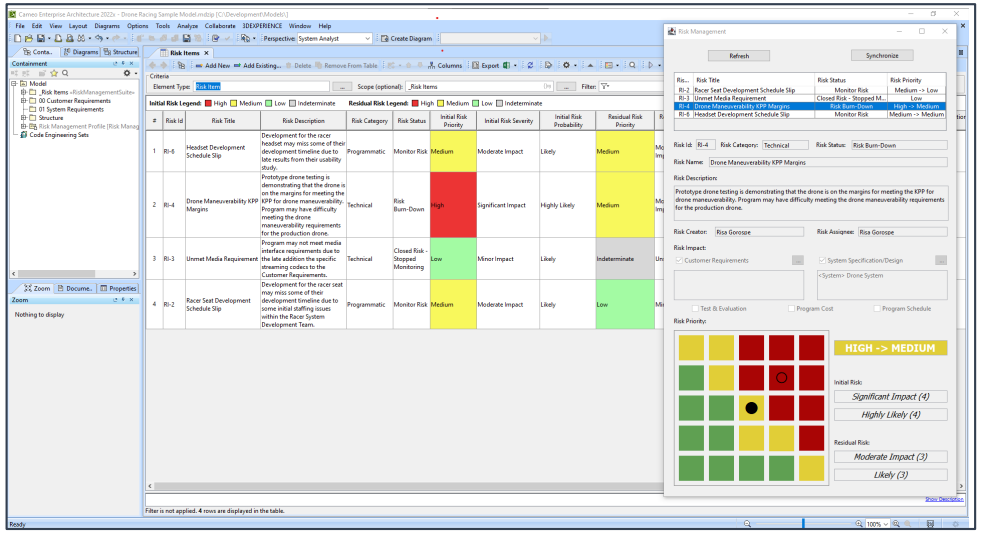


Research Prototype & Example

Overview

- The research prototype is an example implementation of the risk management-system architecting digital thread concept
- The prototype enables the users at both ends of the digital thread to use customized versions of their respective tools to coordinate with each other
  - For the risk management users:
    - Atlassian Jira with the SoftComply Risk Manager plugin and other customizations
  - For the system architecting users:
    - Dassault Systemes' Cameo Systems Modeler with some profile and plugin customizations
- In this presentation, we will do quick overview of the prototype with an example scenario
  - For a deep dive, review the Vitech Integrate23 presentation: *"Understanding the Digital Thread between MBSE and Program Risk Management"*

