



Agile Planning and Technical Reviews for Systems Engineering

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About the Collaborators



Gordon Kranz

Mr. Kranz is President of Enlightened IPM, a consulting firm providing Government agencies and contractors advice and guidance on performing disciplined integrated program management, with focus on managing programs using Agile methods.

- Mr. Kranz was a Senior Executive in the Department of Defense and served as Deputy Director PARCA for Earned Value Management, the Executive Director, Engineering and Analysis, for the Defense Contract Management Agency, and the Director of Systems and Software Engineering for OSD/AT&L.
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Sundar Thyagarajan

Sundar Thyagarajan is a Sr. Scientist, Systems Engineering with L3Harris. He has over 30 years of Software and Systems Engineering experience in both commercial and defense related organizations. Sundar has over 15 years leading Systems Engineering activities on various DoD and USG programs. Sundar is actively involved in promoting Agile practices in Systems Engineering through his association with NDIA and INCOSE. His other interests are in Model Based Systems Engineering and Digital Engineering. He holds an MBA in Entrepreneurship and a Masters degree in engineering.

Sundar can be contacted at Sundar.Thyagarajan@L3Harris.com



Paul Zajac

Paul Zajac is Technical Fellow with Lockheed Martin where he provides technical guidance and direction to create modern, efficient agile organizations.

- Paul has over 30 years of professional experience including leading technology development as the Chief Technology Officer for the Augustine Institute where he built the teams that grew the FORMED platform, a Catholic, faith-based media sharing platform from 150,000 to 850,000 users during Paul’s tenure as CTO, becoming the premier Catholic faith formation platform.
- Paul also served as the Chief Technology Officer for InfoFUSION, a Professional Services Software firm with a specialty in geospatial engineering and custom software development. Paul can be contacted at paul.m.Zajac@lmco.com

Outline SE and Agile Integration – Planning



- **Simplified Scenario**
- **Problem Statement**
- **Up Front Planning Alternatives**
- **Technical Design Review**
- **Call to Action**

Automobile Safety Capability + Features – An Example

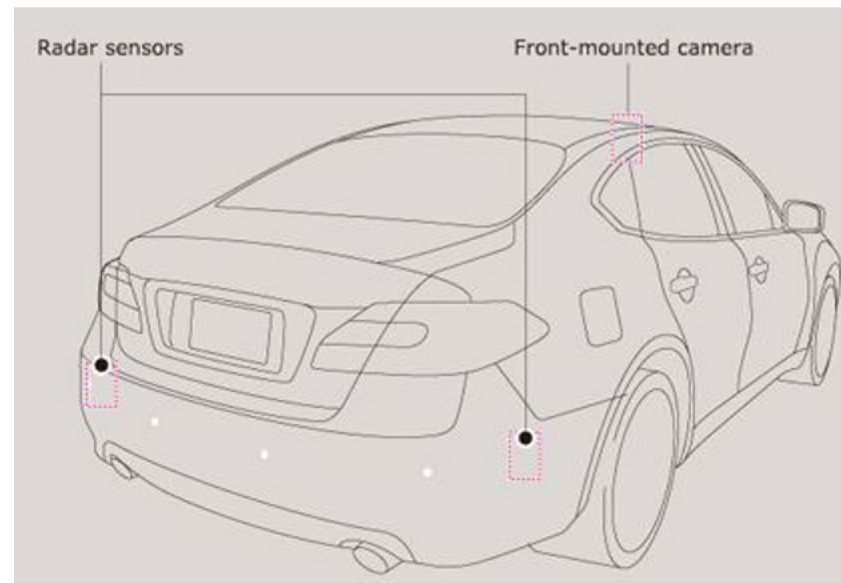
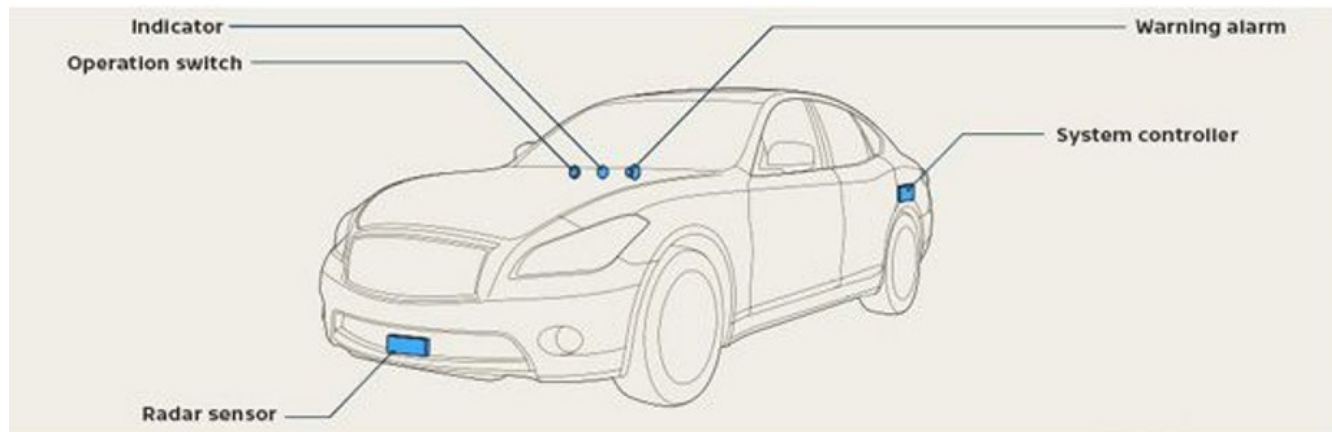
This **capability** of the automobile provides safety for the occupants, the automobile and others outside the automobile. This is provided by the entire list of features



