



33<sup>rd</sup> Annual **INCOSE**  
international symposium

hybrid event

Honolulu HI USA



Mixing Code-Centric and Evidenced-Based development

Visualizing **AGILE** inside the V

# Agenda

- Clashing Cultures
- Analysis Methods
- Conclusions

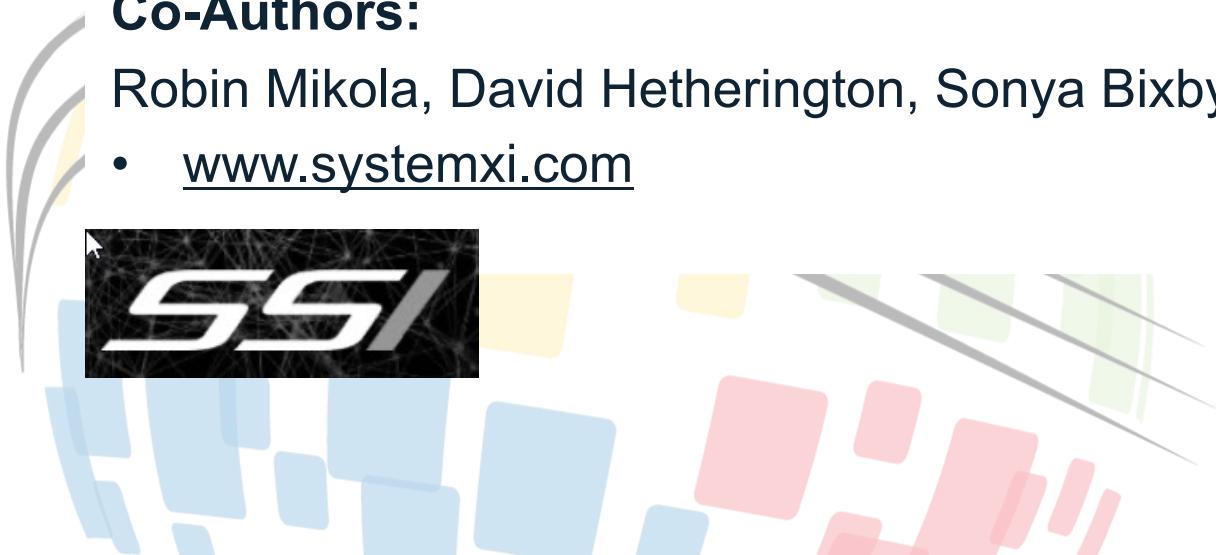
**Presented by:**

Robin Mikola and David Hetherington

**Co-Authors:**

Robin Mikola, David Hetherington, Sonya Bixby, and Robert Peters

- [www.systemxi.com](http://www.systemxi.com)



# The Problem

Too many differing perspectives, language and priority



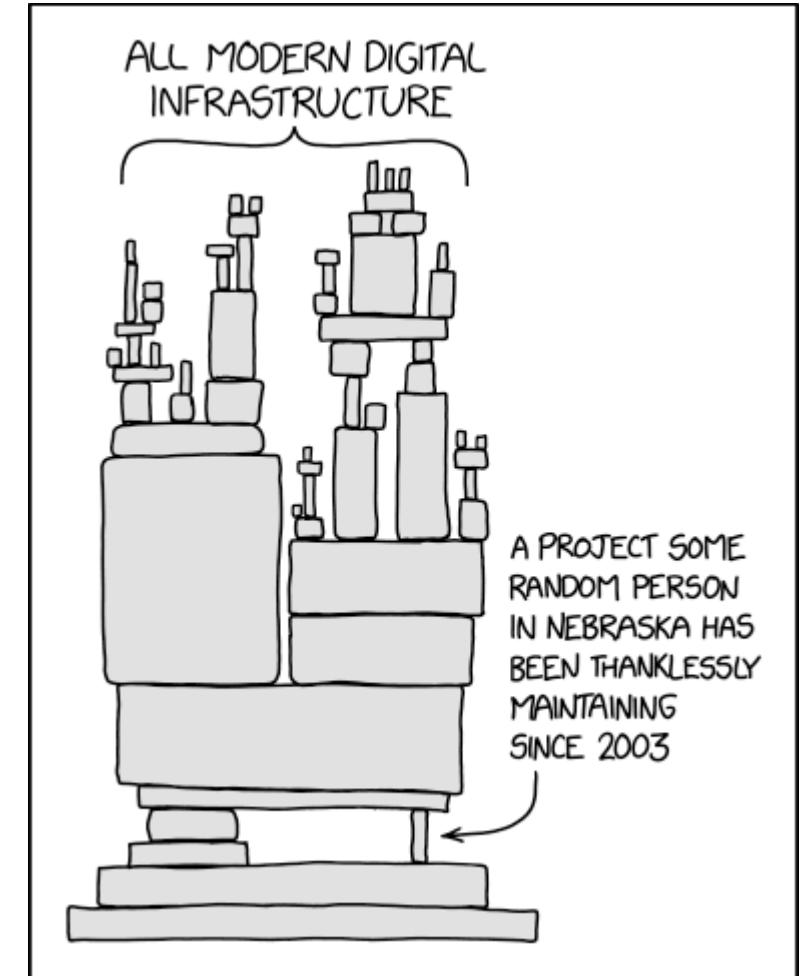
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<https://www.linkedin.com/pulse/technical-debt-non-tech-people-alex-di-mango>



<https://xkcd.com/2347/>



Why is this so difficult to synchronize?

# Clashing Cultures

# Not Every Application Needs Careful Planning



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If you are developing a “Cat Eating Cheesburger” social media application, overly formal requirements, modeling, and documentation approaches would be counter-productive.

# Some Applications Need Careful Planning

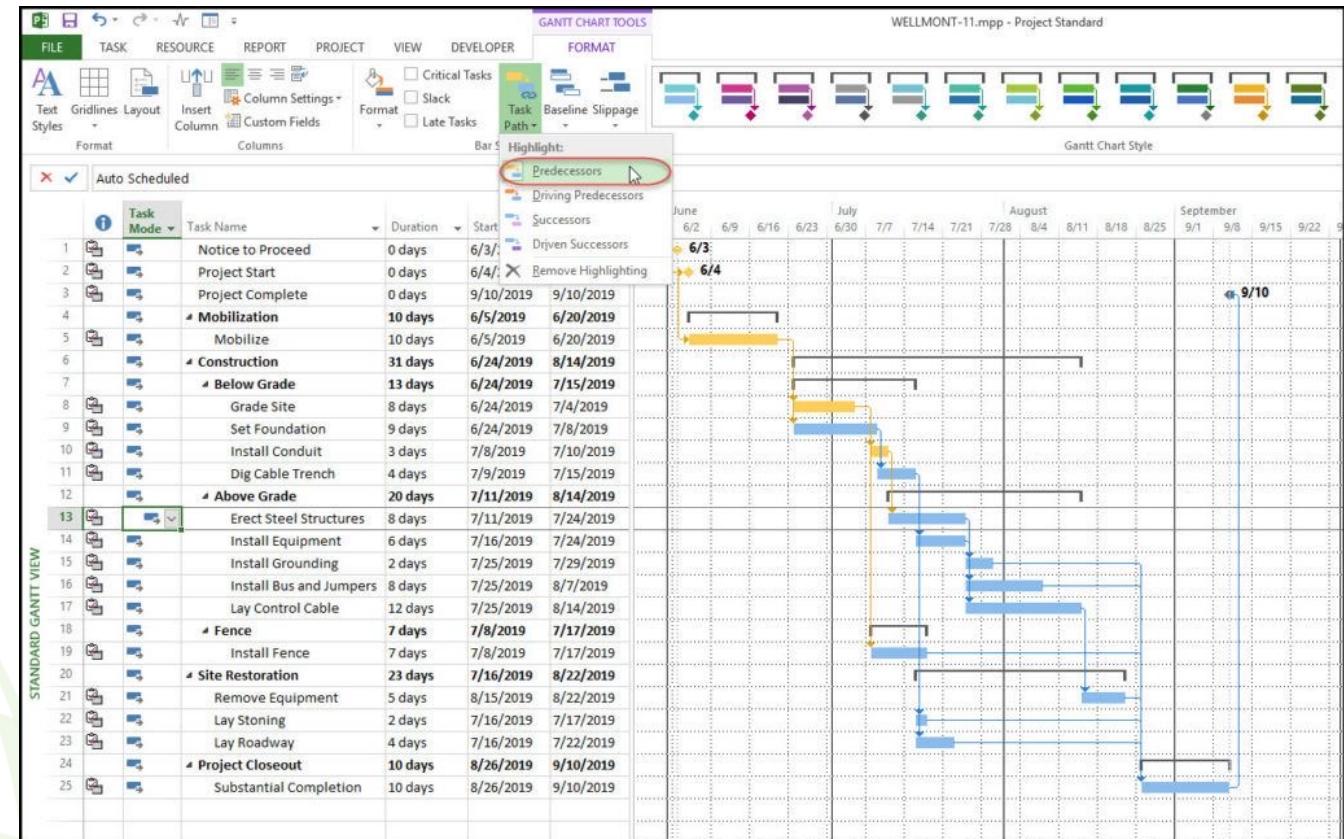
If a careless mistake in your requirements, coding, or verification can incinerate a family of five, casual software development approaches are simply not morally acceptable.



*Video Licensed from Shutterstock by David Hetherington on 17 Feb 2020*

# Waterfall/Vee Weakness – The Illusion of Certainty

- It looks wonderful in Microsoft Project
- The project manager prints out 120 sheets of the grand master plan and covers an entire hallway, carefully taping them all together so that the arrows line up...
- The problem is that this sort of chained plan is an assumption built on an assumption built on an assumption built on...
- Even the simplest Markov chain analysis of the probability that any one of the activities will actually happen anywhere near the projected timeframe produces ridiculously tiny probabilities.
- Oh, and then there are “surprises”.
- The project manager’s beautiful plan is out of date before he finishes pinning it to the wall.



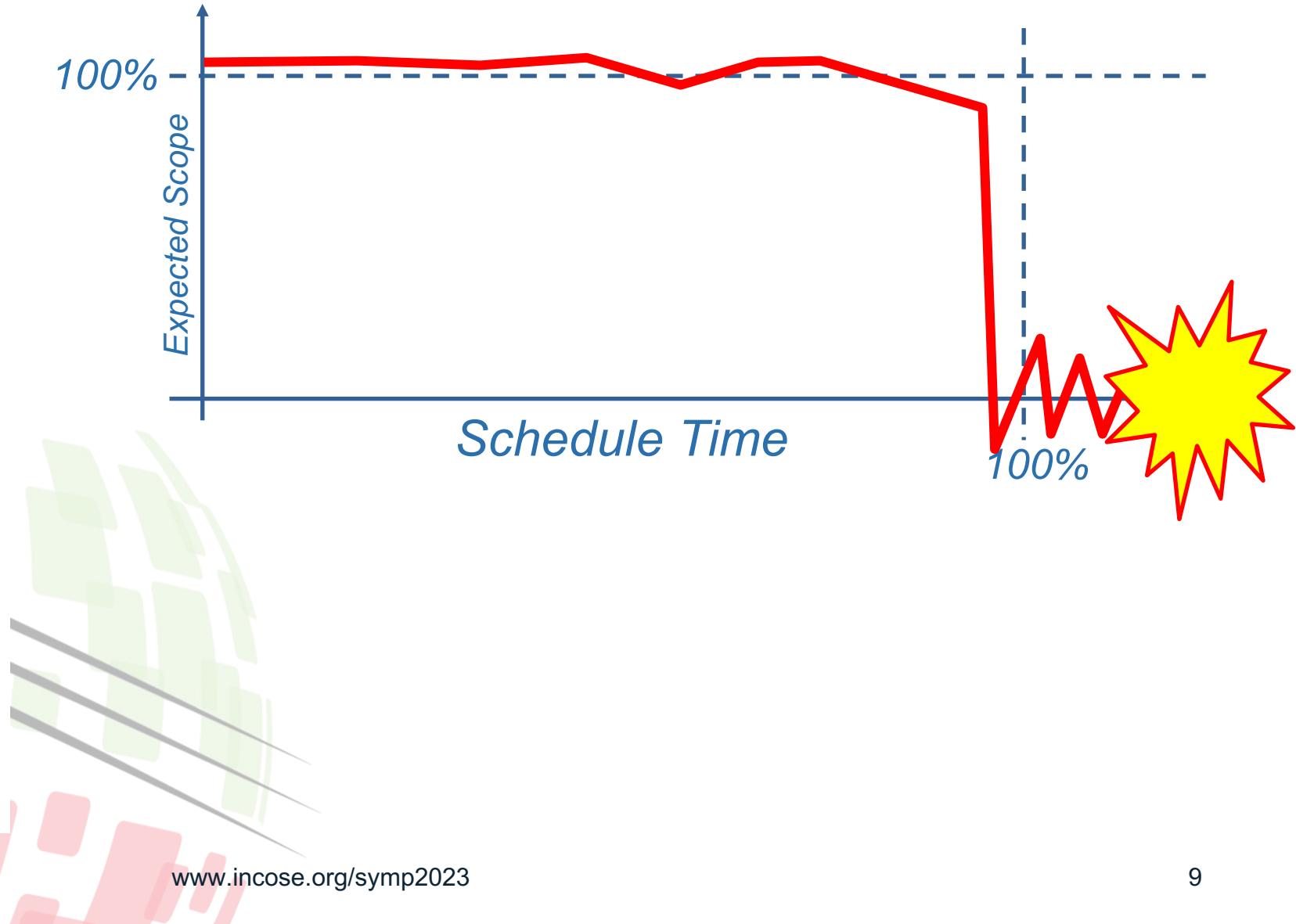
# Agile Weakness – Eyeball Rolling about “Waterfall”

- This is a 20,000-ton drill ship.
- You don't pick up the steel for it at *Home Depot*.
- It has about 10 decks.
- It gets built from the keel upward, one deck at a time.
- As each deck gets built, pieces of large equipment get craned into position.
- There is no such thing as a “*minimum viable drillship*” that can be seat-of-the-pants iterated into satisfactory product.
- This is a Waterfall/Vee project. Period.
- Having the software developers sitting around rolling their eyeballs and moaning about “*Braindead Waterfall Dinosaurs who just don't get it*” is not helpful.



# Waterfall/Vee Weakness – Scope/Risk Management

- Waterfall/Vee projects tend to have difficulty thinking about scope and risk.
- Wildly risky and unrealistic objectives – usually ignoring the reality of previously failed projects – are bought into with rousing cheers of *“This time it is going to be different!”* and *“We will overcome the problem with team spirit!”*
- This group fiction is maintained religiously by all team factions until shortly before the project deadline...
- At which time a catastrophic scope collapse occurs.



# Agile Weakness – Small Team Assumption

- During World War II many bomber prototype/production lines were organized with the engineers in balcony offices above the production floor.
- Often the planes were still being designed as the first production units were moving down the line.
- Engineers could walk down the stairs and have a quick chat in front of the nose of the aircraft.
- **It was a perfect implementation of Agile's: *“Individuals and interactions over processes and tools”***
- After World War II, the aircraft became so complex that no geometry of building could house the team this way.
- Document-based systems engineering was born.
- **Agile Weakness:** Beyond a certain system and team size, you can't just “have a cup of coffee and talk it over”.



