

The background of the entire image is a vibrant nighttime cityscape. It features a mix of urban architecture, including a prominent power line tower on the left and various skyscrapers. Long-exposure light trails from vehicles create dynamic streaks of orange and yellow across the lower right. Overlaid on the scene are futuristic digital elements: glowing blue lines, circular patterns, and a triangular warning sign with a car icon, suggesting a theme of smart infrastructure and technology.

# **Realize** **LIVE**

GREATER CHINA

**SIEMENS**  
*Ingenuity for life*





**SIEMENS**  
*Ingenuity for life*

**Realize**  
**LIVE**  
GREATER CHINA

**The E/E Centric Design Flow – Russ Swanson, AP IES Director**  
以 E/E 为中心的设计流程

# Motivation

## 动机

# Industry Challenged by Disruption

## 行业面临颠覆性挑战



### Electrification

**200+ by 2022**

electric / hybrid models  
+Emerging Start-ups



Source: McKinsey

### Autonomous

**\$21m by 2035**

annual sales of  
autonomous vehicles



Source: IHS

### Connected

### Shared Services

**\$6b by 2030**

forecasted ride share  
passenger miles



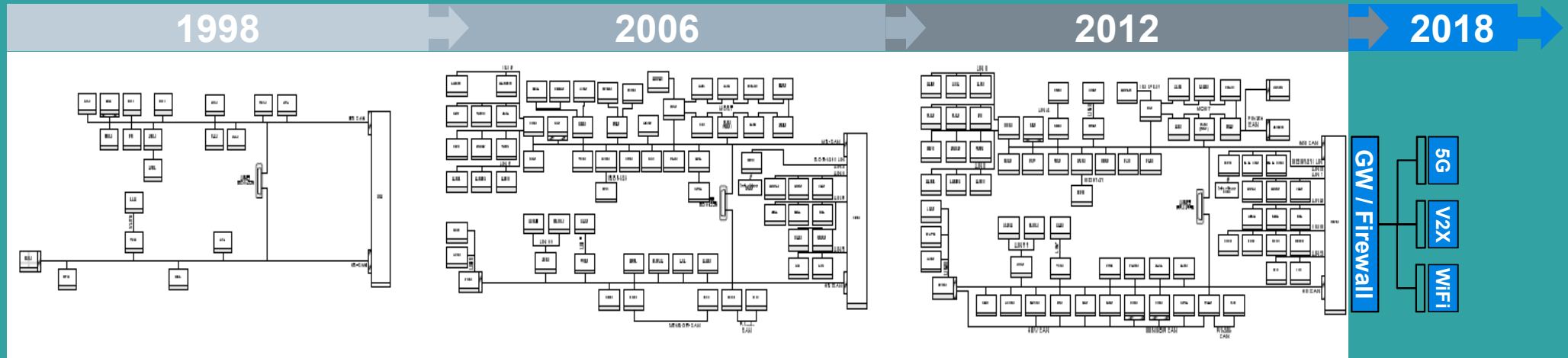
Source: ReThinkX

Companies need to innovate more than ever creating new business models and services throughout the eco system

# Automotive Industry Challenges / 汽车行业挑战

## Architecture Evolution – In-Vehicle Communication Networks

### 架构演进 – 车载通信网络



- Architecture mostly developed for specific car models – not scalable and reusable
- High Bandwidth needs drive Ethernet Adoption
- Software download too long for production and service
- Software with complex dependencies – everything is connected to everything else
- Electrical power consumption is at its physical limit for 12 V → 48V

Source: Designed around You - Volvo's all new EE Architecture and Development Process

Dr. Thomas M. Müller, Vice President, Electrical & Electronic Systems Engineering, Volvo Car Group