Safety features of an automobile :

- Electronic stability control
- Rear view backup camera
- Blind spot detection
- Pedestrian detection
- Forward collision warning
- Rear cross-traffic alert
- Lane-departure warning
- Lane keep assist
- Active head restraints
- Automatic high beams
- Parking assist systems

Definitions of Capability and Feature come from the NDIA Agile and EVM Handbook



4 **Most features use many types of sensors and cameras**

Background

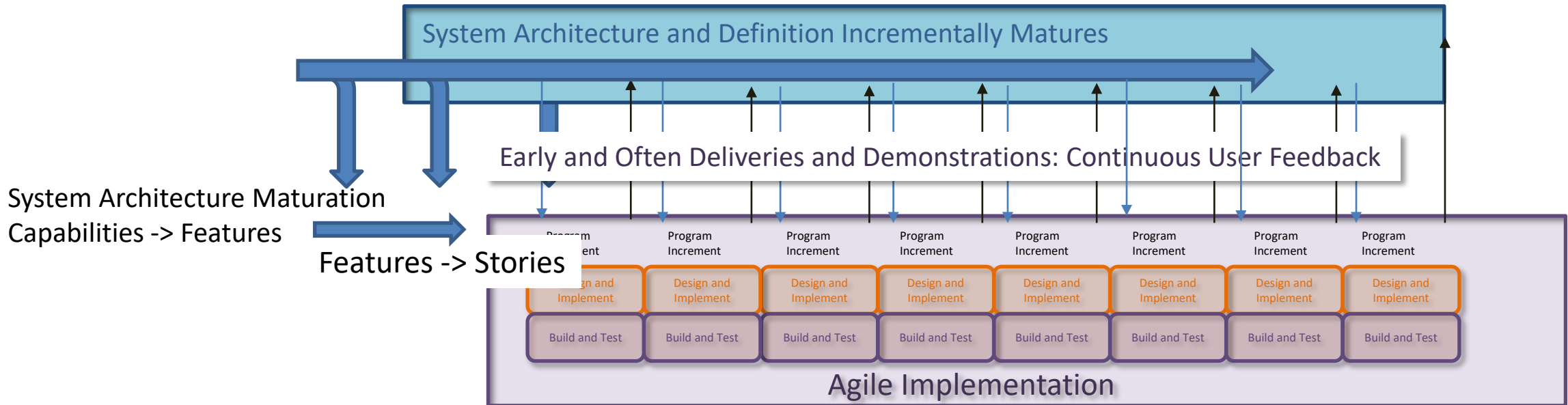


- **Agile Planning for Systems Engineering Working Group**
 - NDIA Integrated Program Management Division Working Group
 - **Goal: Collaboratively Develop White Paper (Lessons Learned / Best Practices)**
- **Currently Engaged with**
 - NDIA ADAPT
 - NDIA SE Architecture
 - OMG Model Based Systems Engineering

Agile Planning For SE Problem Concept Diagram



How much upfront planning and SE work is required to feed the Agile development teams and what level of maturity should be expected in the planning artifacts?



How do the traditional technical reviews change when using agile development methods?

ASR SRR SFR PDR CDR TRR SVR/ FCA PRR PCA



AGILE AND SE UPFRONT PLANNING

Agile Planning For Systems Engineering Questions?



