Example Cyber-Physical Agile Implementation White Paper

Paul Zajac, Lockheed Martin

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About the Speaker

Paul Zajac

Paul Zajac is a Technical Fellow with Lockheed Martin Space and has an extensive background in technical and modern Agile and DevSecOps methodologies for both software and hardware systems. Paul provides technical guidance and direction to the core Lockheed Martin team that helps the company's -programs meet the government's need for creating 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. During his tenure as CTO, Paul he built the teams that grew the FORMED platform, a Catholic, faith-based media sharing platform, from 150,000 to 850,000 users, making it 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

Where credit is due – colleagues in this effort

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.

- Prior to his retirement, 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.
- Mr. Kranz has more than 35 years of technical and program management defense acquisition experience managing complex weapon systems including 10 years as an USAF acquisition program manager, 18 years in private industry as a systems engineer lead and program manager, and 7 years as an SES in the Pentagon. gmkranz@eipm-llc.com

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 ranging from US Army Tactical radios, USAF program, FAA' FTI. Along with leading and mentoring Systems Engineers on major programs, he is also 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**

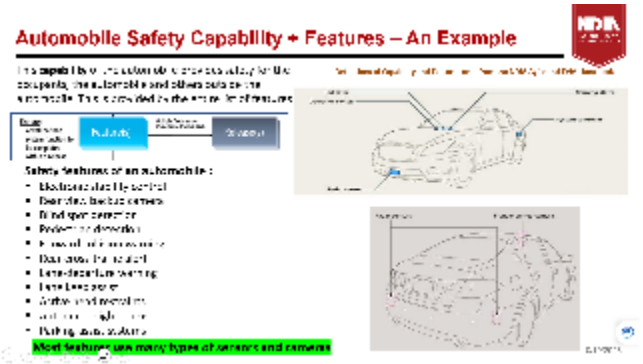
Outline SE and Agile Integration – Planning

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

SAMPLE PROBLEM - ADAS

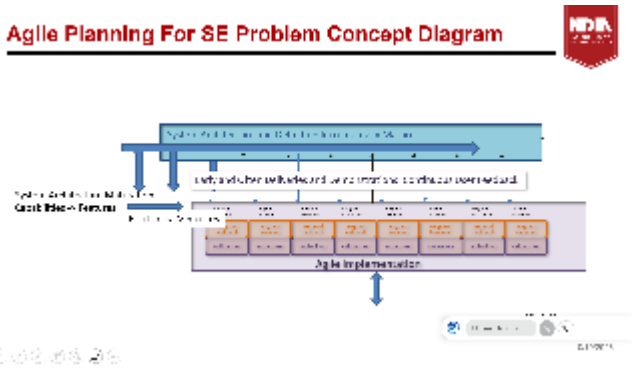
- **ADAS = Advanced Driver Awareness System**
- **Abstract – A product that can be used to upgrade existing cars to integrate sensors and value to a user.**
- **4 different jobs**
  - Safety
  - Infotainment
  - Convenience
  - User Feedback
- **But which job is the most important?**

2021 Ford Mustang Mach-E SYNC 4 / Photo Credit: Ford



ESSENTIAL CAPABILITIES AND BUSINESS VALUE (OKR)

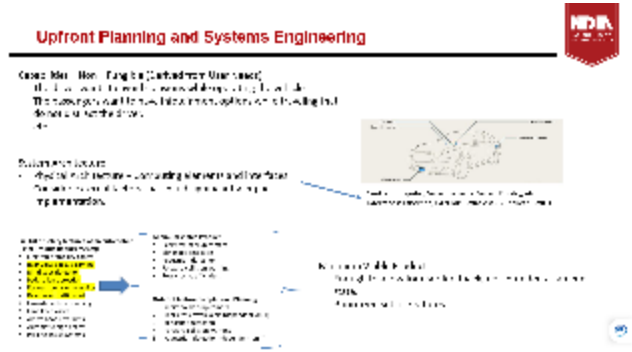
- **Enhanced Safety – Accidents per 1,000,000 Miles driven**
  - Rear view backup and collision avoidance
  - Side view awareness, lane keeping and collision avoidance
  - Front view safety and collision avoidance
- **In-Vehicle Infotainment – Hours Spent utilizing various functions, add-on subscription revenue**
  - Weather Updates
  - Traffic Alerts
  - Driving Directions
  - Smartphone Integration
  - Internet Access
  - Cellphone Mirror
- **User Feedback – Number of users opting into analytics collection, usage statistics per system function, speed of release.**
  - User Analytics
  - Over the Air Updates