Automobil Elektronik Kongress, July 2013, Ludwigsburg Germany

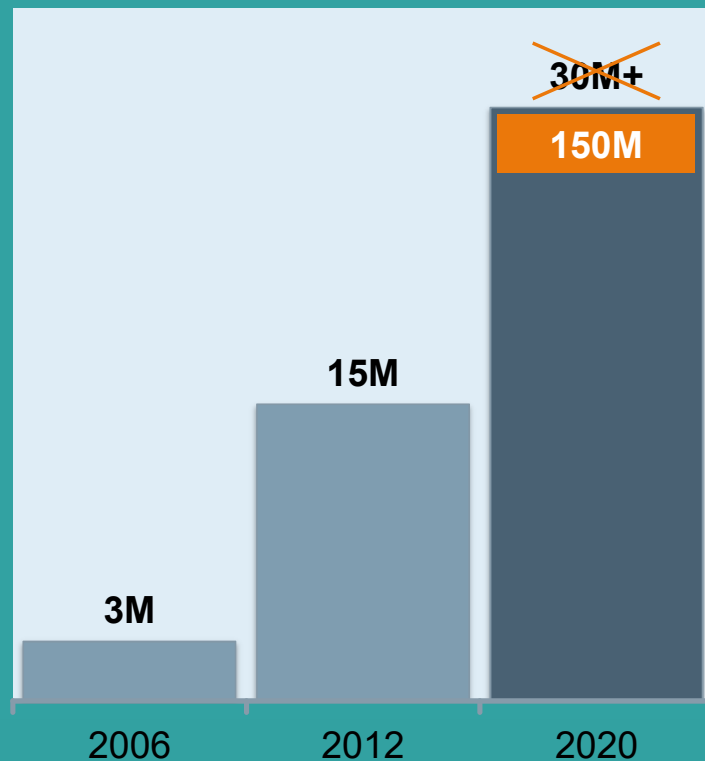
# Automotive Industry Challenges / 汽车行业挑战

## Architecture Evolution – Software & Network Metrics

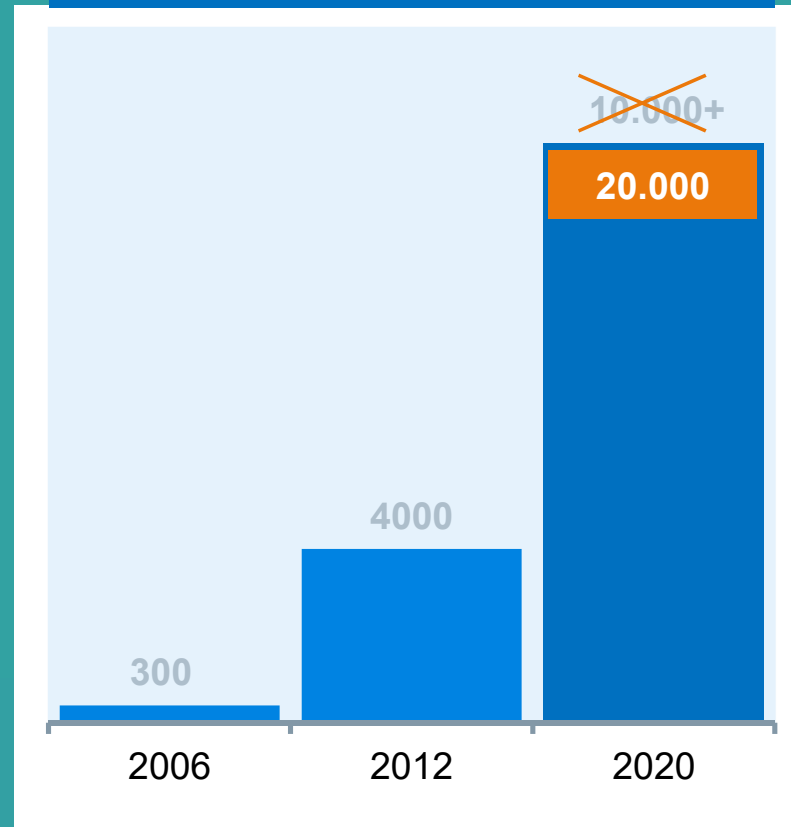
### 架构演进 – 软件和网络指标



Number of Software Lines Of Code



Number of Network Signals



Source: 2014 Deutsche Bank Global Auto Industry Conference (January 14, 2014)