# Waterfall/Vee Weakness – Inability to Prioritize

- Waterfall/Vee projects tend to have difficulty thinking about requirements priority.
- Since the requirements are often decided through a political consensus process, it is extremely difficult for leadership to admit that any of them are anything other than “Critical Must Have” requirements.
- This phenomenon is basically weak leadership.
- Weak leadership that does not have the fortitude to explain to stakeholders that not more than 10% of the requirements can be “Critical Must Have” simply sets up the catastrophic scope failure mentioned previously.
- (Better leadership will work harder on contingency plans for all medium and higher requirements. What is plan B if we can't have it, or it arrives too late?)
- (The Agile process makes the prioritization inherent and helps sidestep the emotional problems)



*(After much gnashing of teeth, we managed to identify two requirements that we might possibly be able to imagine living without.)*



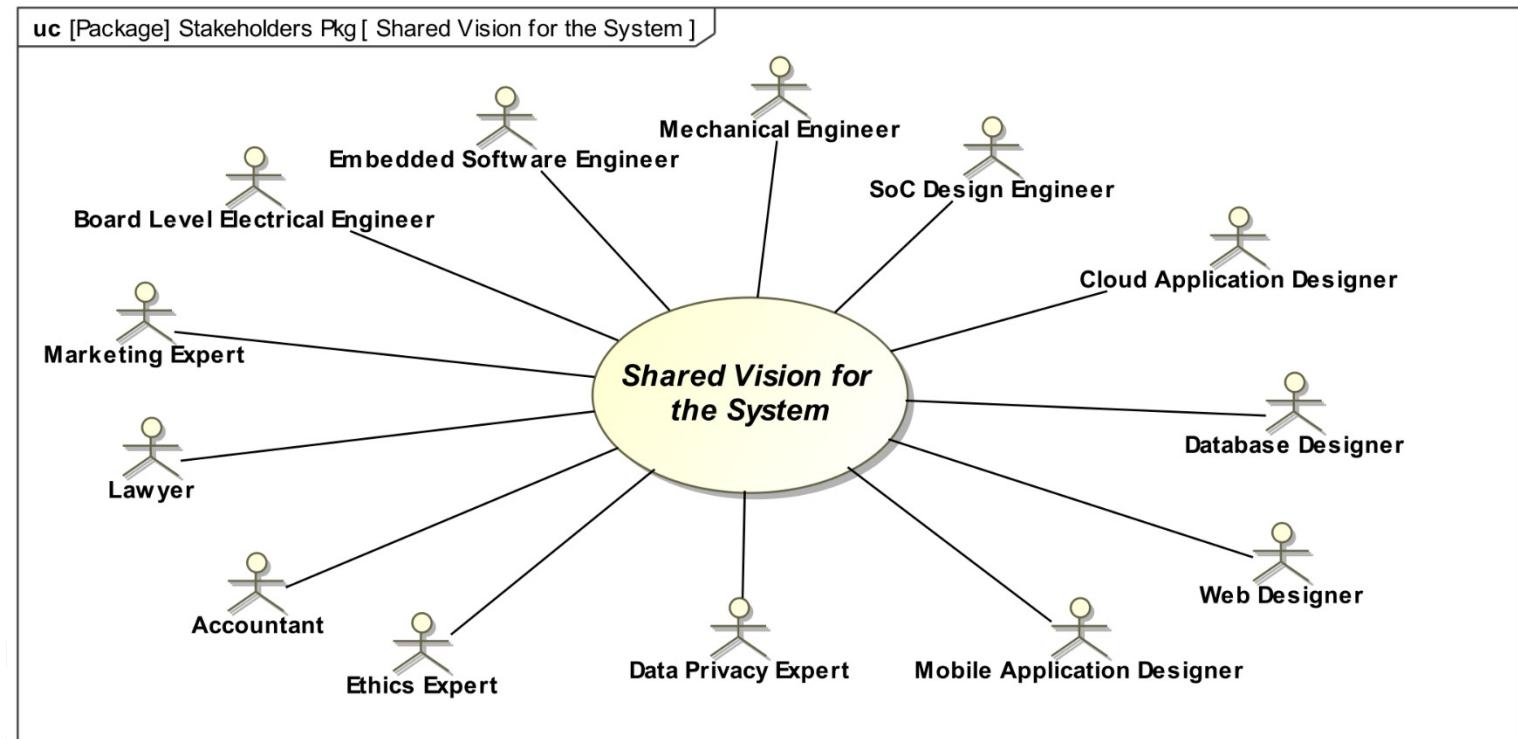
# Agile Weakness – Software Belly Button Gazing

- *“The code is the documentation”*
- *“Models should be drawn on whiteboards and the whiteboards should be erased when the team leaves the room.” (Martin Fowler)*

These software team slogans make a lot of sense... if software coders are the only people in the universe. Maintaining models and elaborate design documentation only for the software coders makes no sense at all. Indeed, after the initial problem analysis, the whiteboard should be erased, and the source code should be the authoritative source of the truth.

The problem with engineered systems is that the software coders are NOT the only people in the universe. It takes a large and diverse team to put an engineered product on the market – especially one that is cybersecure, complies with global rules and laws, and does not kill its users.

In this sort of environment, the software team has to understand that the source code is NOT the only critical work product. Rigorous models and solid design documentation are critical and cannot simply be ignored.



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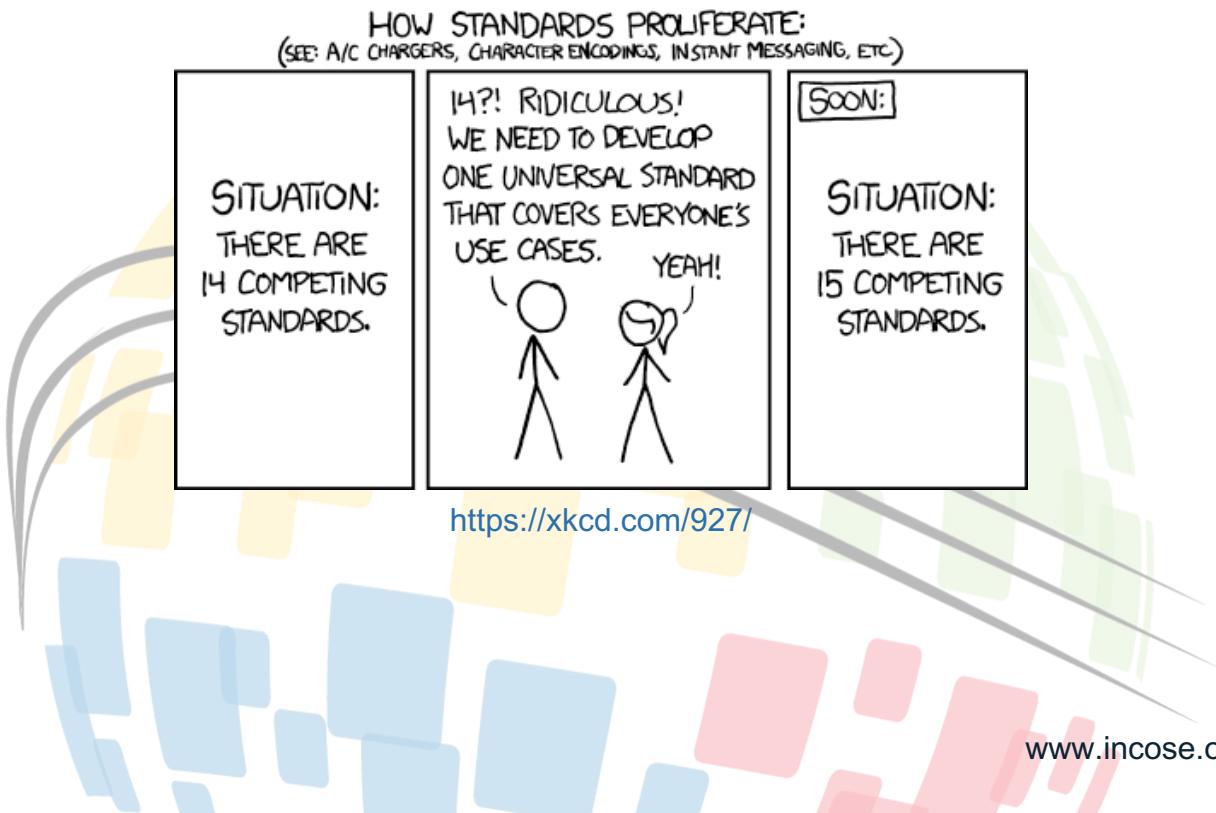


How do we bring this together to achieve project resilience, quality and accountability?

## Merging Worlds

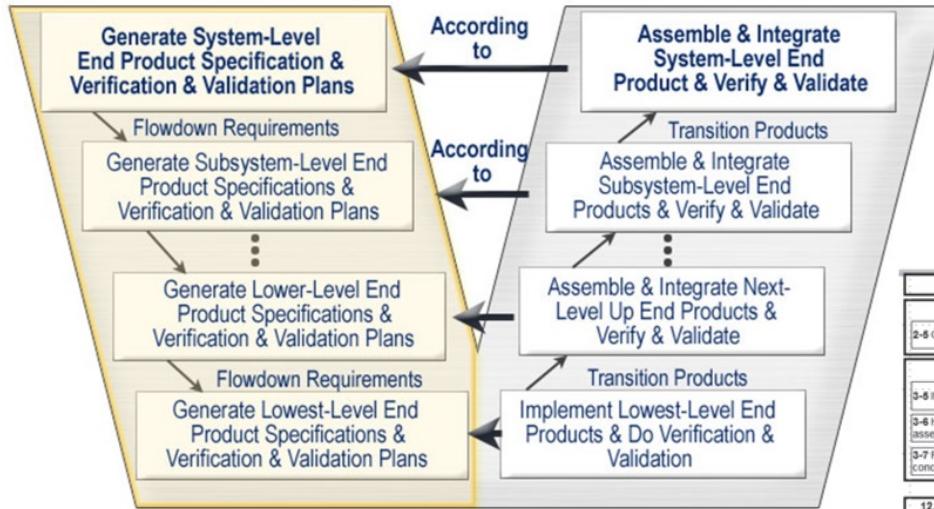
# Not Another Standard!

*“In this presentation we will present techniques for bringing these worlds together and achieving both project resilience, and the high levels of quality and accountability required for safety-critical and similar systems.”*

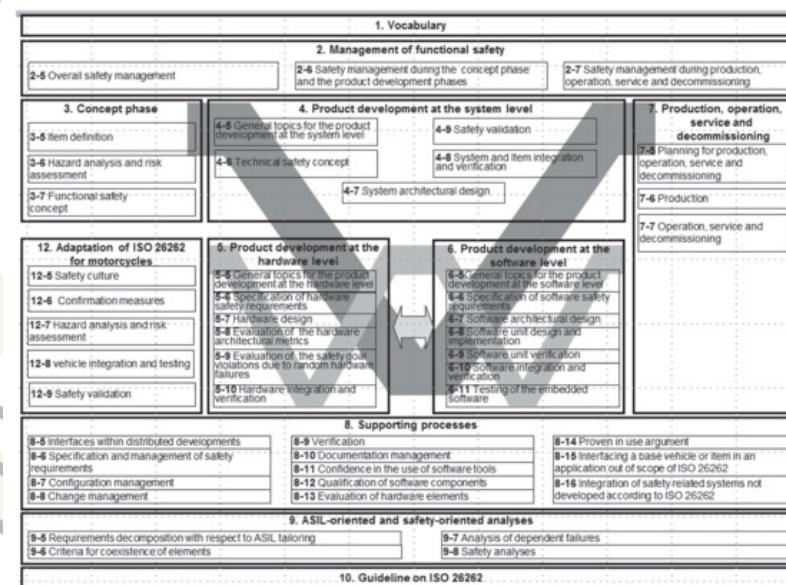


# Vee Model Processes

## The 'V' – A Macro View



[https://sebokwiki.org/wiki/System\\_Lifecycle\\_Process\\_Models:\\_Vee](https://sebokwiki.org/wiki/System_Lifecycle_Process_Models:_Vee)



<https://www.iso.org/standard/43464.html>

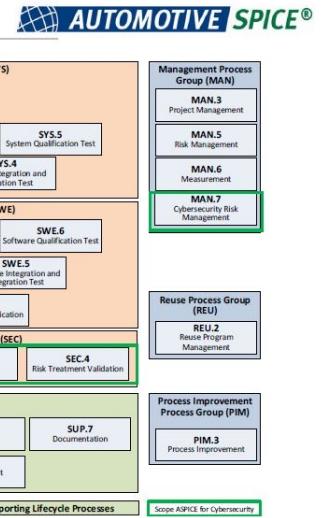
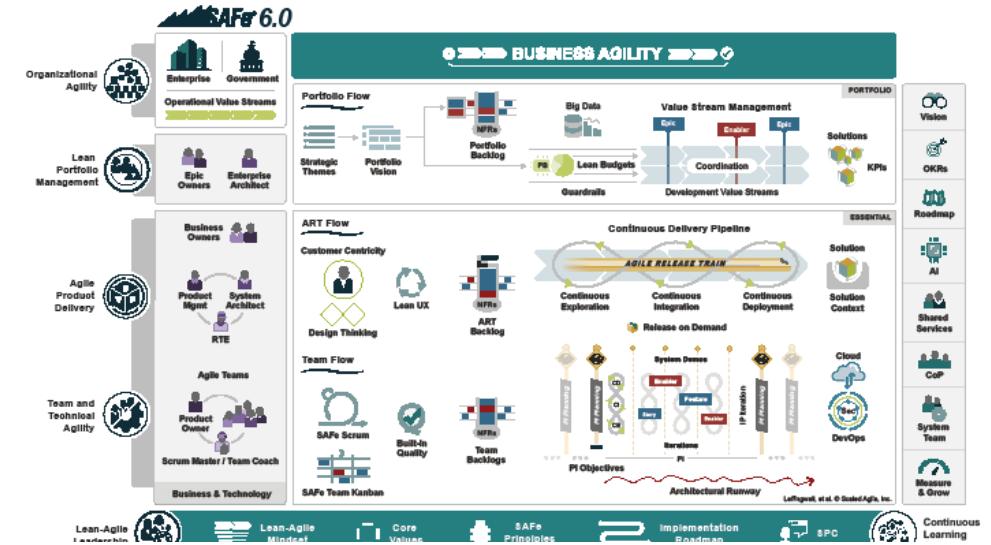
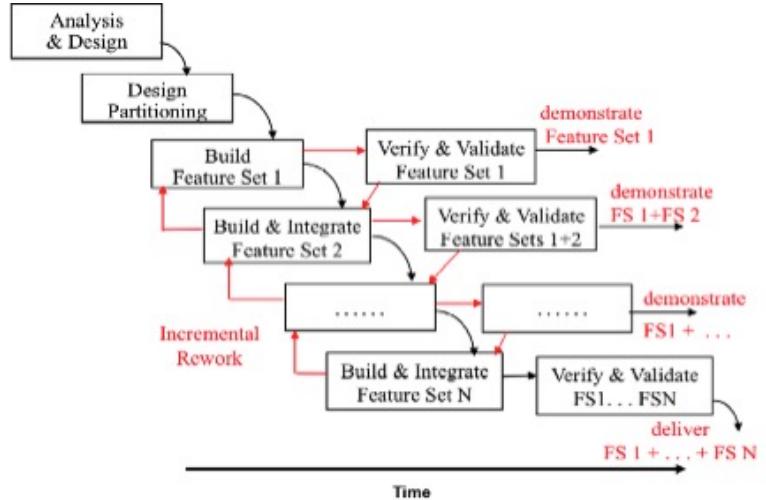