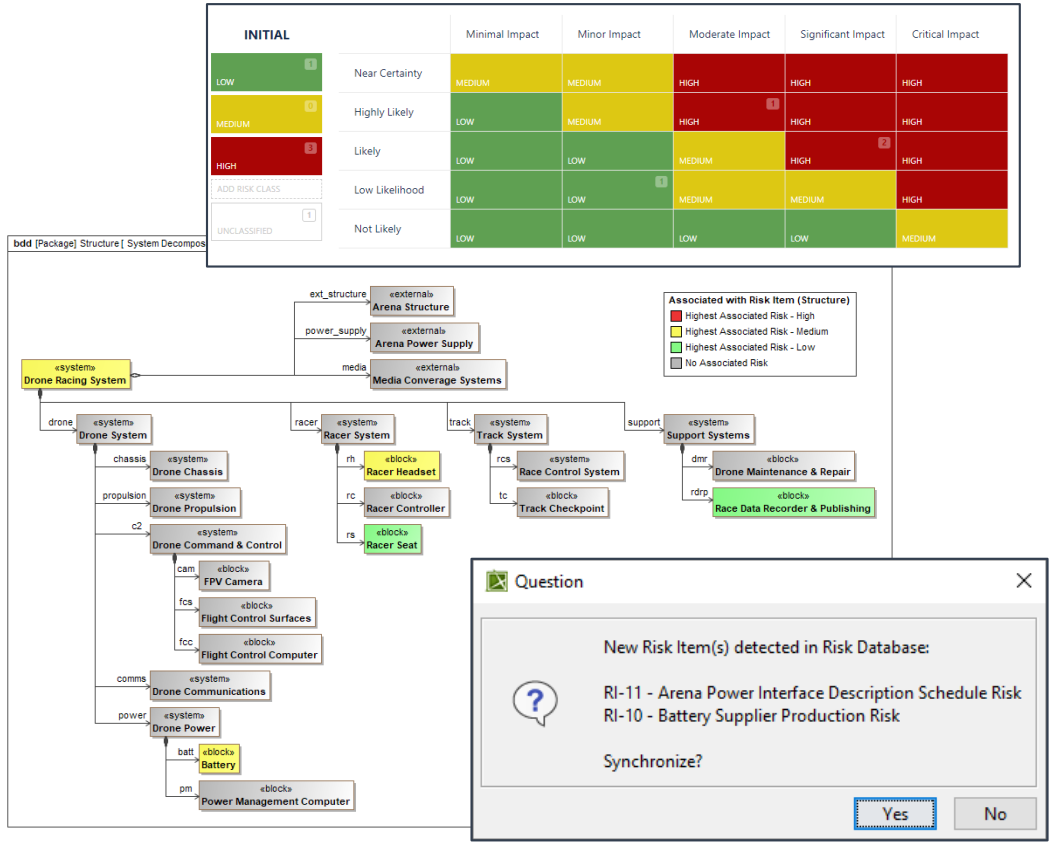


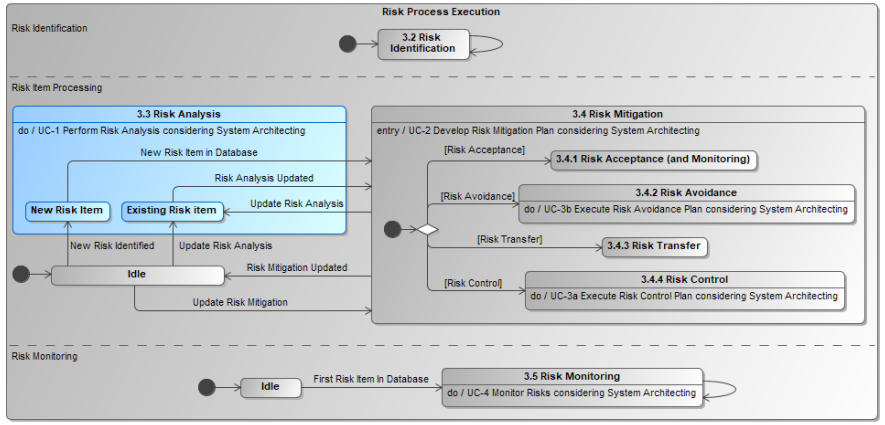


Research Prototype & Example

Current Functionality

- The risk manager can:
  - Enter risk item information into Jira
  - Review risk item content using Jira and SoftComply's risk dashboards
  - Receive updates for risk item traceability from Cameo
- The system architect can:
  - Pull down architecture-impacted risk items from Jira
  - Review architecture-impacted risk items using a custom Cameo plugin dashboard
  - Trace the risk items to system architecture elements and requirements in Cameo
  - Use diagram legends as risk overlays for architecture and requirement diagrams
  - Push updates for risk item traceability to Jira
- The prototype currently enables the execution of risk impact analysis (Use Case 1 from the research paper)