- **How much technical description is enough to start implementation?**
 - System Architecture
 - Capabilities (Representing the end system behaviors are needed – Typically not fungible)
 - Minimum Viable Product (MVP) (Defined as the initial starting point from which user feedback can be obtained)
- **What is needed as part of the initial planning to begin the Agile implementation (Sprinting)**
 - Product Roadmap
 - Program Set Up – Organization, Work Breakdown Structure, Performance Measures
 - Cost, Schedule, Technical Reporting Hierarchy

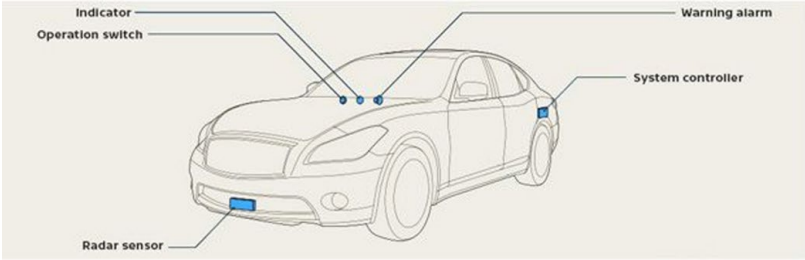
Upfront Planning and Systems Engineering

Capabilities – Non – Fungible (Derived from User Needs)

- The driver wants to avoid collisions while operating the vehicle
- The passengers want to have infotainment options while traveling that do not distract the driver.
- etc

System Architecture

- Physical Architecture – Computing elements and interfaces.
- Consider external factors that could significantly impact implementation.



Central Computer, Smart Sensors, Smart Display, etc
Interfaces: Ethernet, CAN bus, Wireless (Bluetooth, WiFi)

Full list of safety features of an automobile (Final Product Requirements):

- Electronic stability control
- Rear view backup camera
- Blind spot detection
- Pedestrian detection
- Forward collision warning
- Rear cross-traffic alert
- Lane-departure warning
- Lane keep assist
- Active head restraints
- Automatic high beams
- Parking assist systems



Minimum Viable Product

- Rearview backup camera
- Blindspot detection
- Pedestrian detection
- Forward collision warning
- Rear cross-traffic alert

Order of feature completion - Planning

1. Rearview backup camera
2. Rear cross-traffic alert (dependent on 1)
3. Blindspot detection
4. Forward collision warning
5. Pedestrian detection (dependent on 4)

Minimum Viable Product

- Enough to allow for user feedback, not intended as an end-state.
- Prioritized set of Features

Program Set-Up / Reporting



Product 

Capabilities and Features	Product Oriented WBS								
	Displays		Central Computer	Cameras		Sensors			
	Driver	Passenger		Rear	Other	Cross Rear	Right	Left	Forward
Safety									
- S1 Rearview Backup Camera	X		X	X					
- S2 Rear Cross-traffic alert	X		X			X			
- S3 Blindspot Detection	X		X				X	X	
- S4 Forward Coollision Warning	X		X						X
- S5 Pedestrian Detection	X		X						X
Infotainment		X	X						

Government Customers are going to want cost and schedule reporting against both Product and Capability Progress

 Capability/Feature

Capabilities and Features	Product Oriented WBS								
	Displays		Central Computer	Cameras		Sensors			
	Driver	Passenger		Rear	Other	Cross Rear	Right	Left	Forward
Safety									
- S1 Rearview Backup Camera	X		X		X				
- S2 Rear Cross-traffic alert	X		X			X			
- S3 Blindspot Detection	X		X				X	X	
- S4 Forward Coollision Warning	X		X						X
- S5 Pedestrian Detection	X		X						X
Infotainment		X	X						