Figure 2 — Automotive SPICE and Automotive SPICE for Cybersecurity Process Reference Model – Overview

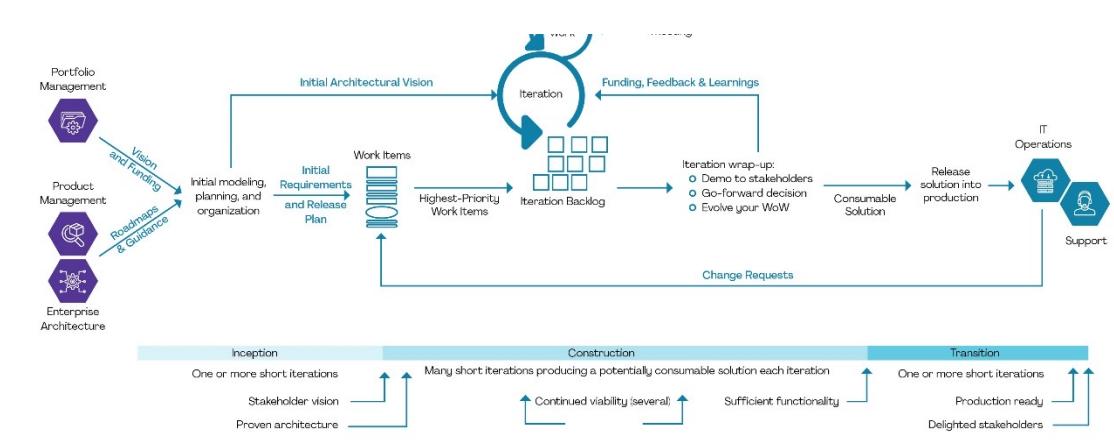
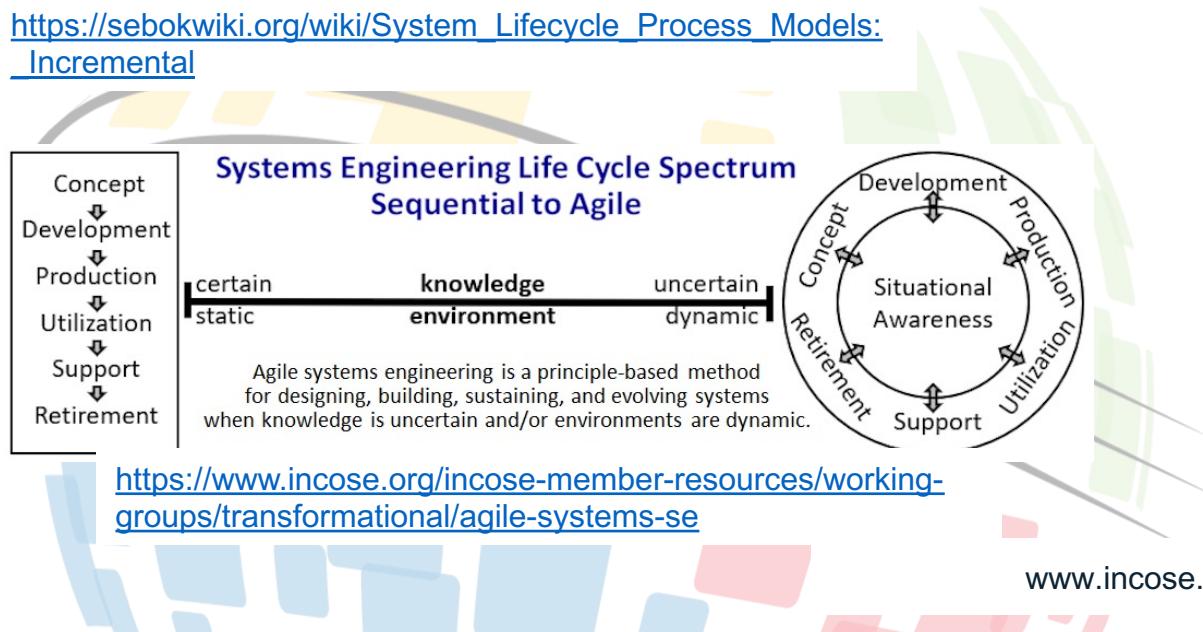
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# Agile Processes



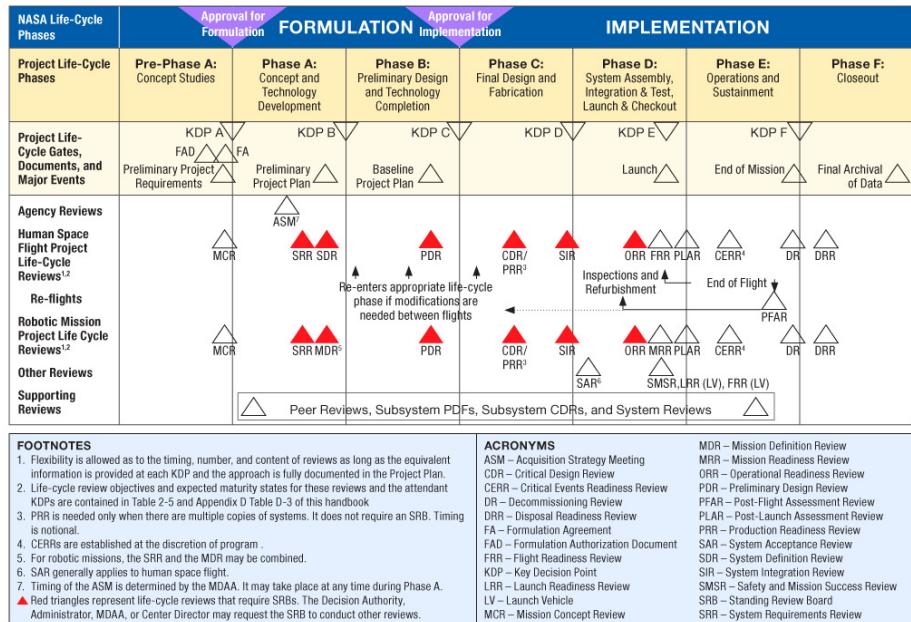
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[https://sebokwiki.org/wiki/System\\_Lifecycle\\_Process\\_Models:Incremental](https://sebokwiki.org/wiki/System_Lifecycle_Process_Models:Incremental)



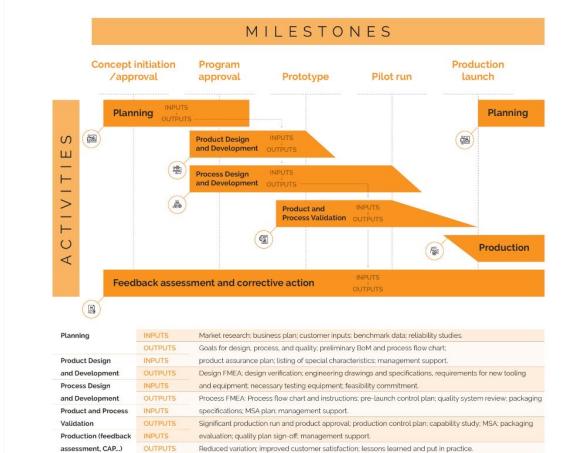
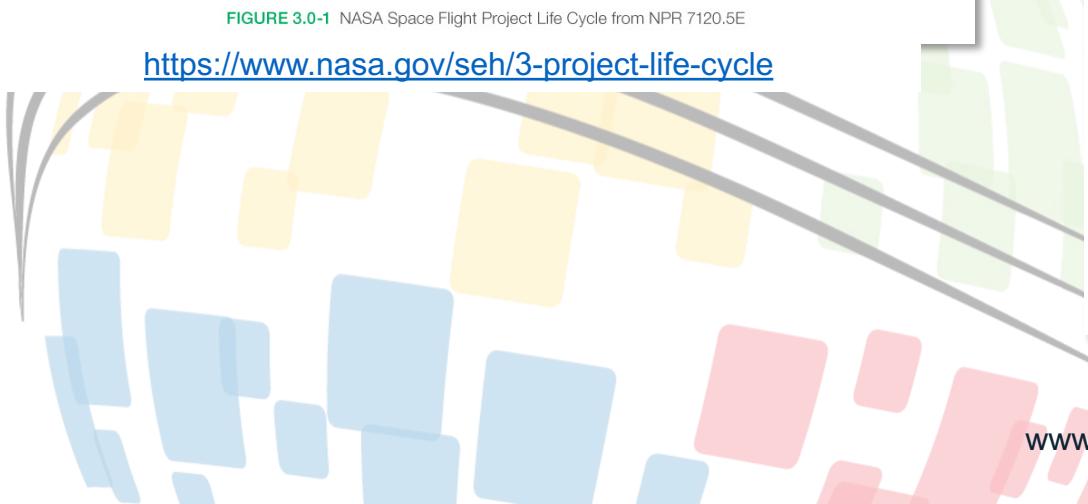
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# Product Development Lifecycles

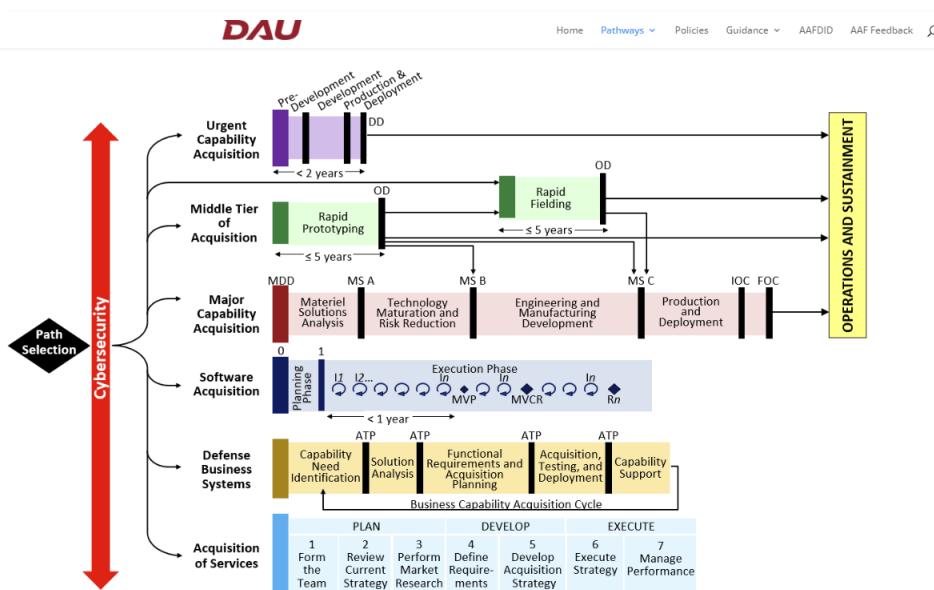


**FIGURE 3.0-1** NASA Space Flight Project Life Cycle from NPR 7120.5E

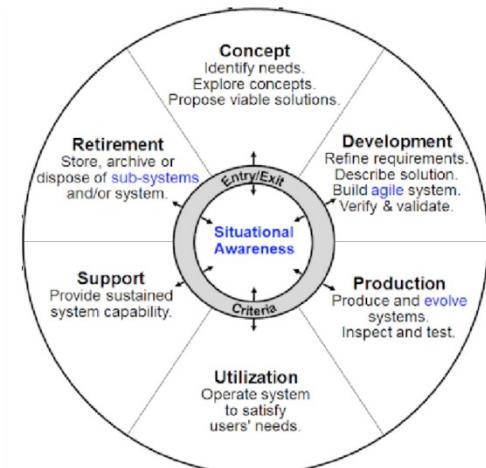
<https://www.nasa.gov/seh/3-project-life-cycle>



<https://qualityinspection.org/advanced-product-quality-planning/>



<https://aaf.dau.edu/aaf/aaf-pathways/>

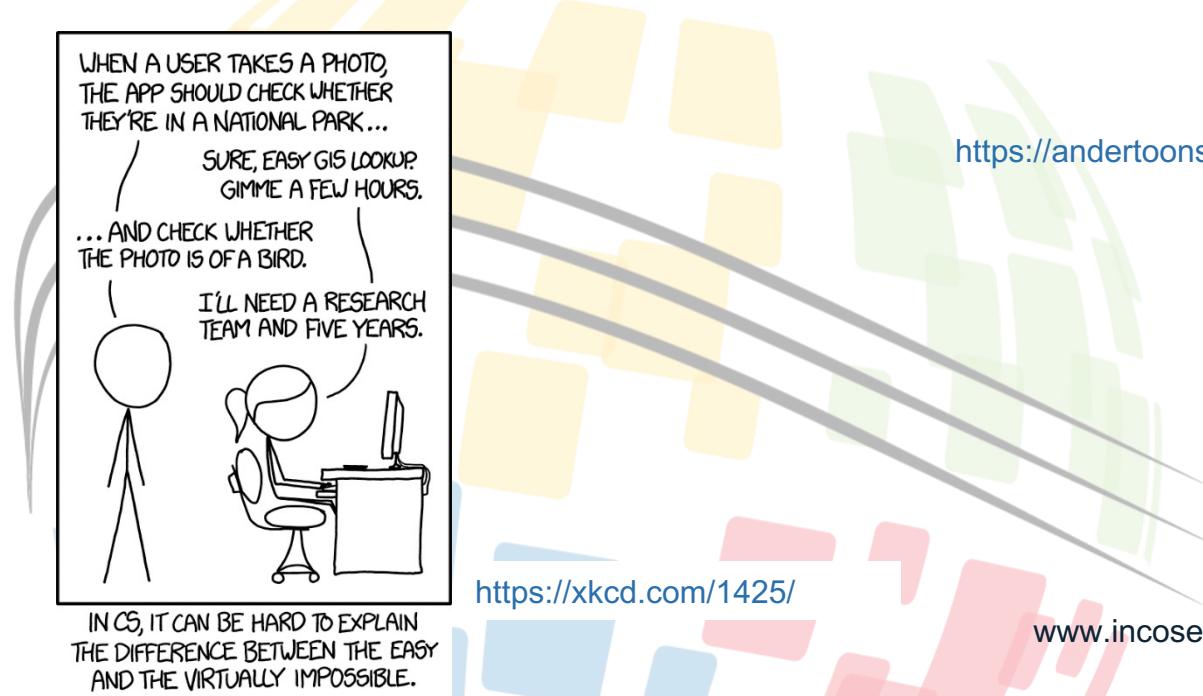


[https://sebokwiki.org/wiki/System\\_Life\\_Cycle\\_Process\\_Models:\\_Agile\\_Systems\\_Engineering](https://sebokwiki.org/wiki/System_Life_Cycle_Process_Models:_Agile_Systems_Engineering)

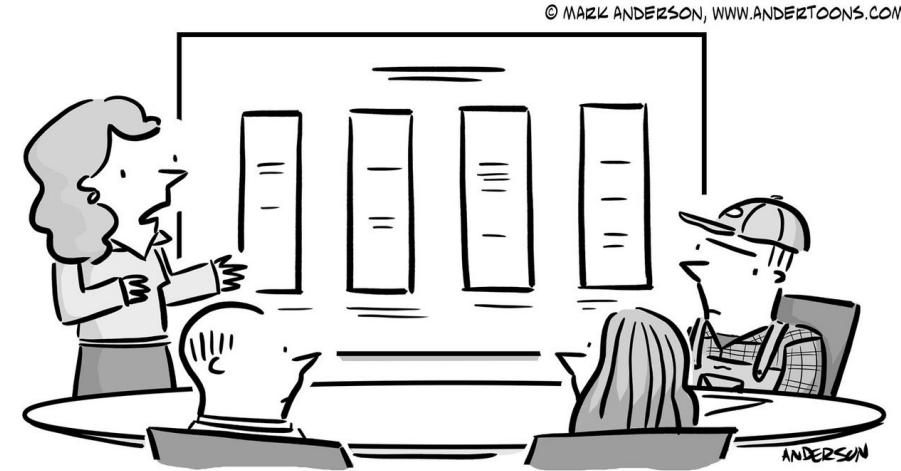
# Team and Organizational Structures



<https://giphy.com/explore/eight-bosses>



<https://xkcd.com/1425/>



"I know not all of us are excited about the prospect of breaking down silos..."