PLANNING PHILOSOPHY / UPFRONT ARCHITECTURE

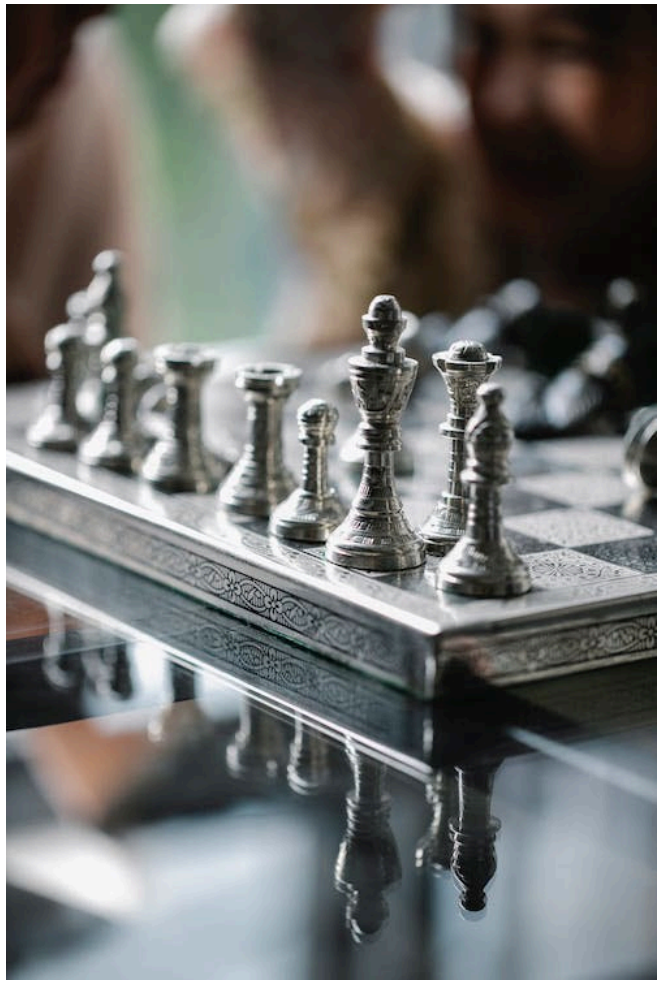
- **From Agile – Think Minimum Viable Product / Next Viable Product roadmap**
  - What is the simplest possible thing that I could build that will validate my product?
  - What data sources can I draw upon to help inform my decision?
  - How do I allow for the initial fielding of capability with an approach to evolutionary product design based on user feedback

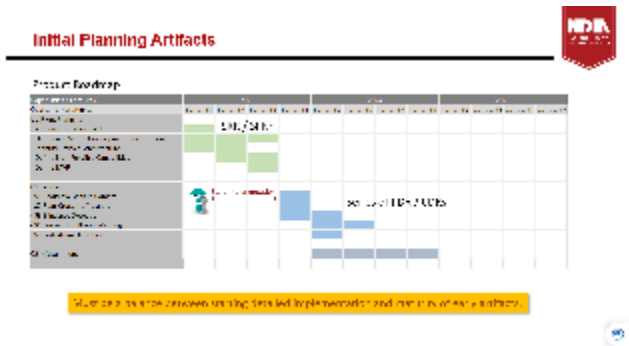
- **Initial Architectural Decisions**
  - CANBus (where it exists)
  - Bluetooth sensor integration (for aftermarket providers and for cell phone integration)
  - Simple Compute Infrastructure – leverage Open Source Tools and Operating System
  - Componentized product set – provide the customer with many (standards-based) options to integrate into the product
    - CANBus / ISO-11898 (https://blog.ansi.org/2017/02/controller-area-network-can-standards-iso-11898/#gref)
    - Bluetooth Core Specification v 5.4 (https://www.bluetooth.com/wp-content/uploads/2023/02/2301_5.4_Tech_Overview_FINAL.pdf)
    - Linux Standards Base – V5 (https://refspecs.linuxbase.org/lsb.shtml)
    - Etc.