Section Header

AGILE TECHNICAL REVIEWS

Agile Technical Reviews – Problem Statement



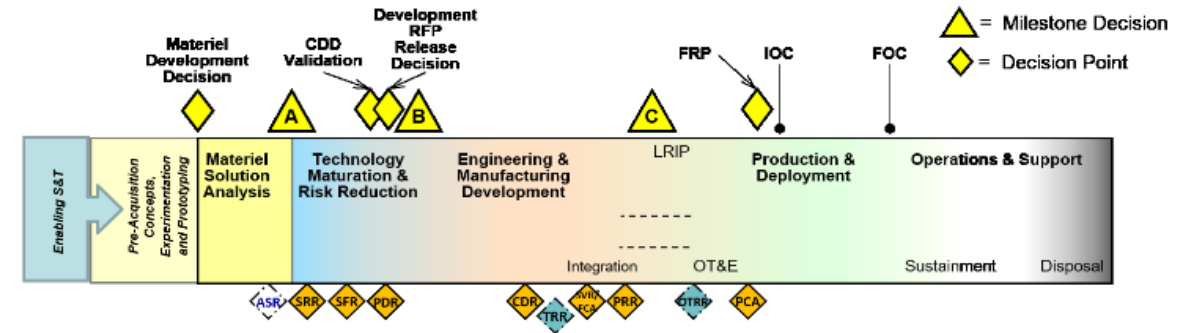
DoD recommends a properly tailored series of technical reviews and audits at key points throughout system development to evaluate significant achievements and progress. As shown in figure, events are held for risk reduction.

How do the traditional technical reviews change when using agile development methods?

This work is suggesting an improved Agile manner to conduct these reviews. Performing these assessments incrementally and iteratively with smaller deliverables will provide for earlier feedback and risk assessment.

Performing Agile mini reviews shall provide an improved value for the DoD customer.

GAO observed a correlation between programs that obtained certain knowledge at key points and better cost and schedule outcomes.



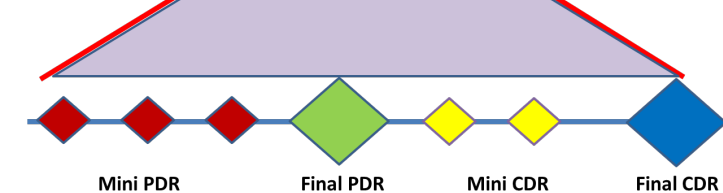
ASR - Alternative Systems Review	PCAR - Physical Configuration Audit	Mandatory technical reviews Best practice technical reviews and audits Test reviews (see T&E Guidance)
CDR - Critical Design Review	PDR - Preliminary Design Review	
FCA - Functional Configuration Audit	PRR - Production Readiness Review	
FOC - Full Operational Capability	SFR - System Functional Review	
FRP - Full-Rate Production	SRR - System Requirements Review	
IOC - Initial Operational Capability	SVR - System Verification Review	
OTRR - Operational Test Readiness Review	TRR - Test Readiness Review	

Traditional Reviews per IEEE 15288

- ASR - Alternative System Requirements
- SRR - System Requirements Review
- SFR - System Functional Review
- PDR - Preliminary Design Review
- CDR - Critical Design Review
- TRR - Test Readiness Review
- SVR - System Verification Review
- FCA - Functional Configuration Audit
- PRR - Production Readiness Review
- PCA - Physical Configuration Audit



Agile Reviews – Incremental



Conduct reviews at shorter intervals

Automobile Safety Features – Full List and MVP



Full list of safety features of an automobile (Final Product Requirements):