# Autonomous & Electrical Increases Complexity

## 汽车和电气系统提高复杂度

Model Based Engineering is Central to Successful Outcomes

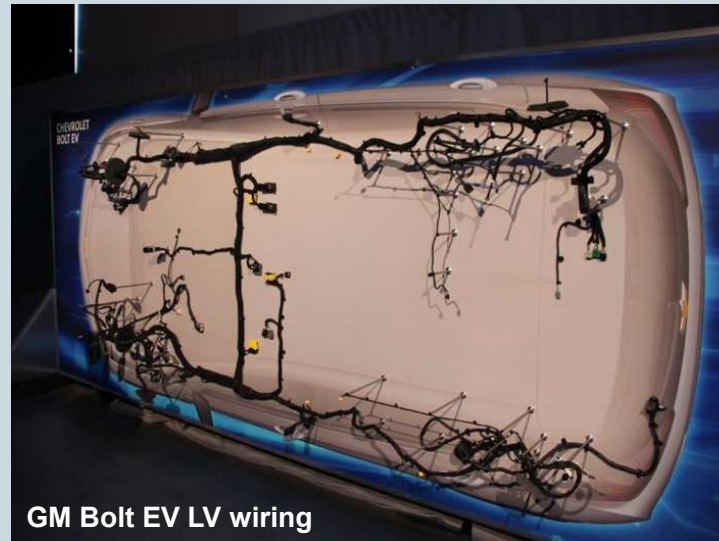
基于模型的工程设计对产品取得成功至关重要



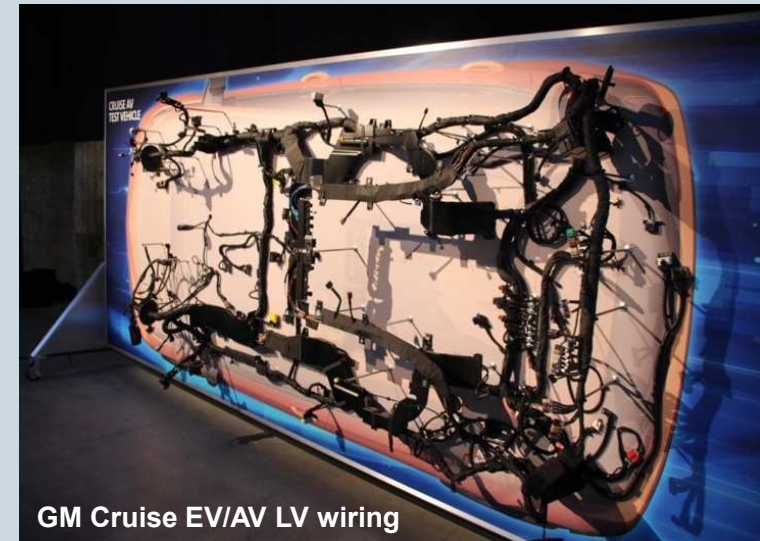
### Explosion of Hardware Interconnect

#### & Data Rates

- New Architectures
- >30 new sensors
- 40% more hardware
- No extra space
- Safety & Security
- Mega to Gigabits
- Power demands

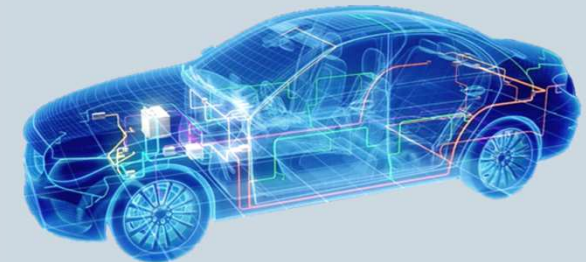


GM Bolt EV LV wiring



GM Cruise EV/AV LV wiring

**Model based system engineering**  
required to understand and address system  
relationships and to optimize packaging



# Industry Challenged by Disruption

行业面临颠覆性挑战

Technical, process, organizational, ownership...

技术、流程、组织、所有权...