OVERARCHING TECHNICAL DECISIONS AND RATIONALE

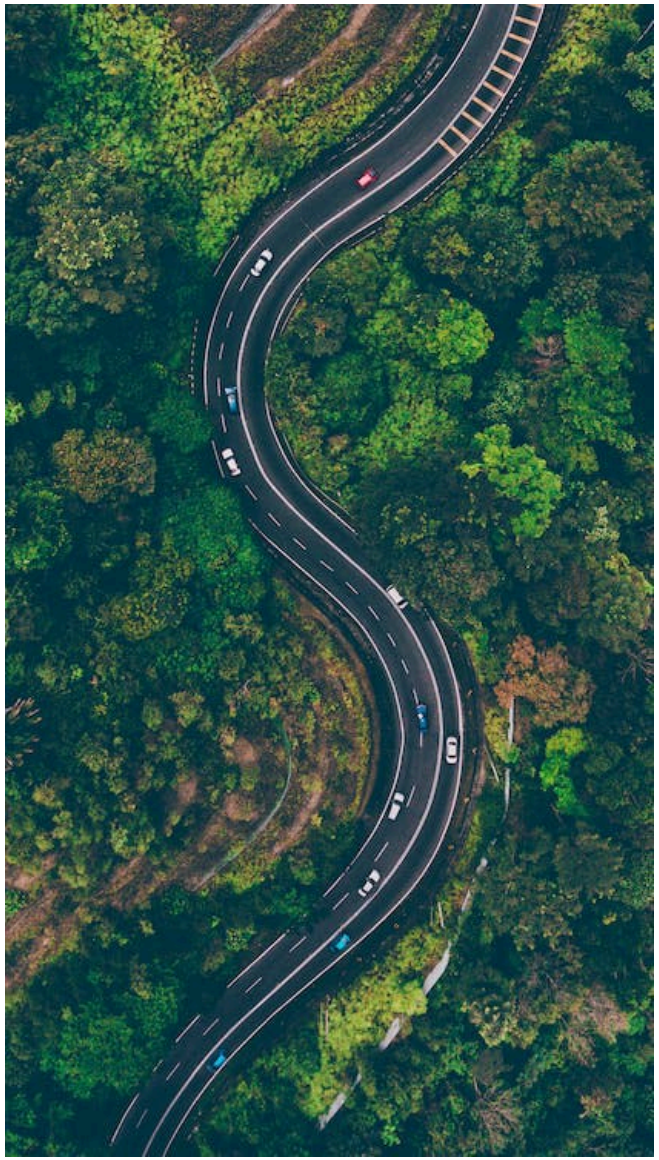
- **Hardware vs Software Functionality**
  - Speed and Cost of update
  - Value of the feature to the end-user
- **System Interface Design and Modularity**
  - Using Interfaces to increase team design freedom to allow for flexibility of design
- **Interface-First Design Approach**
  - System Decomposition and testing philosophy.
- **Technical Standards**
  - CANBus, SAEJ1128, TCP/IP, LTE/5g, Bluetooth, 802.11 x

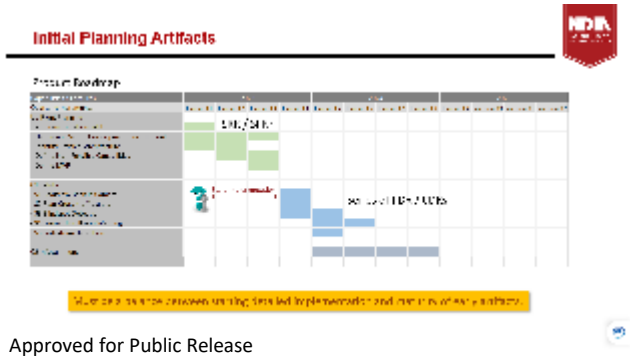




CREATION OF A PRODUCT ROADMAP

- Create a set of needed system features
- Describe features with rationale for feature, and success criteria
- Map Features to needed Hardware
- Assign Features to Business Value
- Identify key experiments that need to be conducted during product development in order to test for a good product-market fit.