<https://andertoons.com/silo/cartoon/7431/i-know-not-all-of-us-are-excited-about-breaking-down-silos>

[www.incose.org/symp2023](http://www.incose.org/symp2023)

# Cyber Security, Safety and Quality

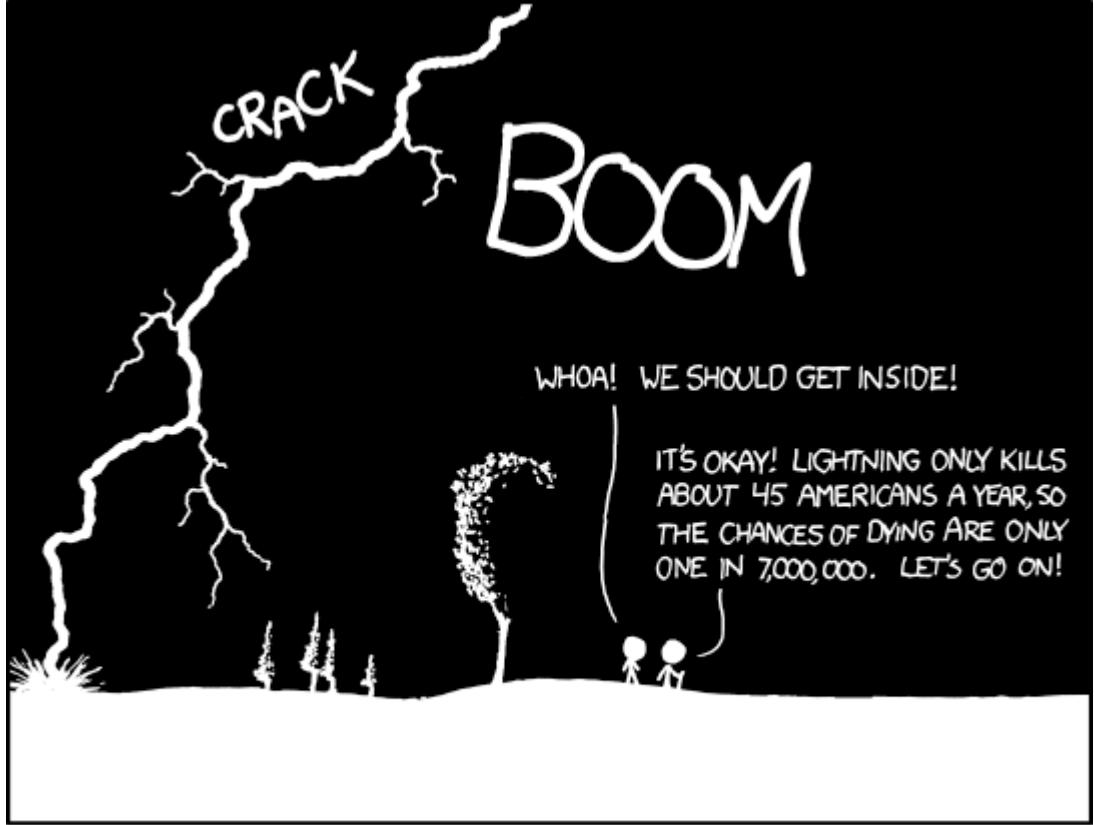
## It's all about Risk Management!

### What do we need to do?

- Identify, categorize, and implement mitigation
- Contain Risk
- Recover from Risk Realization
- Control Risk
- Monitor Risk
- Top Leadership needs data and evidence to be able to accept the risk and own the realizations.



[www.incose.org/symp2023](http://www.incose.org/symp2023)

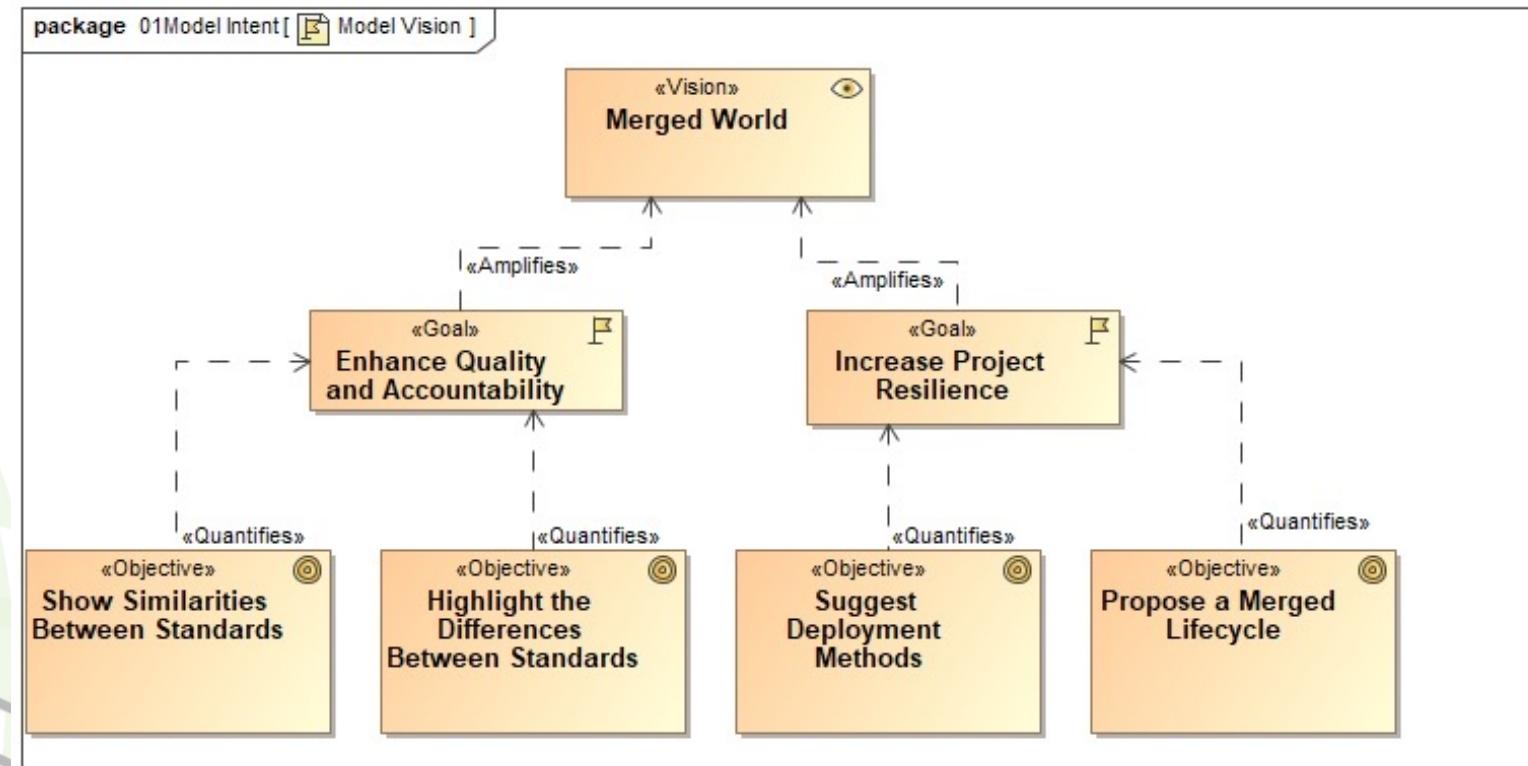


THE ANNUAL DEATH RATE AMONG PEOPLE WHO KNOW THAT STATISTIC IS ONE IN SIX.  
<https://xkcd.com/795/>



# The Analysis Method: BPMN Model

- Process Areas, Objectives, and Activities
- Evidence and Data Types
- Team Structure
- Lifecycles



# Modeling the Processes – Vee Model

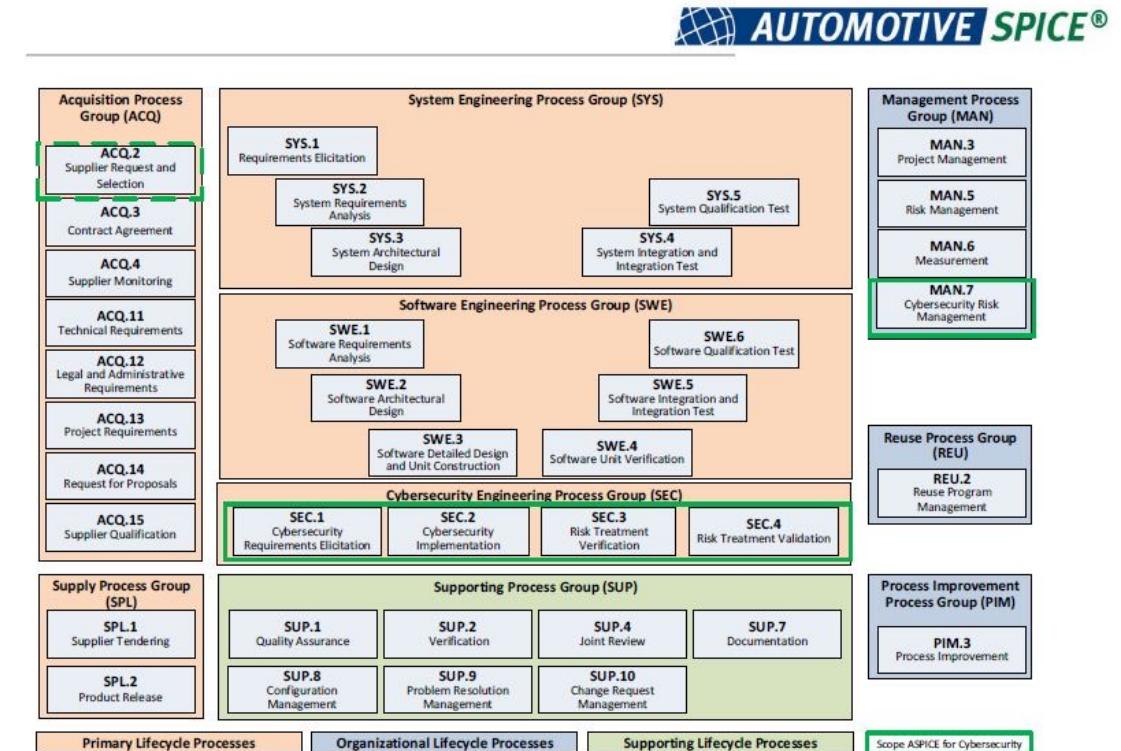
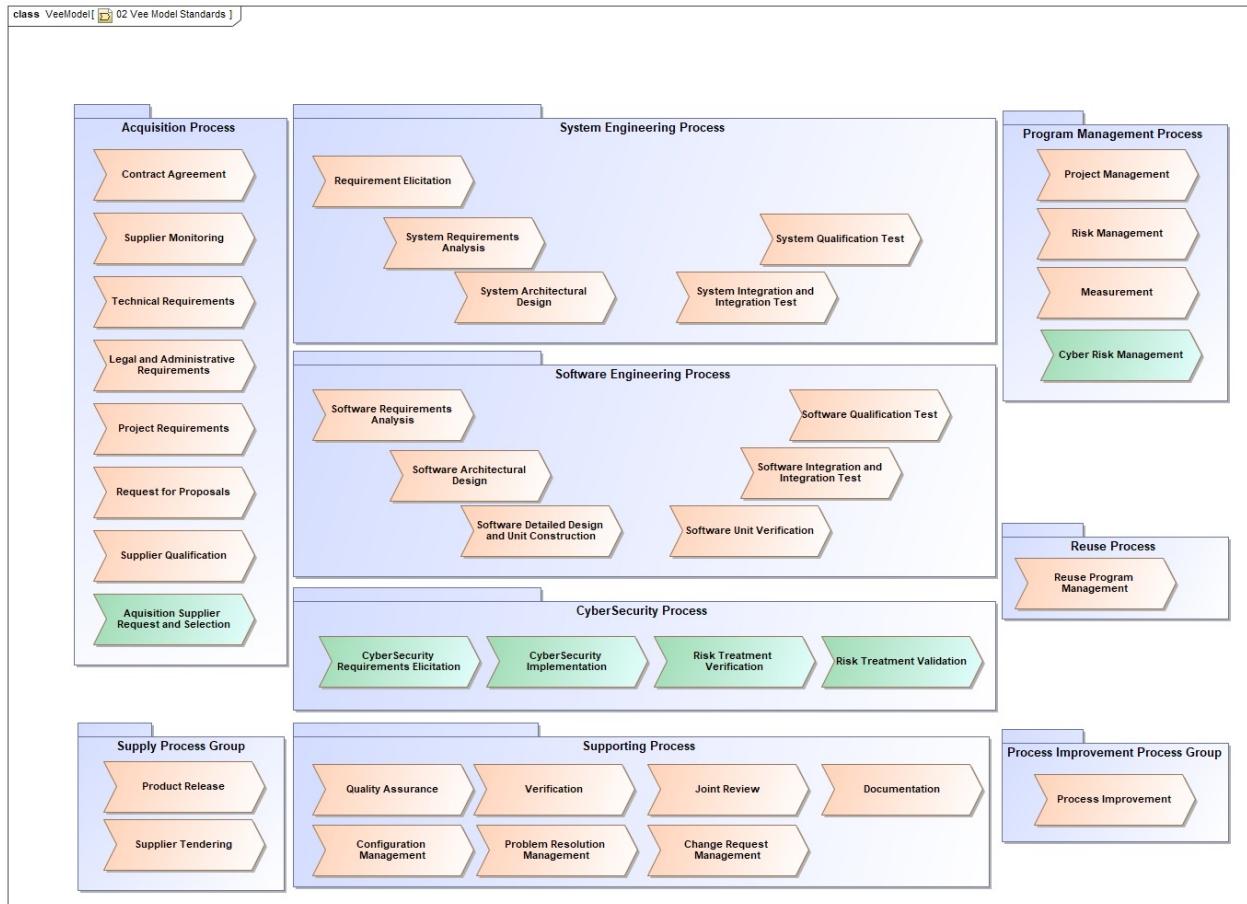
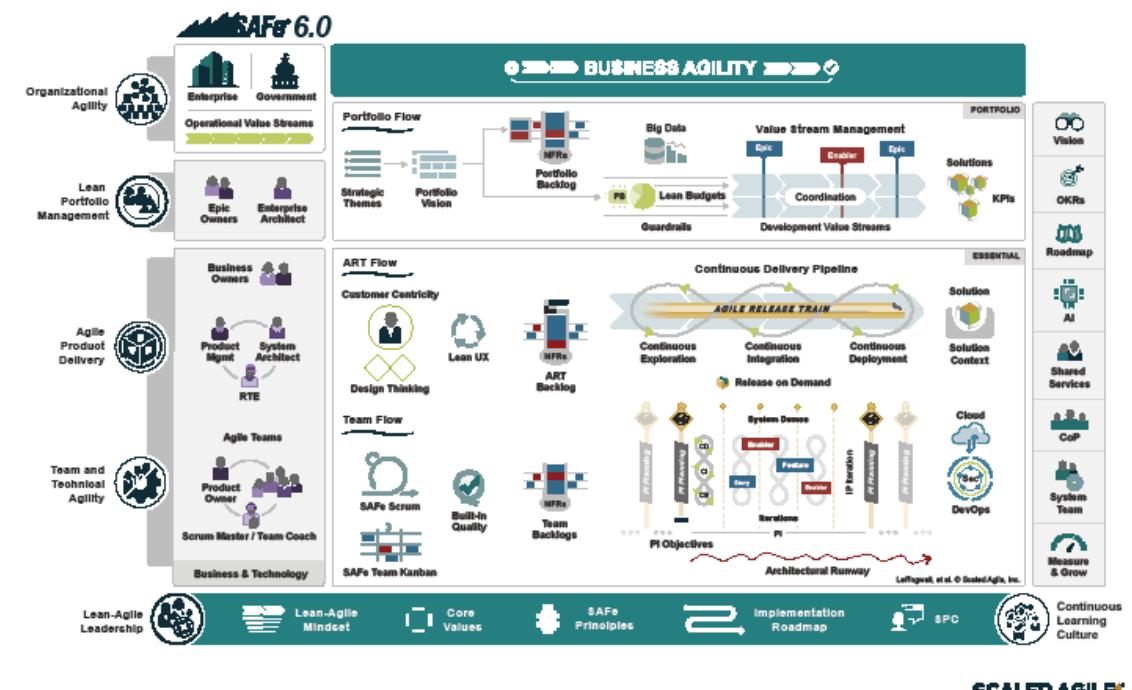
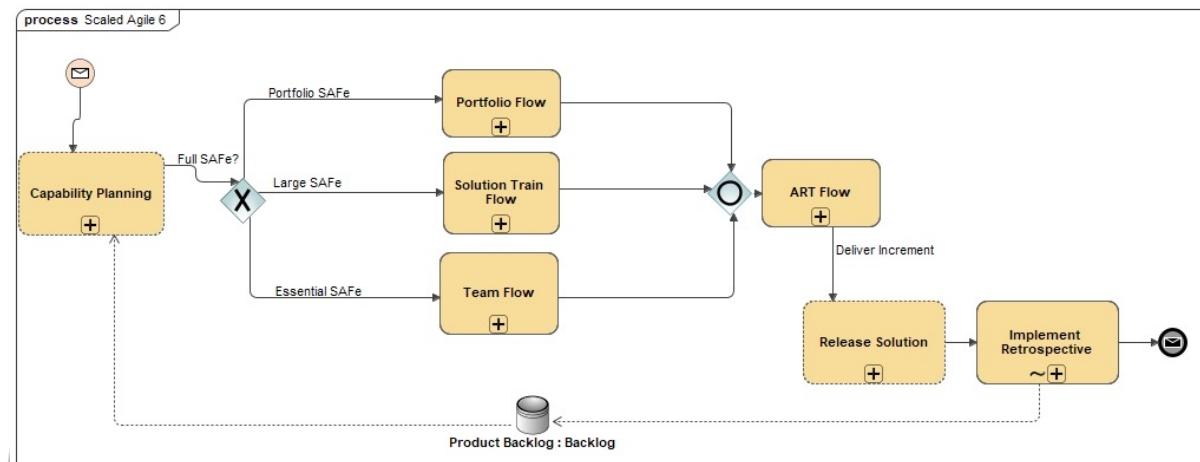