**Electrification**

**Autonomous**

**New Entrants**

**Shared &  
Connected**



# Industry Challenged by Disruption

行业面临颠覆性挑战

Technical & Business Goals

技术和业务目标



Manage Power  
Optimize Range  
Optimize Weight  
Manage EMI

Fail Operational  
Functional Safety  
Optimize Weight  
Manage Complexity

Rapid Start-up  
Efficient Design  
Effectual Design  
Small Team

Always on  
Extendable  
Data Safety  
Data Security

**Electrification**

**Autonomous**

**New Entrants**

**Shared &  
Connected**

# Industry Challenged by Disruption

行业面临颠覆性挑战

Technical Implementation, Method & Tools

技术实施、方法和工具



Generative Design  
Holistic E/E Design  
Behaviour & Controls  
Thermal Simulation  
Electrical Simulation  
System V&V

Generative Design  
Holistic E/E Design  
Behaviour & Controls  
Evidence, FMEA, FTA  
System Simulation  
System V&V

Generative Design  
Holistic E/E Design  
Lightening Change  
Fool proof Process  
Collaboration  
Multi-domain metrics

Generative Design  
Holistic E/E Design  
Behaviour & Controls  
Firewall Configuration  
New Networks  
Diagnose/update via IP

Manage Power  
Optimize Range  
Optimize Weight  
Manage EMI

Fail Operational  
Functional Safety  
Optimize Weight  
Manage Complexity

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# Industry Challenged by Disruption

行业面临颠覆性挑战

Technical Implementation, Method & Tools

技术实施、方法和工具



**Generative Design**  
**Holistic E/E Design**  
Behaviour & Controls  
Thermal Simulation  
Electrical Simulation  
System V&V

**Generative Design**  
**Holistic E/E Design**  
Behaviour & Controls  
Evidence, FMEA, FTA  
System Simulation  
System V&V

**Generative Design**  
**Holistic E/E Design**  
Lightening Change  
Fool proof Process  
Collaboration  
Multi-domain metrics

**Generative Design**  
**Holistic E/E Design**  
Behaviour & Controls  
Firewall Configuration  
New Networks  
Diagnose/update via IP

Manage Power  
Optimize Range  
Optimize Weight  
Manage EMI

Fail Operational  
Functional Safety  
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Manage Complexity

Rapid Start-up  
Efficient Design  
Effectual Design  
Small Team

Always on  
Extendable  
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**Electrification**

**Autonomous**

**New Entrants**

**Shared &  
Connected**



# **Platform – Level Model Based Engineering**

平台级别的  
基于模型的设计

# Platform – Level Model Based Engineering

平台级别的基于模型的设计

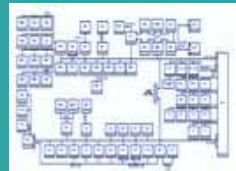
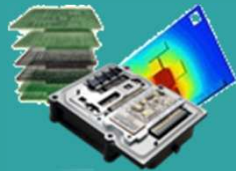
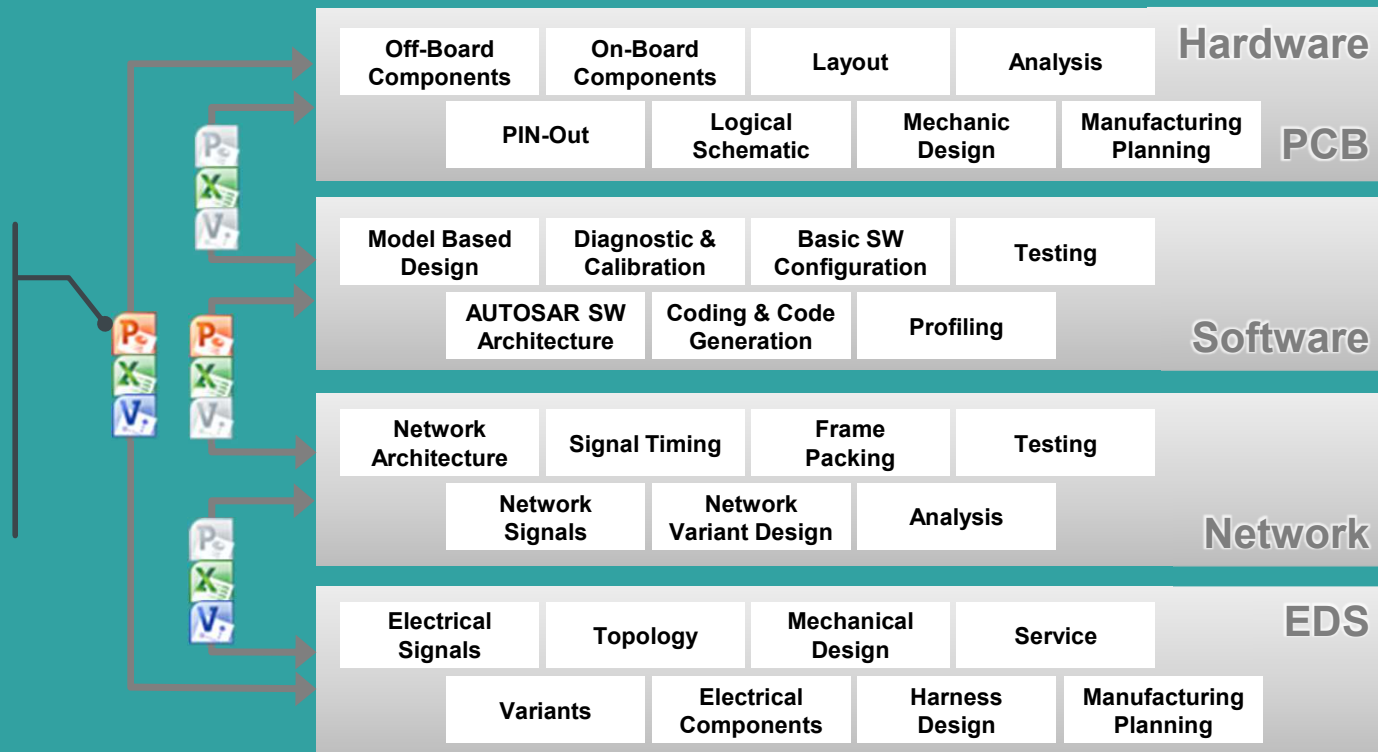
How is it addressed today?