- Electronic stability control
- Rear view backup camera
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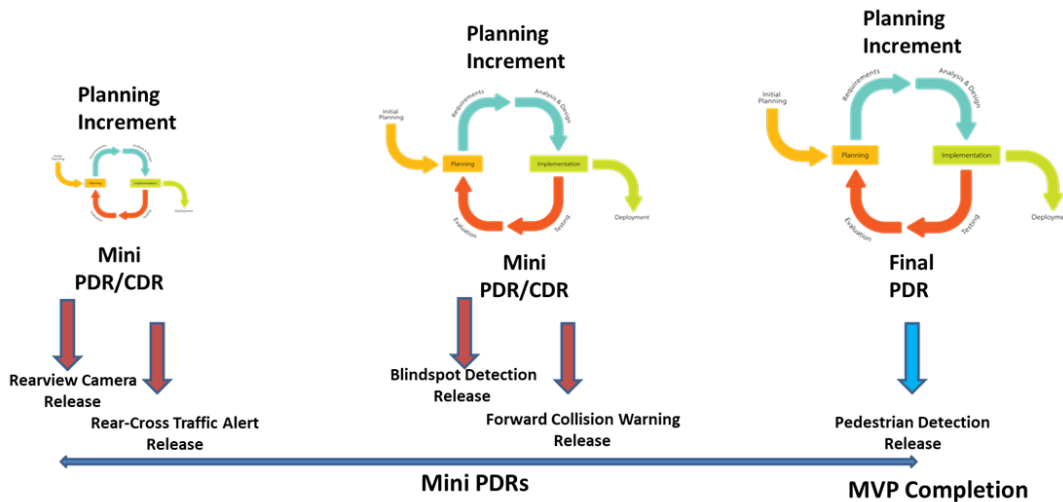
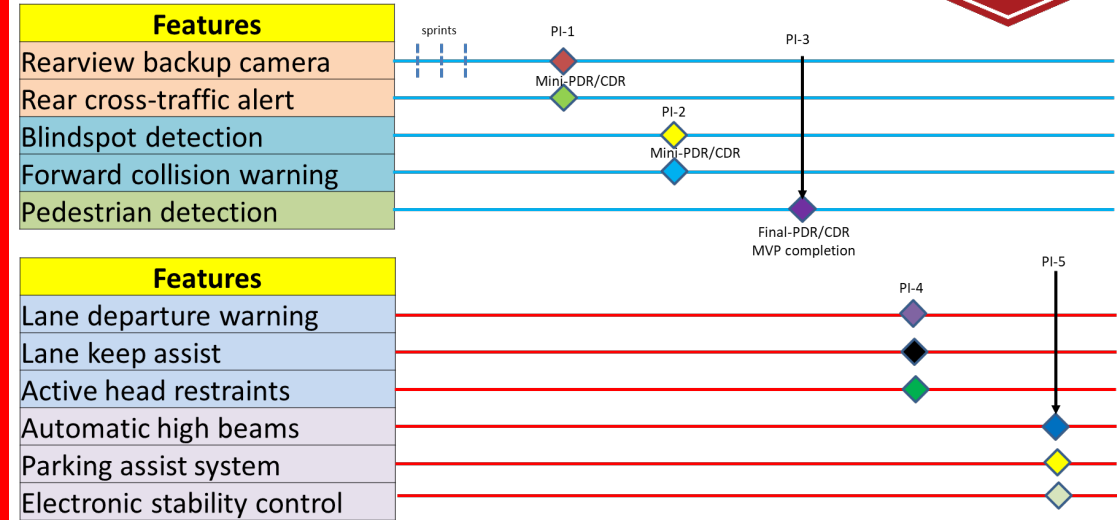


Minimum Viable Product

- Rearview backup camera
- Blindspot detection
- Pedestrian detection
- Forward collision warning
- Rear cross-traffic alert

Order of feature completion - Planning

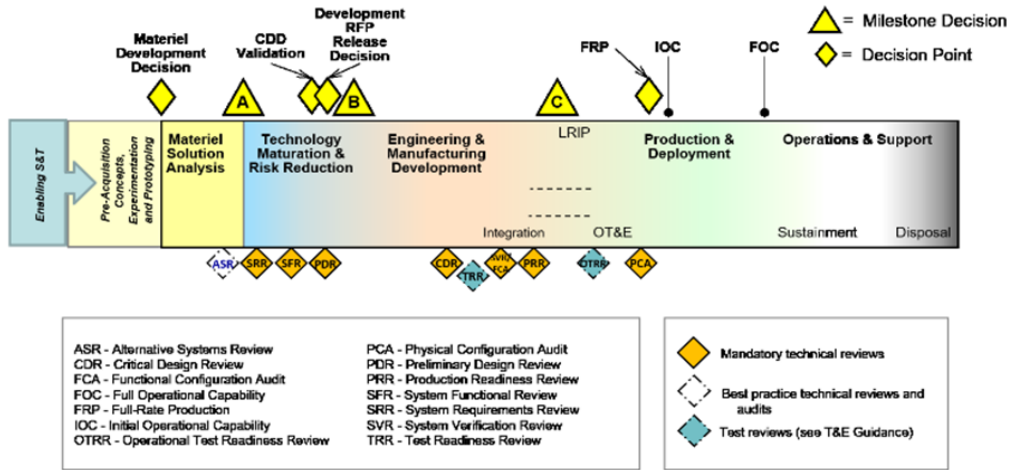
- Rearview backup camera
- Rear cross-traffic alert (dependent on 1)
- Blindspot detection
- Forward collision warning
- Pedestrian detection (dependent on 4)



- ❑ MVP is agreed with the customer
- ❑ Early planning with customer establishes the number of PI to complete MVP
- ❑ Each PI performs a mini-PDR/CDR to review requirements traceability, models and analyses
- ❑ Formal completion checklists reviewed along with ceremonies and demonstrations