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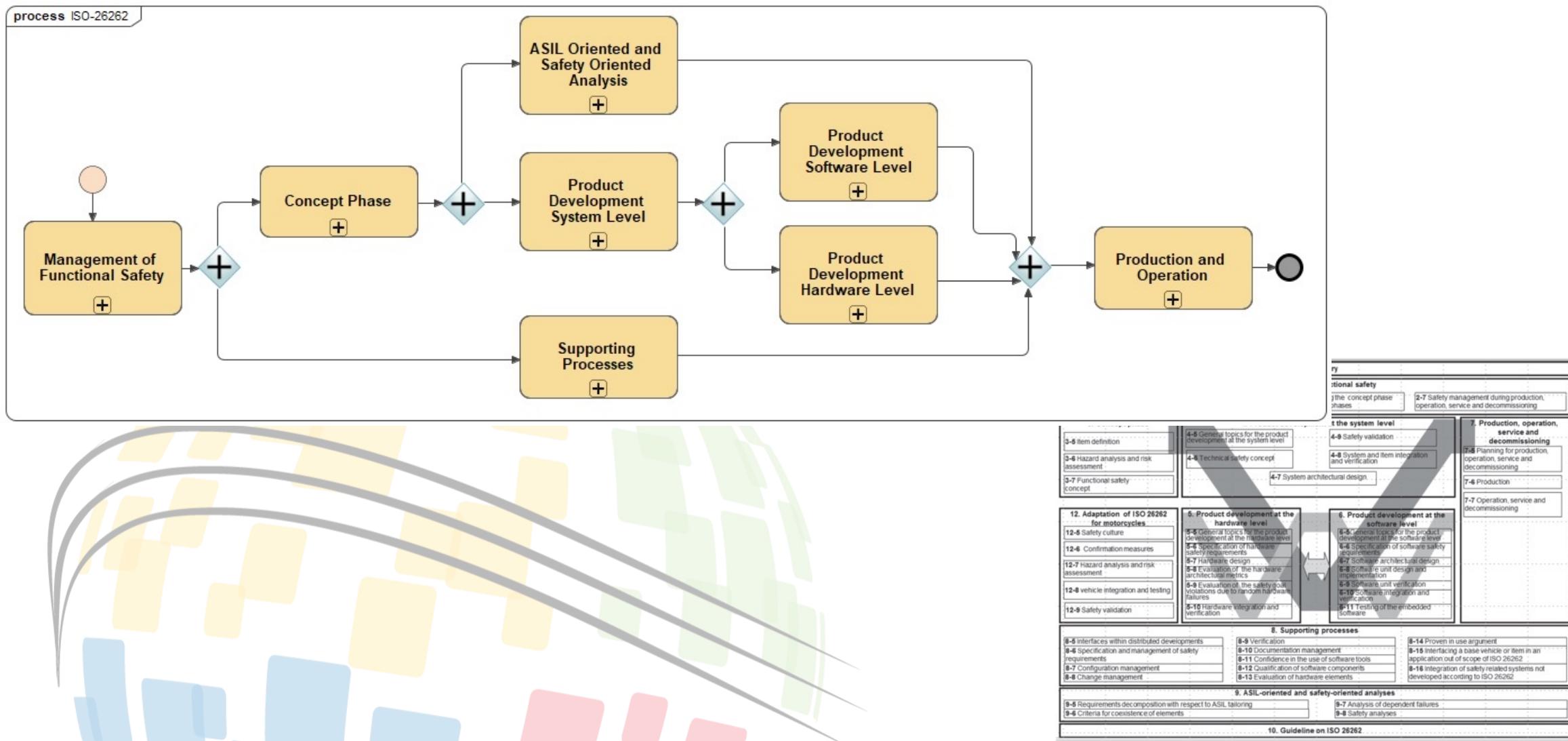
# Modeling the Processes – Agile



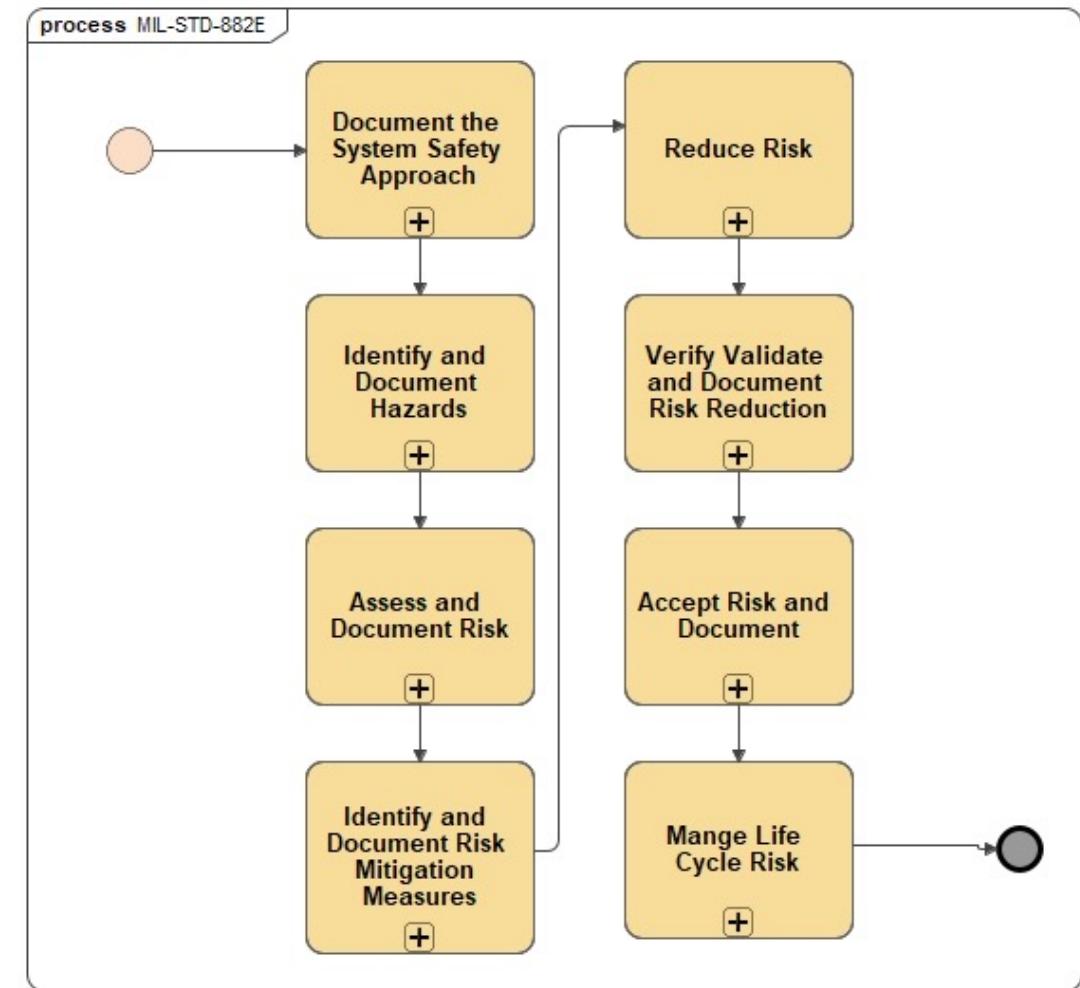
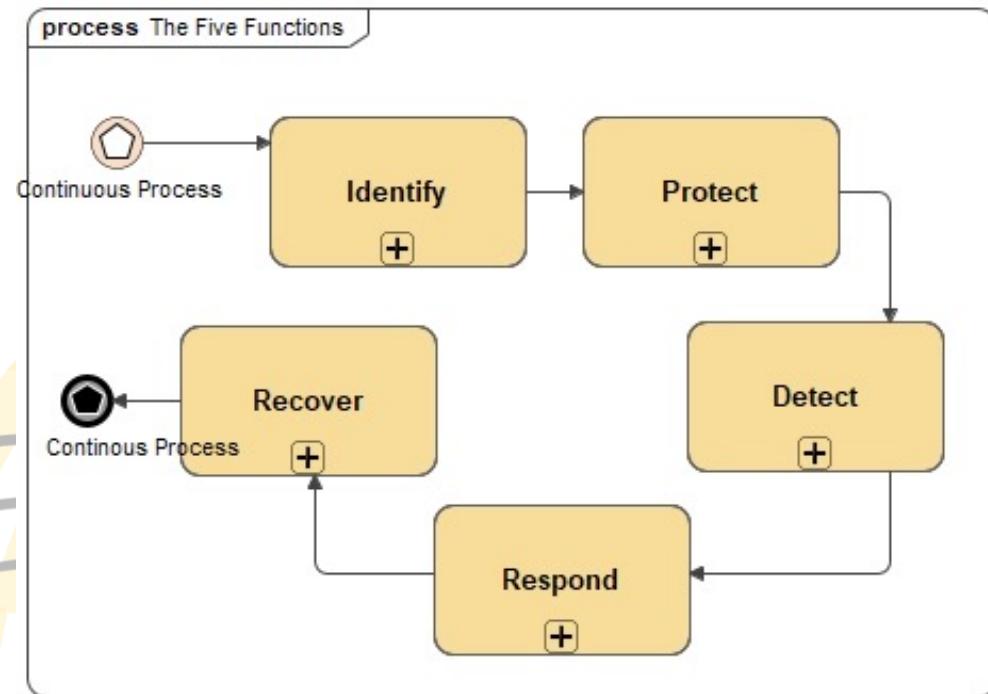
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# Modeling the Supporting Process: Safety ISO-26262



# Modeling the Supporting Process: NIST, MIL-STD-882E



# Comparing Processes

## Legend

### ↗ Alignment

## Similarities

## Same objectives, context and activities

## Differences

Names of activities, sequencing, roles included, and definition of done.

# Narrative

In Agile it covers multiple process areas in a modified parallel workflow.