现在如何解决这个问题？



Disconnected domains, **interfaces as text, picture and table based** file exchange.

Individual contributors loosely coupled by “standard interfaces”.



# Platform – Level Model Based Engineering

平台级别的基于模型的设计

Connecting domains as elegantly as possible

尽可能轻松地将各个设计领域连接起来



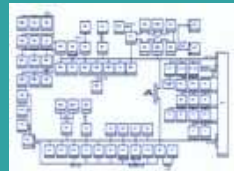
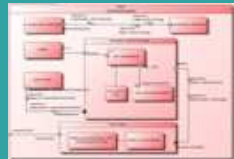
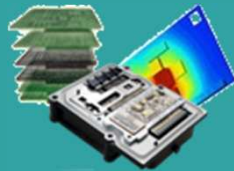
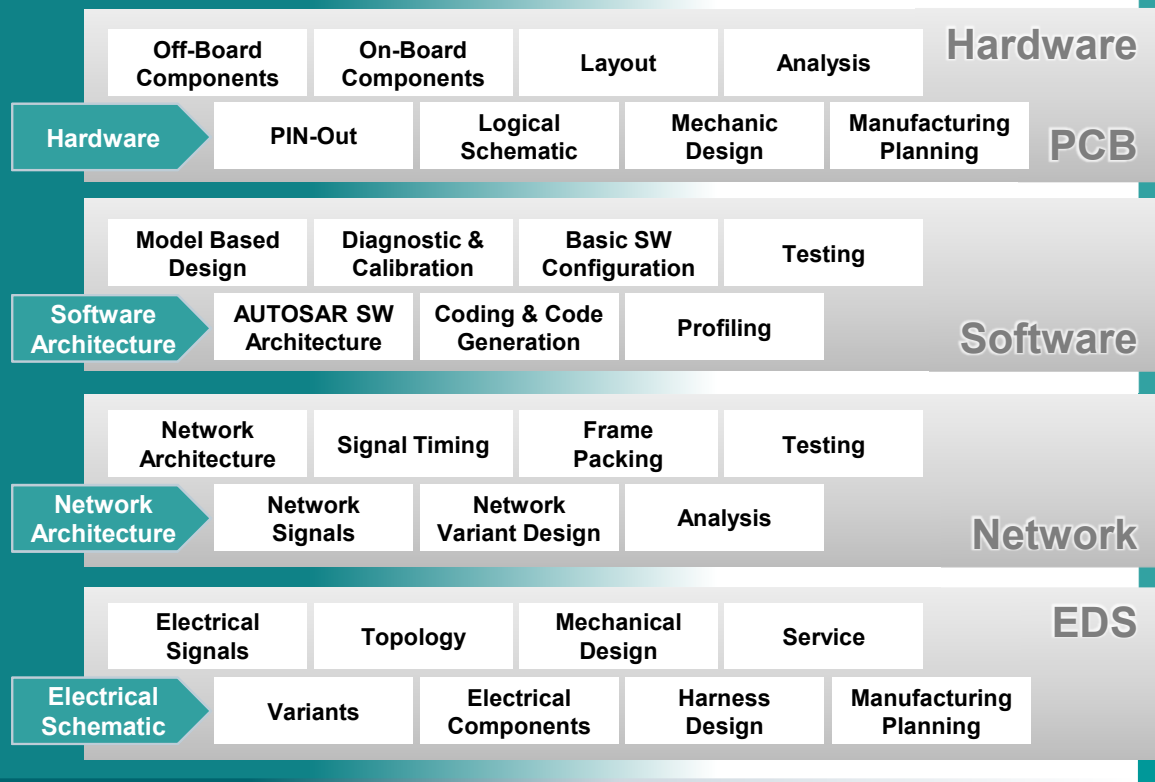
Integrated **functional and architectural design** to feed all connected and targeted domains.