Complete planned features and conduct milestone reviews incrementally

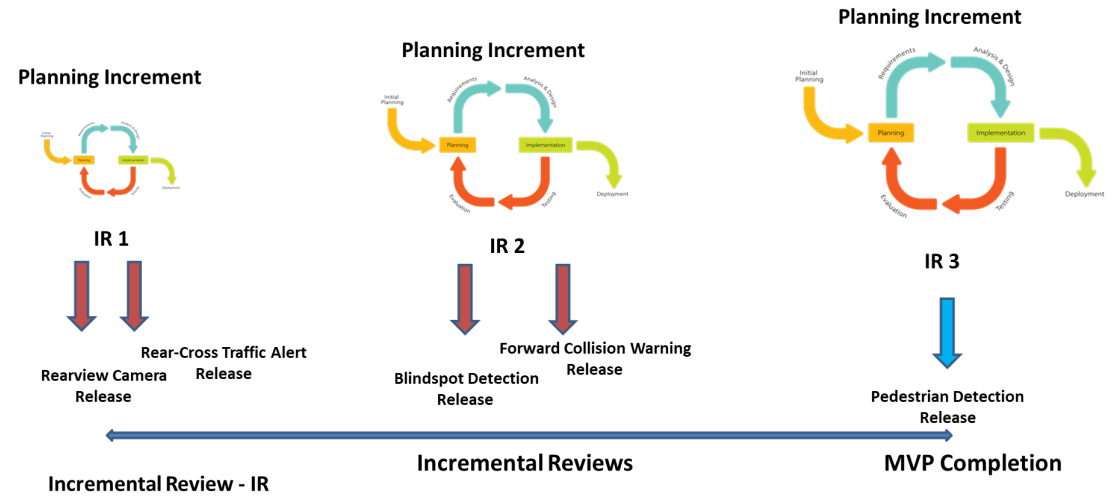
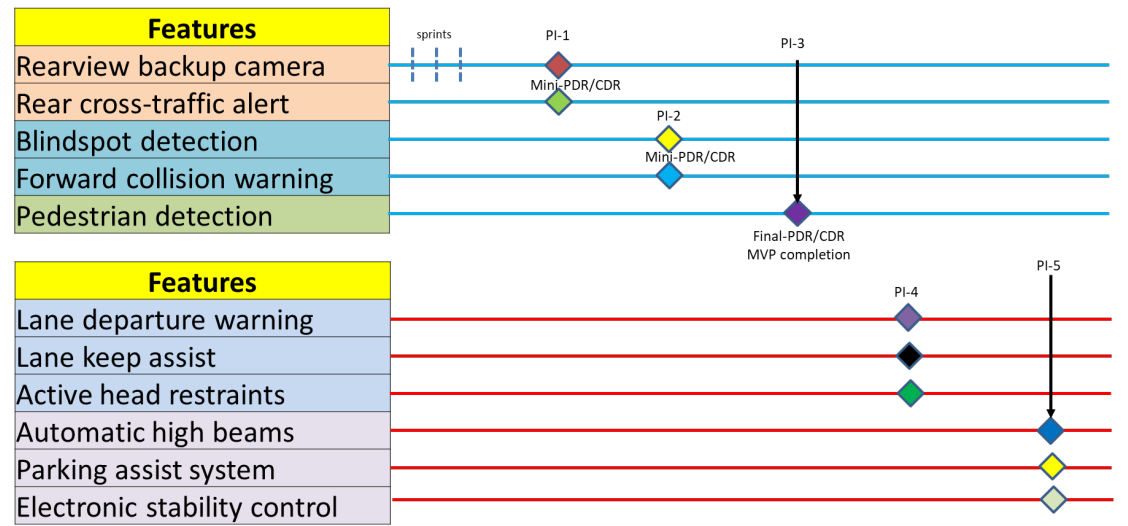
Present, Proposed and Future State of Milestone Reviews



Contracts require milestone reviews at specific points in timeline



- ❑ Weapon Systems contracts modified to accommodate incremental and iterative milestone reviews
- ❑ Plan with customer the PI and the content of each PI towards a formal completion of reviews
- ❑ Combine PDR and CDR milestone reviews into a set of timely incremental and iterative audit reviews performed at PI



Propose incremental and iterative Agile milestone reviews

Where do we see industry going from here?

- **Moving from “One and Done” to “Incremental and Iterative”**
 - Stream the product into the field rather than bulk-shipments
- **Moving from Reviews to Demonstrations**
- **Ability to roundtrip from Requirements to Demonstrations (Tests and Verifications)**
- **Ability to round-trip from Design to Implementation (and vice-versa)**
- **Cross functional, problem solving teams.**