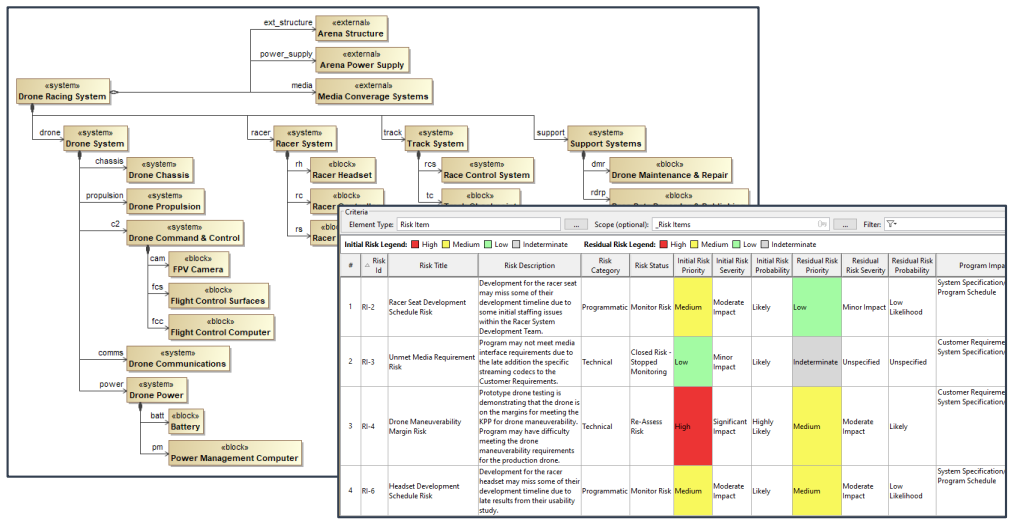




Research Prototype & Example

Prototype Example

- The prototype example is the fictional scenario of developing a drone racing system:
  - A sports league who wants to start a first-person view (FPV) drone racing series
  - We are the technical engineering firm contracted to develop this racing system
  - The league has contracted our firm to:
    - Develop both the drones and any supporting equipment (e.g., FPV headsets, race controller, drone charging stations, etc.)
    - Design, build and integrate from customer requirements to a complete delivered system
- We developed sample data for the prototype to execute the fictional scenario
  - We developed a Drone Racing System model in Cameo to define requirements and system architecture
  - We developed a database of program risk items in Jira



Drone Racing Program Risks - Jir

Drone Racing Program Risks - Jir

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Drone Racing Program Risks

Summary | Board | List | Calendar | Timeline | Forms NEW | Pages | Issues | Reports | Shortcuts | Apps | Project settings

Risk Management for Project Drone Racing Program Risks

Click to View Classifier and Risk Class Information | Work Mode | + Add Risk | Import from CSV | Export

RISK TITLE	ID#	RISK DESCRIPTION	RISK CATEGORY	RISK STATUS	RISK PROGRESS	INITIAL PRIORITY	INIT SEVERITY	INIT PROBABILITY	RESIDUAL PRIORITY	RES SEVERITY	RES PROBABILITY	ASSIGNED TO	PROGRAM IMPACT	IMPA
Drone Maneuverability Margin Risk	RI-4	Prototype drone testing is demonstrating that the drone is on the margins for meeting the KPP for drone maneuverability. Program may have difficulty meeting the drone maneuverability requirements for the production drone.	Technical	Re-Assess Risk		High	4	4	Medium	3	3	Risa Gorospe	Customer Requirements System Specification/Design	<ValueProp <Requireme Velocity <System> D
Drone Operator's Certificate for New York Arena Risk	RI-5	League has not secured a drone operator's certificate for the New York arena. League may not be able to operate a race in New York. Determined no impact to development program.	Business (External)	Closed Risk - Transferred		TBD	!	!	TBD	!	!			
Headset Development Schedule Risk	RI-6	Development for the racer headset may miss some of their development timeline due to late results from their usability study.	Programmatic	Monitor Risk		Medium	3	3	Medium	3	2	Risa Gorospe	System Specification/Design Program Schedule	<Block> Rac
Operational Test Site Readiness Risk	RI-1	League has not secured the contract for the test arena. Program may not have a platform to conduct operational testing at the start of test and evaluation.	Business (External)	Risk Burn-Down		High	4	3	Low	2	2	Risa Gorospe	Test and Evaluation Program Cost Program Schedule	

Lessons Learned

- There may be a program "sweet spot" for specific digital threads
  - In the case of the system architecting-risk management digital thread, the program must be far enough along that the system architecture is defined with enough detail
  - But the program must be not too far along in detailed design where we may decide to trace to other design artifacts (e.g., tracing a risk item to the computer-aided design (CAD) object of drone battery instead of the system architecture element)
- Organizations can apply system engineering practices to digital engineering if we treat digital engineering like a system
  - By understanding the use cases, defining architectures and writing requirements, organizations can be more focused in developing digital engineering capability or assessing potential solutions from vendors
- A complete digital engineering capability supports the needs and execution of the stakeholders in the digital thread
  - More than just integrating different software tools together or dumping data into a model/database
  - A mature digital engineering system should expose the right information at the right time to its users to do their job
- Organizations can learn from digital threads that include non-technical domains (e.g., risk management, schedule management, etc.)
  - Since some of these non-technical functions span over multiple phases of a program's lifecycle, these non-technical domains can drive organizations to consider how digital engineering spans the program lifecycle

Looking Ahead

- Exploring additional details in the current digital thread concept
  - Additional use cases
    - e.g., Coordinated risk mitigation, re-architecting due to program risk, etc.
  - Better understanding configuration management and access control
    - i.e., How can Teamwork Cloud and Jira better coordinate with user access and data rights management?
- Exploring how additional stakeholders and digital threads tie into this base thread
  - How do other technical domains need to interact program risk management?
    - e.g., Requirement management, CAD tools, test databases, etc.
  - Can other non-technical disciplines interact with this base digital thread?
    - e.g., Schedule management with schedule risk analysis, etc.
- Exploring unique analyses and capabilities enabled by digital engineering
  - Can we use this information in a new way now that the information is coordinated?

Questions?

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