Data Driven solutions provide an early perspective at system of systems level & aids implementation planning



Functional Design Solution

Implementation Proposal





# Platform – Level Model Based Engineering

平台级别的基于模型的设计

Utilizing an iterative and effective functional flow

利用迭代和有效的功能流程

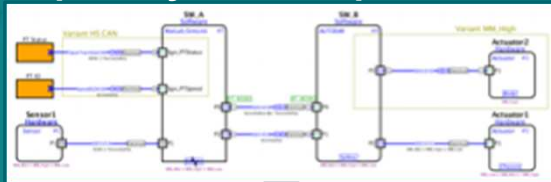


## Capital Systems - Implementation Proposal

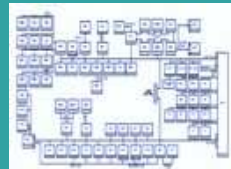
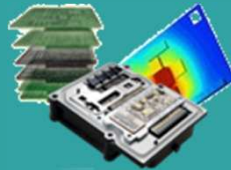
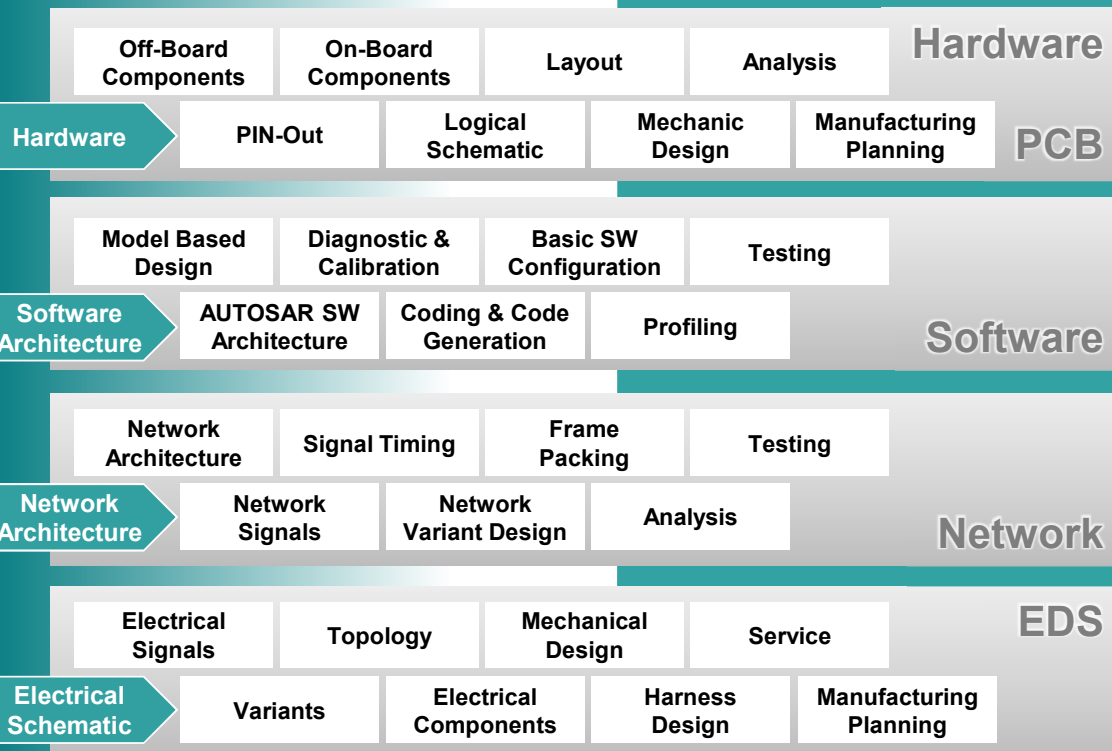
**Functions are the drivers** - not the implementers - of the **downstream flows**

