International Council on Systems Engineering
A better world through a systems approach

Accelerating MBSE Agile deployment for Next gen Automotive Architecture with gen AI based SysML v2

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Agenda

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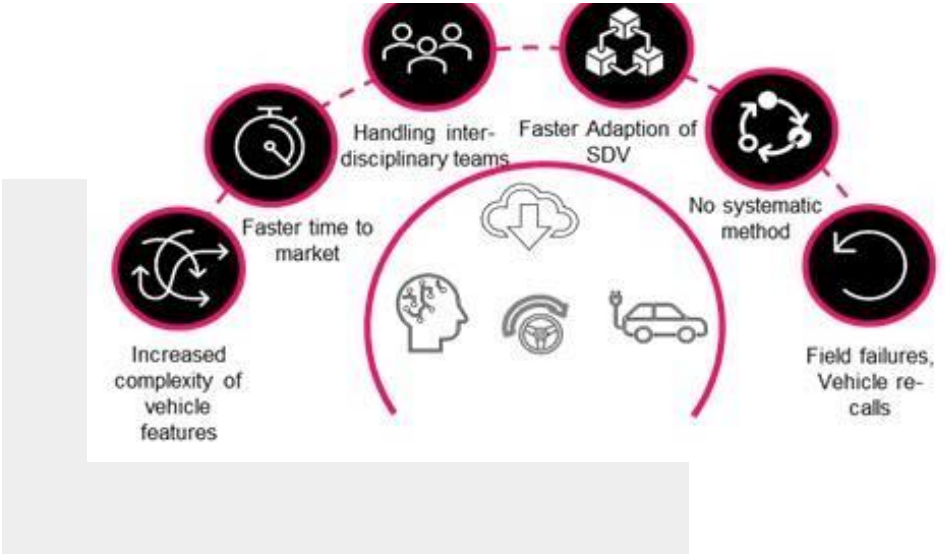
- Problem Description
  - Current Technology Scenario
  - System Engineering smoothens transformations!
- Solution inspiration
- Possible Solution
- Solution Benefits
- Comparative Analysis
- QnA

Current Technology Scenario

Technological Transformations are predominant in every walk of life!!

Automotive domain is no exception!

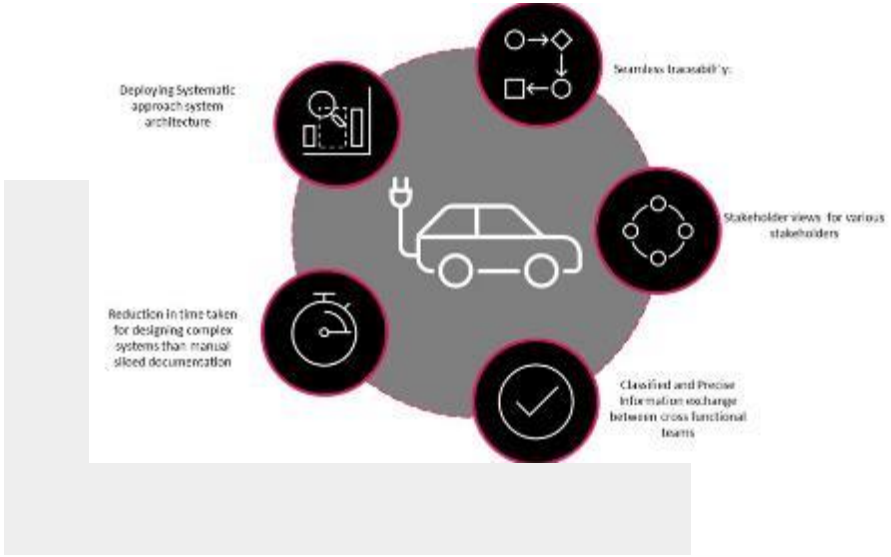


- Sustainability, Autonomous
- Best of customer experience
- Artificial Intelligence
- Connected & Data driven

Systems Engineering smoothens transformations!

Emerging complexity can be well-managed by adopting systems engineering best practices..