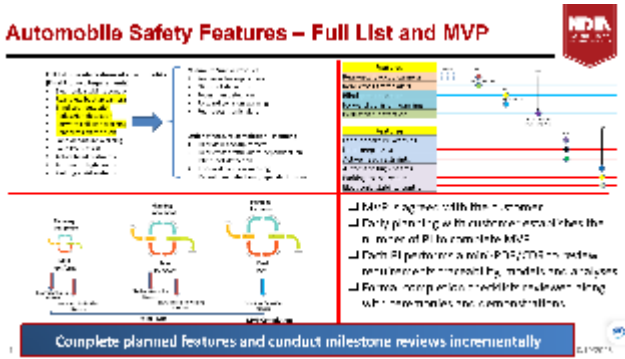


MVP

- **What do I want to learn?**
  - Which is more valuable to the user Safety or Convenience (Cell Phone Integration)?

- **Sensors**
  - Right Rear Radar
  - Left Rear Radar
  - Rear Camera
- **Comms**
  - Bluetooth
  - WiFi

- Compute Infrastructure
  - Computer
  - Display / Input
  - Audio Integration
- Software Features
  - Store and Forward User Analytics
  - Cell Phone Integration
  - Over the Air Updates
  - Rear Camera Sensor Integration
  - Rear Radar Sensor Integration

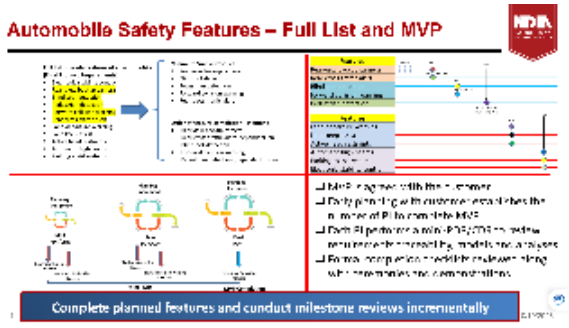


MVP TO NVP-1

- **What do I want to learn?**
  - These features are software centric and with the advent of MVP-1 can be delivered as soon as they are ready

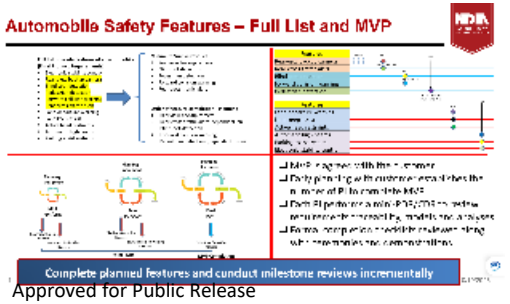
- **Sensors**
  - Right Rear Radar
  - Left Rear Radar
  - Rear Camera
- **Comms**
  - Bluetooth
  - WiFi

- Compute Infrastructure
  - Computer
  - Display / Input
  - Audio Integration
- Software Features
  - Store and Forward User Analytics
  - Cell Phone Integration
  - Over the Air Updates
  - Rear Camera Sensor Integration
  - Rear Radar Sensor Integration
  - Driving Directions
  - Traffic Alerts
  - Weather Alerts
  - Updated User Experience



NVP-1

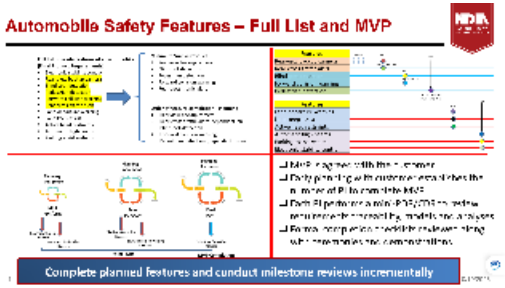
- **What is more important? Infotainment, Convenience or Safety?**
- **NOTE: Content can be adjusted based on what is learned from MVP Analytics.**
- **Sensors**
  - Left Camera
  - Right Camera
  - Right Rear Radar
  - Left Rear Radar
  - Rear Camera
- **Comms**
  - Bluetooth
  - 5g or LTE
  - WiFi
- **Actuators**
  - Where supported integrate with vehicle speed control via the CAN Bus