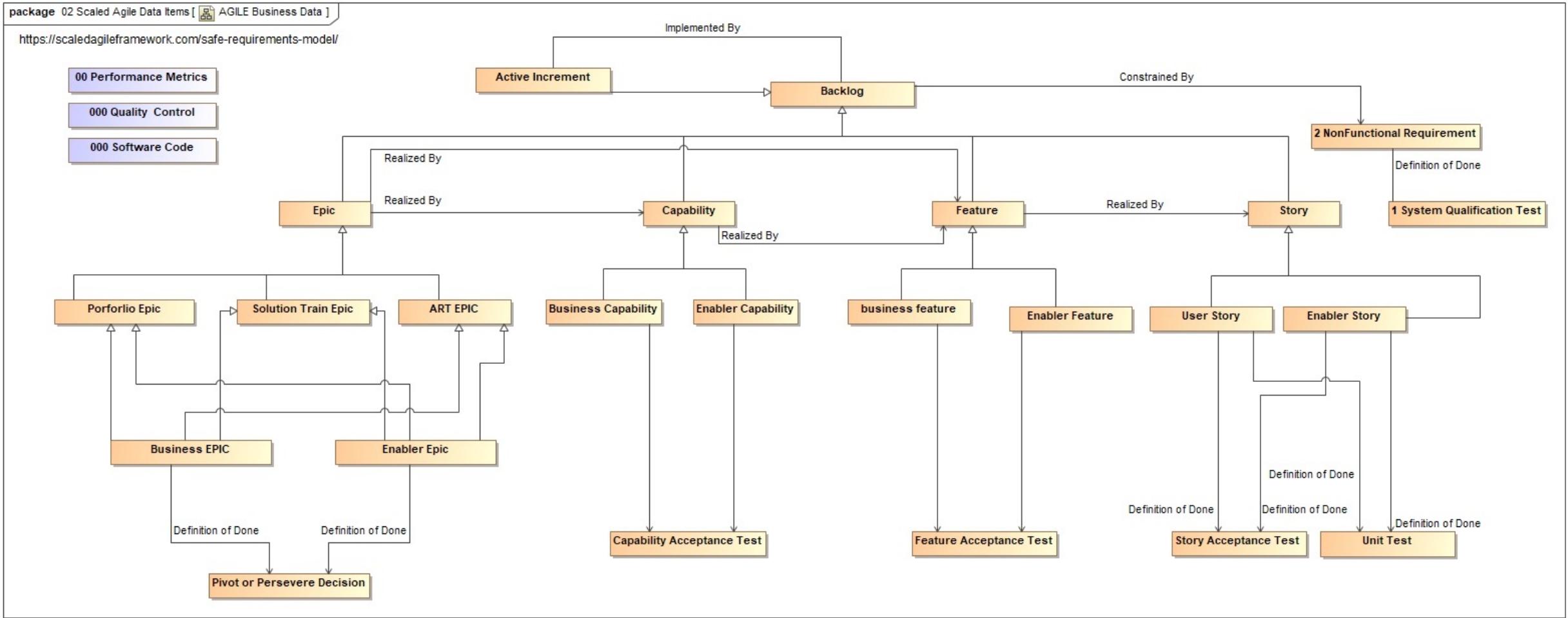
In Vee Model each process is seen as a workflow state and required complete to transition.

# Modeling the Evidence: Vee Model



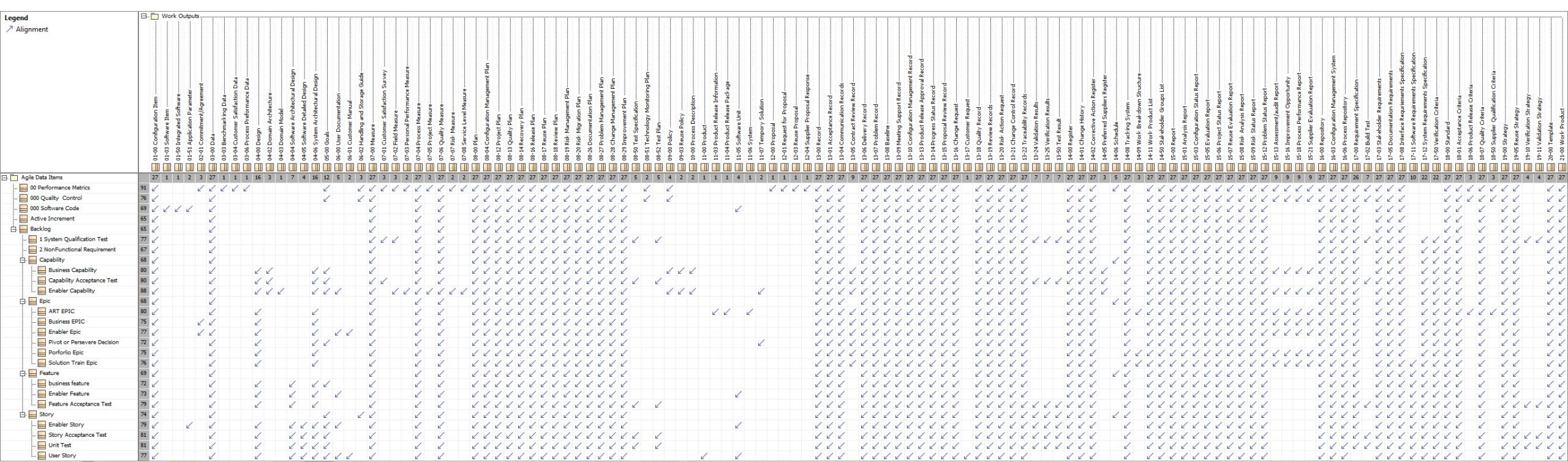
21-00 Work Product	20-00 Template	19-11 Validation Strategy	19-10 Verification Strategy	19-05 Reuse Strategy
19-00 Strategy	18-50 Supplier Qualification Criteria	18-07 Quality Criteria	18-06 Product Release Criteria	18-01 Acceptance Criteria
18-00 Standard	17-50 Verification Criteria	17-12 System Requirements Specification	17-11 Software Requirements Specification	17-08 Interface Requirements Specification
17-05 Documentation Requirements	17-03 Stakeholder Requirements	17-02 Build Test	17-00 Requirement Specification	16-06 Process Repository
16-03 Configuration Management System	16-00 Repository	15-21 Supplier Evaluation Report	15-18 Process Performance Report	15-16 Improvement Opportunity
15-13 Assessment/audit Report	15-12 Problem Status Report	15-09 Risk Status Report	15-08 Risk Analysis Report	15-07 Reuse Evaluation Report
15-06 Project Status Report	15-05 Evaluation Report	15-03 Configuration Status Report	15-01 Analysis Report	15-00 Report
14-50 Stakeholder Groups List	14-11 Work Product List	14-09 Work Breakdown Structure	14-08 Tracking System	14-06 Schedule
14-05 Preferred Suppliers Register	14-02 Corrective Action Register	14-01 Change History		14-00 Register
13-50 Test Result	13-25 Verification Results	13-24 Validation Results	13-22 Traceability Records	13-21 Change Control Record
13-20 Risk Action Request	13-19 Review Records	13-18 Quality Record	13-17 Customer Request	13-16 Change Request
13-15 Proposal Review Record	13-14 Progress Status Record	13-13 Product Release Approval Record	13-10 Configuration Management Record	13-09 Meeting Support Record
13-08 Baseline	13-07 Problem Record	13-06 Delivery Record	13-05 Contract Review Record	13-04 Communication Records
13-01 Acceptance Record	13-00 Record	12-04 Supplier Proposal Response	12-03 Reuse Proposal	12-01 Request for Proposal
12-00 Proposal	11-07 Temporary Solution	11-06 System	11-05 Software Unit	11-04 Product Release Package
11-03 Product Release Information	11-00 Product	10-00 Process Description	09-03 Reuse Policy	09-00 Policy
08-52 Test Plan	08-51 Technology Monitoring Plan	08-50 Test Specification	08-29 Improvement Plan	08-28 Change Management Plan
08-27 Problem Management Plan	08-26 Documentation Plan	08-20 Risk Migration Plan	08-19 Risk Management Plan	08-18 Review Plan
08-17 Reuse Plan	08-16 Release Plan	08-14 Recovery Plan	08-13 Quality Plan	08-12 Project Plan
08-04 Configuration Management Plan	08-00 Plan	07-08 Service Level Measure	07-07 Risk Measure	07-06 Quality Measure
07-05 Project Measure	07-04 Process Measure	07-03 Personal Performance Measure	07-02 Field Measure	07-01 Customer Satisfaction Survey
07-00 Measure	06-02 Handling and Storage Guide	06-01 Customer Manual	06-00 User Documentation	05-00 Goals
04-06 System Architectural Design	04-05 Software Detailed Design	04-04 Software Architectural Design	04-03 Domain Model	04-02 Domain Architecture
04-00 Design	03-06 Process Performance Data	03-04 Customer Satisfaction Data	03-03 Benchmarking Data	03-00 Data
02-01 Commitment/Agreement	01-51 Application Parameter	01-50 Integrated Software	01-03 Software Item	01-00 Configuration Item

# Modeling the Evidence: Agile



<https://www.incose.org/incose-member-resources/working-groups/transformational/agile-systems-se>

# Comparing Evidence



## Similarities

Same objectives, context and required evidence.

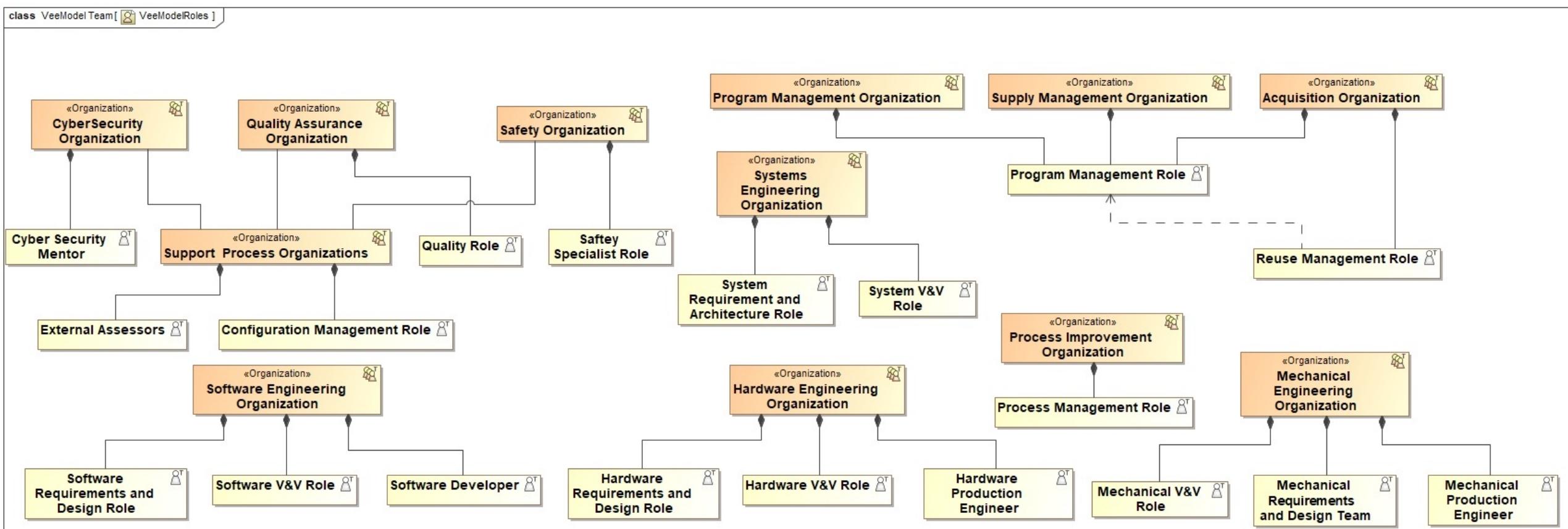
# Differences

## When it is complete.

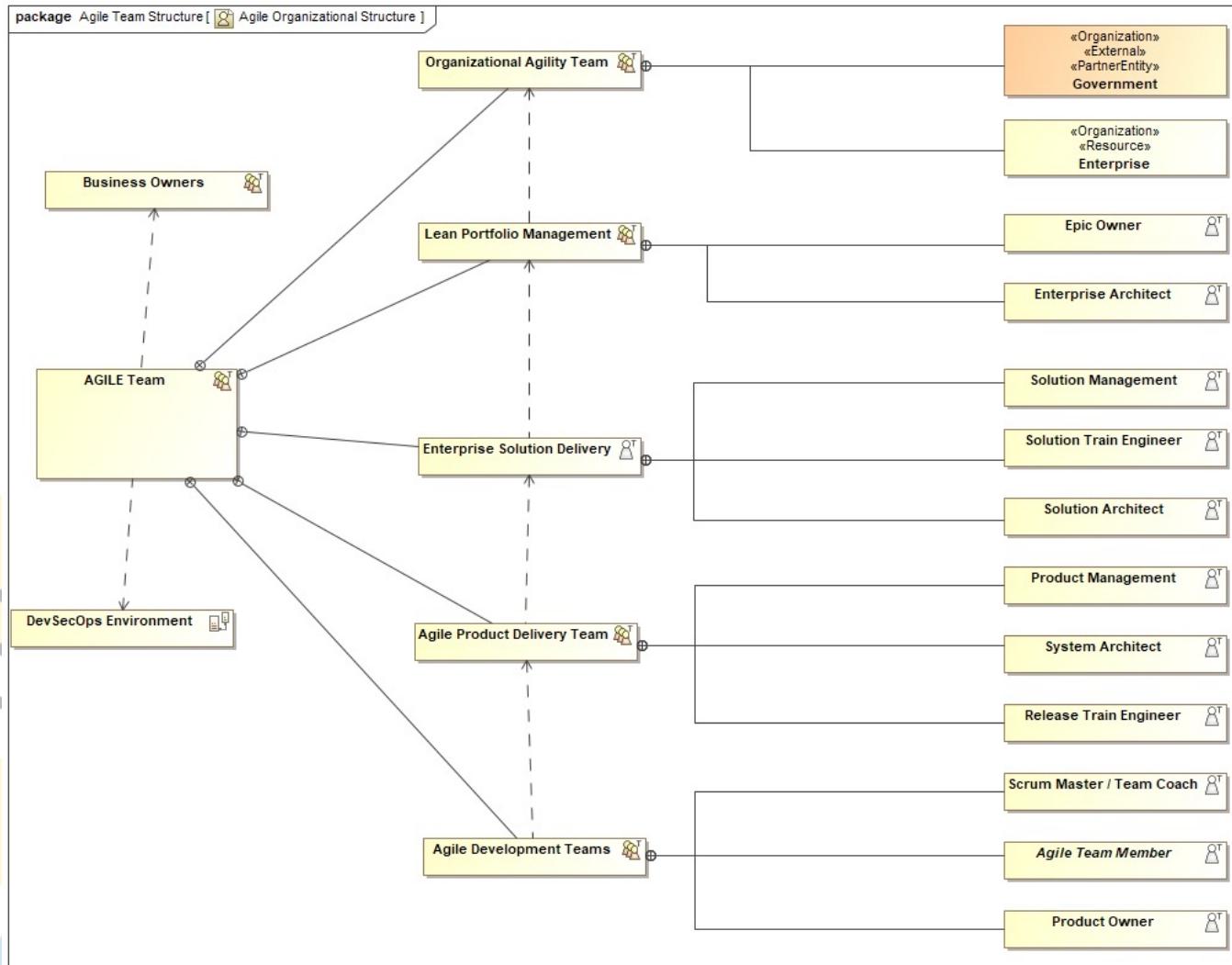
# Narrative

In Agile evidence is complete when the capability is complete.  
In Vee Model the evidence is complete when the artifact is complete.