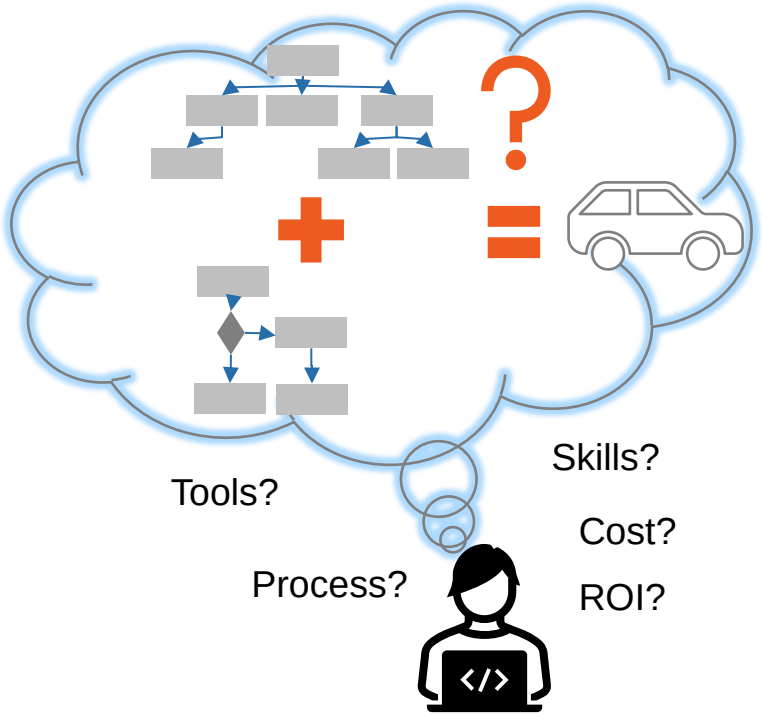
- Model Based Systems Engineering
- Enabling Cross functional Interactions
- Shift Left in lifecycle
- Optimizing development time
- Improving KPIs - quality and time to market



Solution inspiration

While Auto industry is convinced about benefits of MBSE however MBSE deployment still faces many challenges!

- Lack of skills
- Lengthy, inefficient process
- Tool dependency
- No seamless Tool integrations
- Question on ROI!



Solution

The proposed solution has following pillars

Gen AI

- With the advent of GenAI, the Gen AI model can be trained to analyze given inputs and come up with the required notation. (SysML V2 in this case)
- This saves time and effort in coming up with the SYsML diagrams from scratch

SysML V2

- Text based notation
- Equivalent to graphical notation
- Text nature is advantageous to generate automatically as well as to maintain pipeline in a work flow for system engineering activities

Agile practice through CI/CD

- SysML V2 model artifacts can be integrated in pipeline
- Accelerates the integration of systems engineering artifacts as input to software development lifecycle (SDLC)
- Enables collaborative, agile working environment

Solution Flow and outcome

The proposed solution has following high level flow

Input-Stakeholder Requirements

Lane Keeping Assistance

Feature: The system shall apply gentle steering inputs to keep the vehicle within its lane if it detects an unintended lane departure.

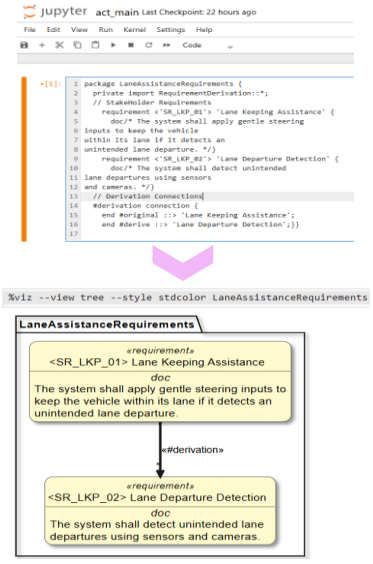
Gen-AI Prompt Inputs : Outputs

Generate a Stakeholder Requirement Table and Requirement diagram in SysML v2 textual notation for the Lane Keeping Assistance (LKA) feature.

SR_ID	SR_Name	SR_Description	Derived From
SR_LKP_01	Lane Keeping Assistance	The system shall apply gentle steering inputs to keep the vehicle within its lane if it detects an unintended lane departure.	*Root*
SR_LKP_02	Lane Departure Detection	The system shall detect unintended lane departures using sensors and cameras.	SR_LKP_01