- Compute Infrastructure
  - Computer
  - Display / Input
  - Audio Integration
- Software Features
  - Store and Forward User Analytics
  - Cell Phone Integration
  - Over the Air Updates
  - Rear Camera Sensor Integration
  - Rear Radar Sensor Integration
  - Driving Directions
  - Traffic Alerts
  - Weather Alerts
  - Updated User Experience
  - Left Camera Sensor Integration
  - Right Camera Sensor Integration
  - Subscription Services (Spotify, iTunes et al)

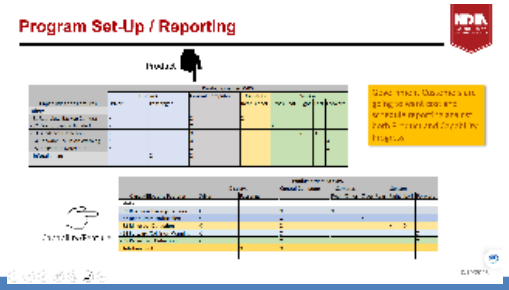
NVP-2

- **Sensors**
  - Forward Radar
  - Forward Camera
  - Left Camera
  - Right Camera
  - Right Rear Radar
  - Left Rear Radar
  - Rear Camera
- **Comms**
  - Bluetooth
  - 5g
  - WiFi
- **Actuators**
  - Where supported integrate with vehicle speed control via the CAN Bus



- Compute Infrastructure
  - Computer
  - Display / Input
  - Audio Integration
- Software Features
  - Forward Sensor Integration (by type)
  - Store and Forward User Analytics
  - Cell Phone Integration
  - Over the Air Updates
  - Rear Camera Sensor Integration
  - Rear Radar Sensor Integration
  - Driving Directions
  - Traffic Alerts
  - Weather Alerts
  - Updated User Experience
  - Left Camera Sensor Integration
  - Right Camera Sensor Integration
  - Subscription Services (Spotify, iTunes et al)

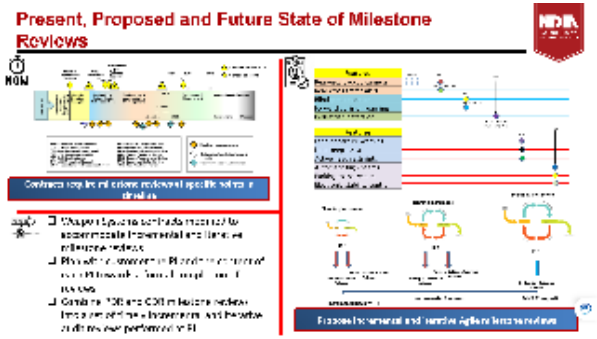
ORGANIZATIONAL STRUCTURE



Team	Interfaces	Skills
Infotainment Computer	Infotainment Display Communications Module Rear Camera Module	Electrical, Mechanical, Software, Test and Systems Engineering
Infotainment Display	Infotainment Computer	Vendor Management, Contracts Management, Supply chain, Electrical and Mechanical Engineering for harnessing and enclosure
Rear Camera	Infotainment Computer	Electrical, Mechanical, Software, Test and Systems Engineering
Communications Module	Infotainment Computer	Electrical, Mechanical, Software, Test and Systems Engineering
Harness	All Components	Electrical, Mechanical, Test and Systems Engineering
Leadership	Contracts, Finance	Sub-contracting, Architecture, Finance and Project Management
Manufacturing		Technicians, Machine operators and Assemblers.

CORE MANAGEMENT DECISIONS

- **Making Tradeoffs**
  - Just-in-Time Decision Loop
  - Time
  - Money
  - Technical Content
- **Clarity of Understanding**
  - Priority
  - Concurrency
  - Execution Order
- **Ensuring Value Delivery**
  - Integration Approach
  - Technical Reviews
  - Verification Approach



FUTURE FOR SYSTEMS ENGINEERING

- Movement from reviews to demonstrations
- Movement from Requirements to Tests
- Movement from Design to Implementation
- Necessity of Automated Testing
- Iterate / Experiment / Adapt / Learn

QUESTIONS & DISCUSSION