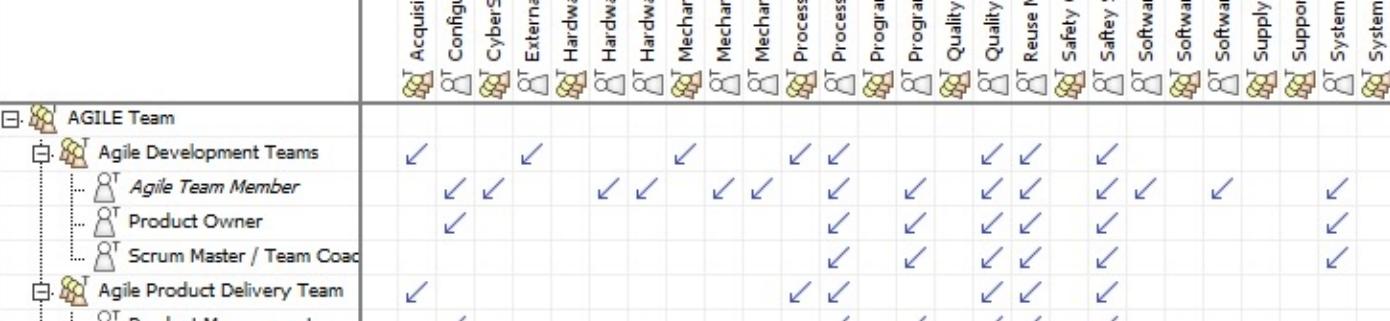
# Modeling the Team Structure: Vee Model



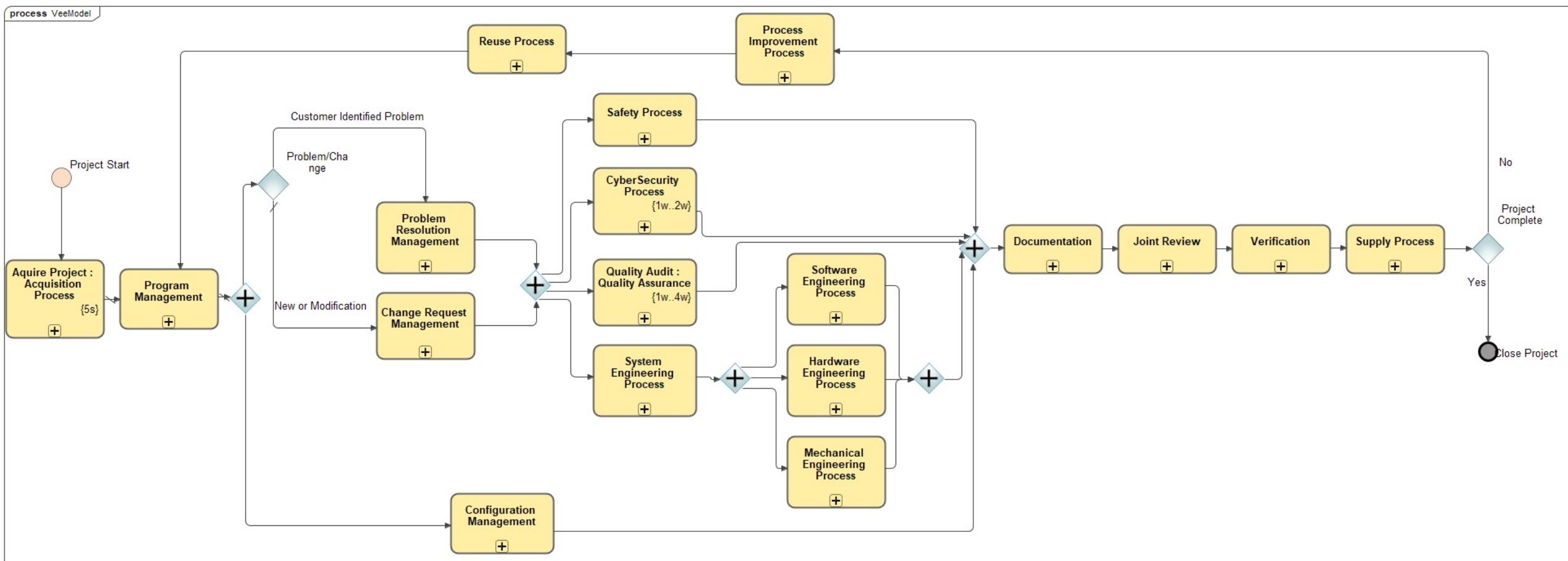
# Modeling the Team Structure: Agile



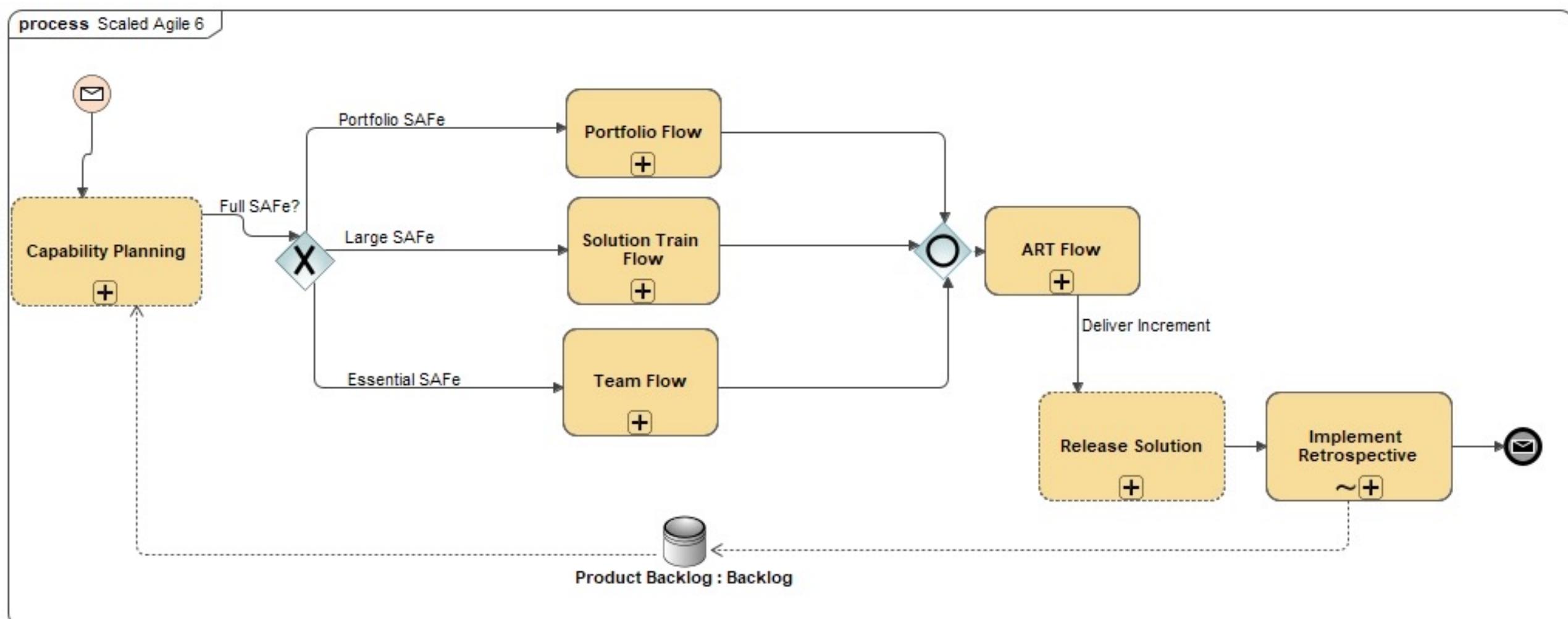
# Comparing Team Structures

Similarities	Same objectives, context and required skills.	
Differences	When to perform which roles and when to collaborate between roles.	 <pre>     graph TD         subgraph Agile_Team [Agile Team]             subgraph Agile_Development_Teams [Agile Development Teams]                 Agile_Team_Member[Agile Team Member]                 Product_Owner[Product Owner]                 Scrum_Master[Scrum Master / Team Coach]             end             Agile_Product_Delivery_Team[Agile Product Delivery Team]             Business_Owners[Business Owners]             subgraph Enterprise_Solution_Delivery [Enterprise Solution Delivery]                 Solution_Architect[Solution Architect]                 Solution_Management[Solution Management]                 Solution_Train_Engineer[Solution Train Engineer]             end             Lean_Portfolio_Management[Lean Portfolio Management]             subgraph Organizational_Agility_Team [Organizational Agility Team]                 Enterprise[Enterprise]             end         end          subgraph Vee_Model_Team [Vee Model Team]             subgraph Acquisition_Organization [Acquisition Organization]                 Configuration_Management_Role[Configuration Management Role]                 CyberSecurity_Organization[CyberSecurity Organization]                 External_Assessors[External Assessors]                 Hardware_Engineering_Organization[Hardware Engineering Organization]                 Hardware_Prod_Engineer[Hardware Production Engineer]                 Hardware_Requirements_Design_Role[Hardware Requirements and Design Role]                 Mechanical_Engineering_Organization[Mechanical Engineering Organization]                 Mechanical_Prod_Engineer[Mechanical Production Engineer]                 Mechanical_Requirements_Design_Team[Mechanical Requirements and Design Team]                 Process_Improvement_Organization[Process Improvement Organization]                 Process_Management_Role[Process Management Role]                 Program_Management_Organization[Program Management Organization]                 Quality_Assurance_Organization[Quality Assurance Organization]                 Quality_Role[Quality Role]                 Reuse_Management_Role[Reuse Management Role]                 Safety_Organization[Safety Organization]                 Safety_Specialist_Role[Safety Specialist Role]                 Software_Developer[Software Developer]                 Software_Engineering_Organization[Software Engineering Organization]                 Supply_Management_Organization[Supply Management Organization]                 Support_Process_Organizations[Support Process Organizations]                 System_Requirement_Architecture_Role[System Requirement and Architecture Role]             end         end          Agile_Team_Member --&gt; Configuration_Management_Role         Agile_Team_Member --&gt; CyberSecurity_Organization         Agile_Team_Member --&gt; External_Assessors         Agile_Team_Member --&gt; Hardware_Engineering_Organization         Agile_Team_Member --&gt; Hardware_Prod_Engineer         Agile_Team_Member --&gt; Hardware_Requirements_Design_Role         Agile_Team_Member --&gt; Mechanical_Engineering_Organization         Agile_Team_Member --&gt; Mechanical_Prod_Engineer         Agile_Team_Member --&gt; Mechanical_Requirements_Design_Team         Agile_Team_Member --&gt; Process_Improvement_Organization         Agile_Team_Member --&gt; Process_Management_Role         Agile_Team_Member --&gt; Program_Management_Organization         Agile_Team_Member --&gt; Quality_Assurance_Organization         Agile_Team_Member --&gt; Quality_Role         Agile_Team_Member --&gt; Reuse_Management_Role         Agile_Team_Member --&gt; Safety_Organization         Agile_Team_Member --&gt; Safety_Specialist_Role         Agile_Team_Member --&gt; Software_Developer         Agile_Team_Member --&gt; Software_Engineering_Organization         Agile_Team_Member --&gt; Supply_Management_Organization         Agile_Team_Member --&gt; Support_Process_Organizations         Agile_Team_Member --&gt; System_Requirement_Architecture_Role          Product_Owner --&gt; Configuration_Management_Role         Product_Owner --&gt; CyberSecurity_Organization         Product_Owner --&gt; External_Assessors         Product_Owner --&gt; Hardware_Engineering_Organization         Product_Owner --&gt; Hardware_Prod_Engineer         Product_Owner --&gt; Hardware_Requirements_Design_Role         Product_Owner --&gt; Mechanical_Engineering_Organization         Product_Owner --&gt; Mechanical_Prod_Engineer         Product_Owner --&gt; Mechanical_Requirements_Design_Team         Product_Owner --&gt; Process_Improvement_Organization         Product_Owner --&gt; Process_Management_Role         Product_Owner --&gt; Program_Management_Organization         Product_Owner --&gt; Quality_Assurance_Organization         Product_Owner --&gt; Quality_Role         Product_Owner --&gt; Reuse_Management_Role         Product_Owner --&gt; Safety_Organization         Product_Owner --&gt; Safety_Specialist_Role         Product_Owner --&gt; Software_Developer         Product_Owner --&gt; Software_Engineering_Organization         Product_Owner --&gt; Supply_Management_Organization         Product_Owner --&gt; Support_Process_Organizations         Product_Owner --&gt; System_Requirement_Architecture_Role          Scrum_Master --&gt; Configuration_Management_Role         Scrum_Master --&gt; CyberSecurity_Organization         Scrum_Master --&gt; External_Assessors         Scrum_Master --&gt; Hardware_Engineering_Organization         Scrum_Master --&gt; Hardware_Prod_Engineer         Scrum_Master --&gt; Hardware_Requirements_Design_Role         Scrum_Master --&gt; Mechanical_Engineering_Organization         Scrum_Master --&gt; Mechanical_Prod_Engineer         Scrum_Master --&gt; 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Support_Process_Organizations         Enterprise --&gt; System_Requirement_Architecture_Role     </pre>
Narrative	<p>In Agile, Roles are more hats you wear when you have the required skills to collaborate on the solution.</p> <p>In Vee Model, Roles are your position in the hierarchy of the project organizational structure and Silo'd away from the project team.</p>	