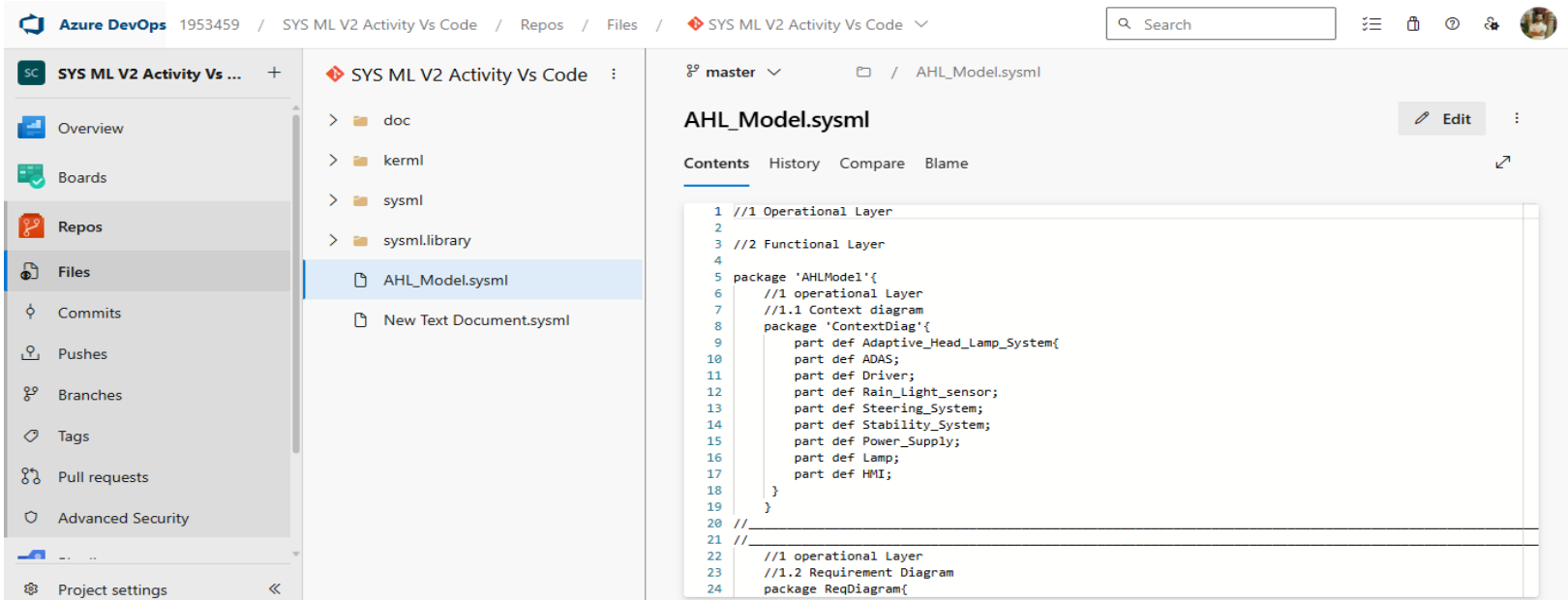
```
package LaneAssistanceRequirements {
  private import RequirementDerivation::*;
  // StakeHolder Requirements
    requirement <'SR_LKP_01'> 'Lane Keeping Assistance' {
      doc/* The system shall apply gentle steering inputs to keep the
vehicle within its lane if it detects an unintended lane departure. */}
    requirement <'SR_LKP_02'> 'Lane Departure Detection' {
      doc/* The system shall detect unintended lane departures using
sensors and cameras. */}
  // Derivation Connections
  #derivation connection {
    end #original ::> 'Lane Keeping Assistance';
    end #derive ::> 'Lane Departure Detection';}}
```

Jupyter Notebook-SysML Kernel : Outputs



Agile practice through CI/CD

The SysML V2 notation can be maintained and the complete model can be worked upon collaboratively



Solution Benefits

Below are direct benefits one will get with the solution that we have mentioned.





Improved quality and lesser rework

- Auto generation of SysML V2 notation can result in outputs which are compliant to rules
- Reduction in manual errors
- Review efforts lesser

No binding with costly tools

- SysML V2 being standardized interface, supported by multiple tools, no dependency on single tool
- Increased Flexibility on tool usage, bottleneck due to a particular tool eased out with alternate tools, for time and cost optimization

Time and Effort reduction

- Design time reduction due to shift left approach
- Reduction in manual efforts of drawing SysML diagrams
- Upskilling time for learning SysML V2 is lesser than a tool specific SysML graphical notation
- Faster delivery

Agile way of MBSE

- SysML V2 notations can be maintained in cloud based collaborative working platforms
- CI/CD platform helps in task planning, e.g. kanban board and to track the task and reviews

Effective return on investment

- Optimization of infrastructure cost is possible
- Improved quality and reduced rework
- Lesser upskilling efforts

Comparative Analysis

Deploying newer practices may have benefits over conventional way, based on some of the in progress POCs we initiated-

	Conventional way	Our solution
Time Required	At least 3 day a diagram, it increases based on increased complexity	1 day a diagram and as newer technique handles the complexity better, so no further increase in time if complexity increases
Tools Costings	SysML tool costs around 10-12K USD	GPU+LLM+Data+ PC cost ~ 5-6 K USD
Skills required	Continuous learning and tool experience required	Training time relatively lesser for text notation
Review time required	Manual review requires 1 day per diagram, for complex design, review time will increase	Manual review requires 1 day per diagram, review comments may be lesser
Quality of output	Human errors possible- grammatical , spelling , some time relation direction errors	Much less human error and errors can be detected easily with Gen Ai

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