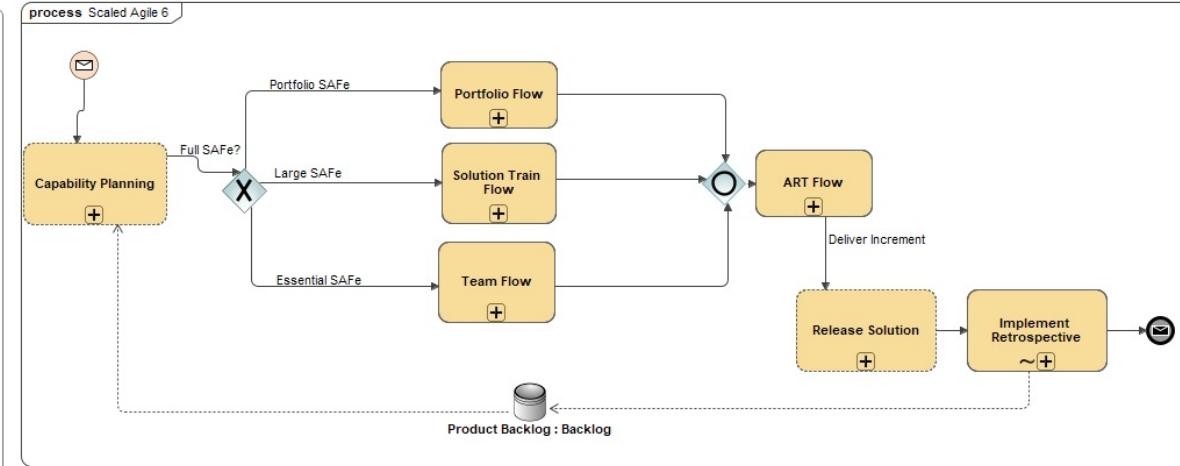
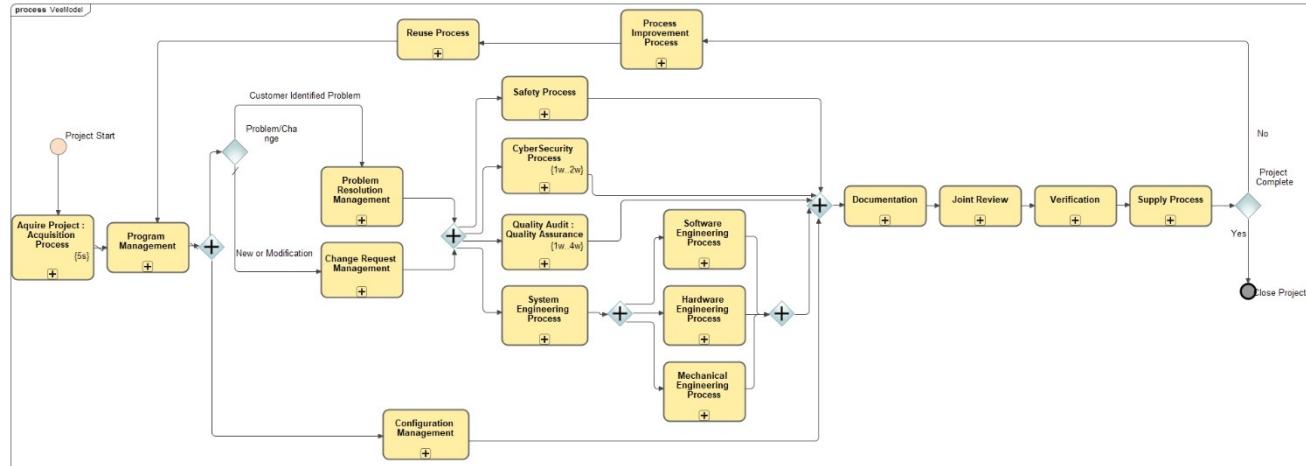
# Modeling Lifecycles: Vee Model



# Modeling Lifecycles: Agile

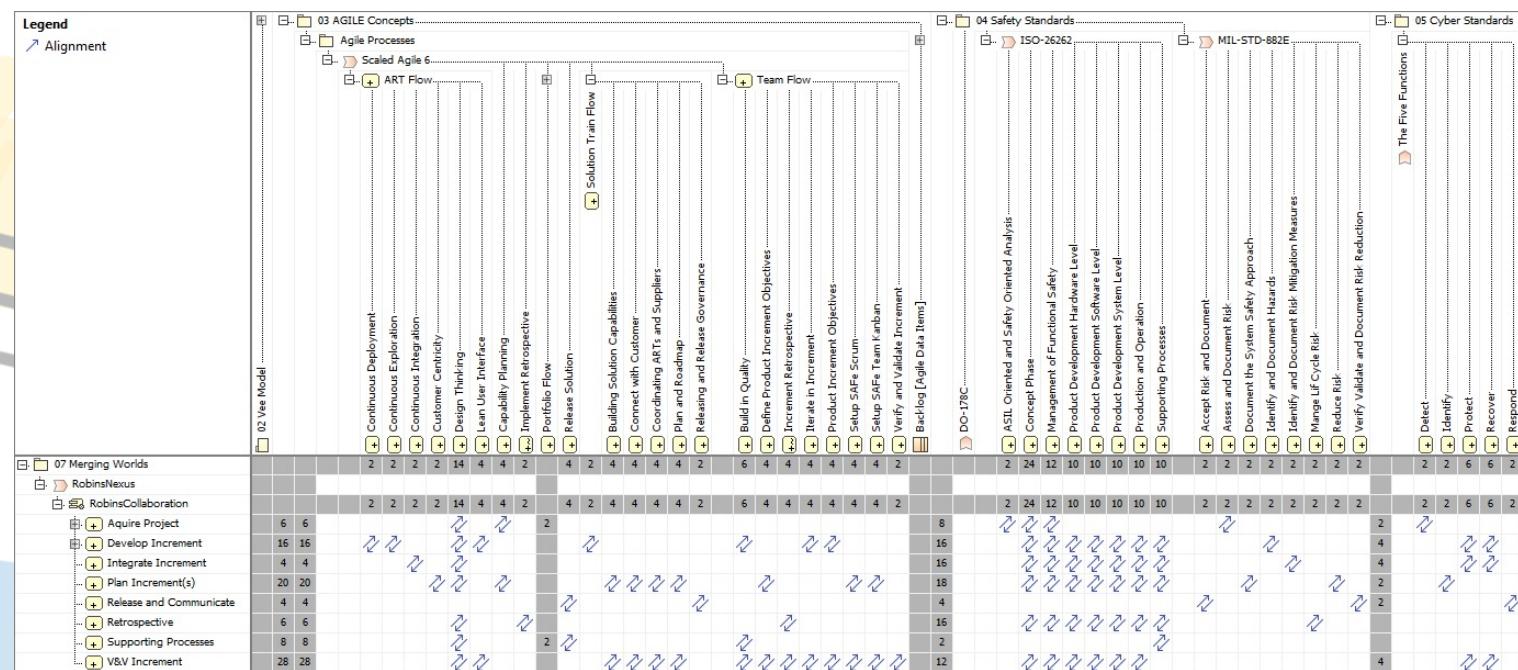
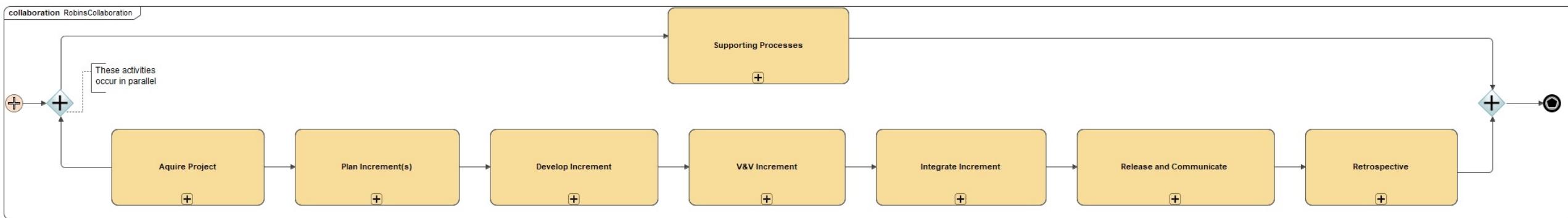


# Comparing Lifecycles



Similarities	Differences	Narrative
Both lifecycles can meet the process and evidence requirements and objectives.	Agile covers process areas in a workflow for a solution. Vee Model covers solutions by silo'd process areas.	Agile is collaborative across silos by definition of the team. Solutions are found together. Vee Model requires continuous hand offs between separated process areas relying on checkpoints or phase gates for integration while forcing silo'd structures and development.
Both could be benefited by the other.	Capability vs Process Focus. Wait Times, Lean Value Stream	Agile aligns all activities at the beginning and end of each increment and integration event. Vee Model aligns at phase gates which can be months apart.

# Robins Example Simplified Merged Lifecycle Model





Why is knowing this important?

## Conclusions

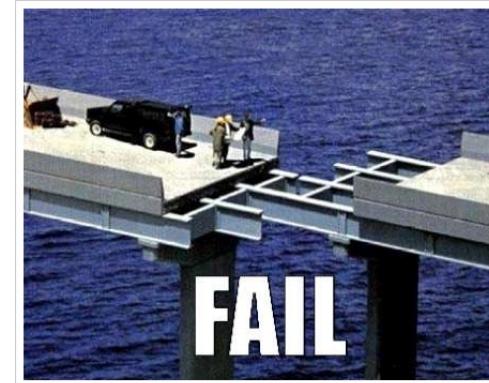
# Why?

Techniques for bringing these two worlds together and achieving both

- i. Project resilience
- ii. The high levels of quality and accountability required for safety-critical and similar systems.



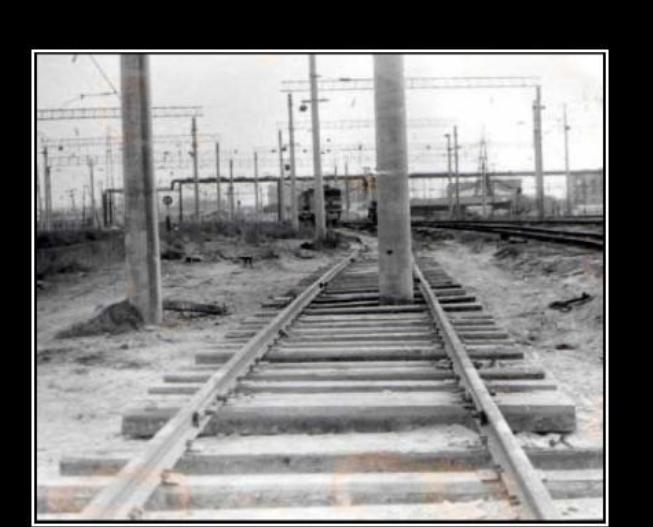
[https://www.reddit.com/r/ProgrammerHumor/comments/u5pyji/incoming\\_flood\\_of\\_merge\\_conflicts/](https://www.reddit.com/r/ProgrammerHumor/comments/u5pyji/incoming_flood_of_merge_conflicts/)



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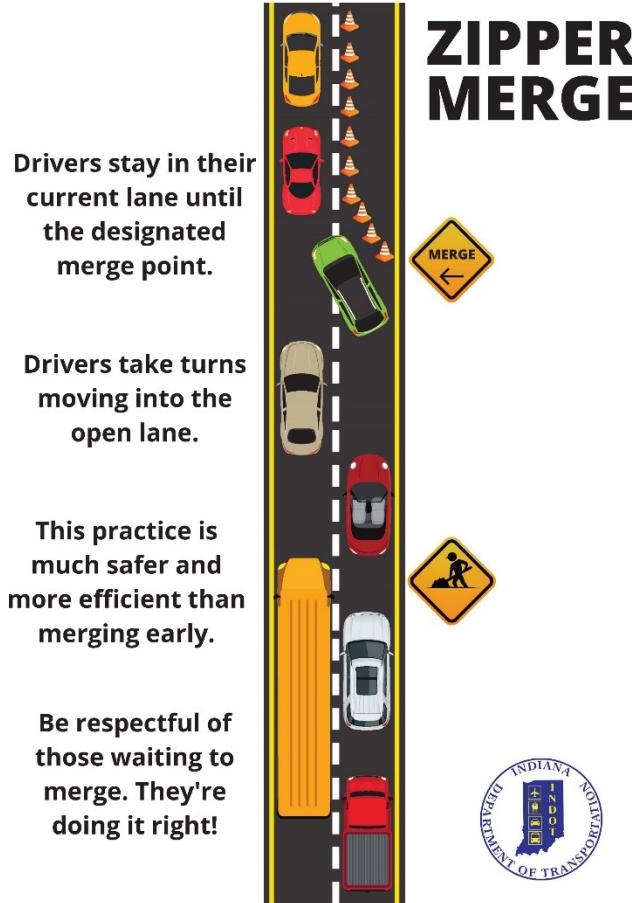
[www.incose.org/symp2023](http://www.incose.org/symp2023)



Still a good thing to do first.

VERY DEMOTIVATIONAL.com  
<https://cheezburger.com/3216448768/planning>

# Conclusions



## Key Values Achievable with Merging:

- Shared acceptance of goals, objectives and risks and the methods for tracking and sharing them.
- Focus on the process objective, capability and customer need instead of document and section number in the document tree.
- Know the dependencies and priorities for just in time development.
- Shared risk and resolution
- Reduced team member spool up
- Continuous and integrated improvement.

# Recommendations for Deployment to a project team.

1. Start by capturing your processes.
2. Take credit for existing good practices.
3. Create tasks for areas of improvement.
4. Ensure the tasks are in the project backlog
5. Plan them like any other backlog task for teams.
6. Collaborate and find solutions to problems together!
7. Share, accept, and mitigate all risks
8. Continuously Improve
9. Share Knowledge with Lessons Learned.

HOW LONG CAN YOU WORK ON MAKING A ROUTINE TASK MORE EFFICIENT BEFORE YOU'RE SPENDING MORE TIME THAN YOU SAVE?  
(ACROSS FIVE YEARS)

		HOW OFTEN YOU DO THE TASK					
		50/DAY	5/DAY	DAILY	WEEKLY	MONTHLY	YEARLY
HOW MUCH TIME YOU SHAVE OFF	1 SECOND	1 DAY	2 HOURS	30 MINUTES	4 MINUTES	1 MINUTE	5 SECONDS
	5 SECONDS	5 DAYS	12 HOURS	2 HOURS	21 MINUTES	5 MINUTES	25 SECONDS
	30 SECONDS	4 WEEKS	3 DAYS	12 HOURS	2 HOURS	30 MINUTES	2 MINUTES
	1 MINUTE	8 WEEKS	6 DAYS	1 DAY	4 HOURS	1 HOUR	5 MINUTES
	5 MINUTES	9 MONTHS	4 WEEKS	6 DAYS	21 HOURS	5 HOURS	25 MINUTES
	30 MINUTES	6 MONTHS	5 WEEKS	5 DAYS	1 DAY	2 HOURS	
	1 HOUR	10 MONTHS	2 MONTHS	10 DAYS	2 DAYS	5 HOURS	
	6 HOURS			2 MONTHS	2 WEEKS	1 DAY	
	1 DAY				8 WEEKS	5 DAYS	

<https://xkcd.com/1205/>

# How does merging increase resilience and accountability?

## Resilience

- *Coverage of the standards is clear and accessible.*
  - *The Why is clear, accepted, and accessible to everyone*
- *Teams have more ability to adapt*
  - *Teams build and improve the How you go.*
- *Collaboration focuses on solutions and not team structures.*
  - *Solutions that meet the needs of the user*
- *Forces teams to share data and tools dynamically and bidirectionally*
- All decisions and activities are collaborative and tracked in backlogs accessible and fully linked.

## Accountability

- Coverage is clear and only done one time
  - Infinite reuse, maintainability and adaptability as processes improve.
- Ability to track maturity over time as a solution.
- *Decision making is done with a broader view of the evidence for a solution not the individual pieces instead of a roll up of the pieces.*

# Tying it All Together



**Cat Eating  
Cheeseburger**

*Seat-of-the-  
Pants Agile is  
for You!*

What Kind of Software  
are You Developing?

**Brake by Wire SW**

**Vee Alone is too  
Slow**

**Sweat the  
Details**

**Source Code Only  
Agile Won't Work**

**Holistic  
Merged  
Process**

**Dynamic Risk  
Management**

- 3-5 week sprints aligned with project phase gates
- Vee is filled in as a mosaic, not a linear sequential slog
- Holistic project backlog management. Work on items that immediately reduce program risk.

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Thank you!



<https://media.giphy.com/media/I0lyjeA5mmMZjhyPm/giphy.gif>

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international symposium

hybrid event

Honolulu HI USA



<https://media.giphy.com/media/P6q7wQz0wlcj6Nhzhd/giphy.gif>