Functional Design Solution

### Capital Systems Capture



### Capital Systems Architect



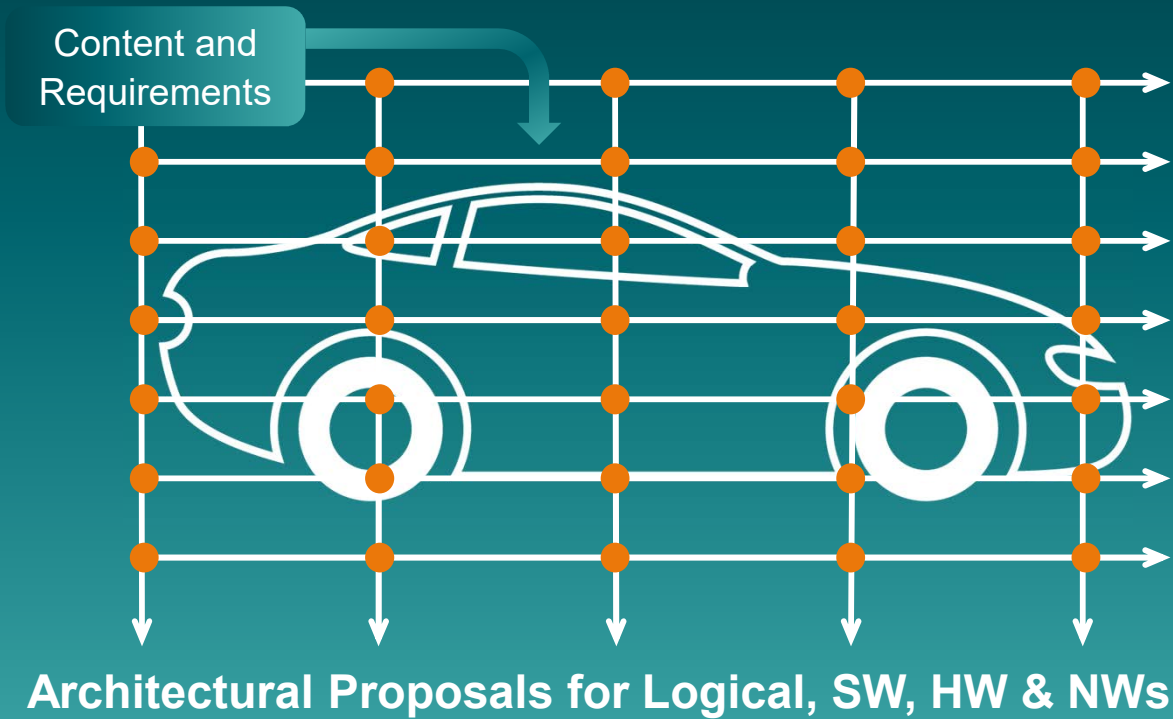
# Capital Flow

## Capital 流程

# Capital – Generative Engineering

## Capital – 生成式工程设计

### EE Architecture Development / EE 架构开发



#### EE Content Consolidated

Functions & Signals allocated across vehicle

#### Outcomes Optimized

Performance balanced against multiple costs

#### Platform Assessment Enabled

Platform level KPI's to support trade studies

#### Implementations Verified

Correctly & optimally sized components

#### EE Integrations Validated

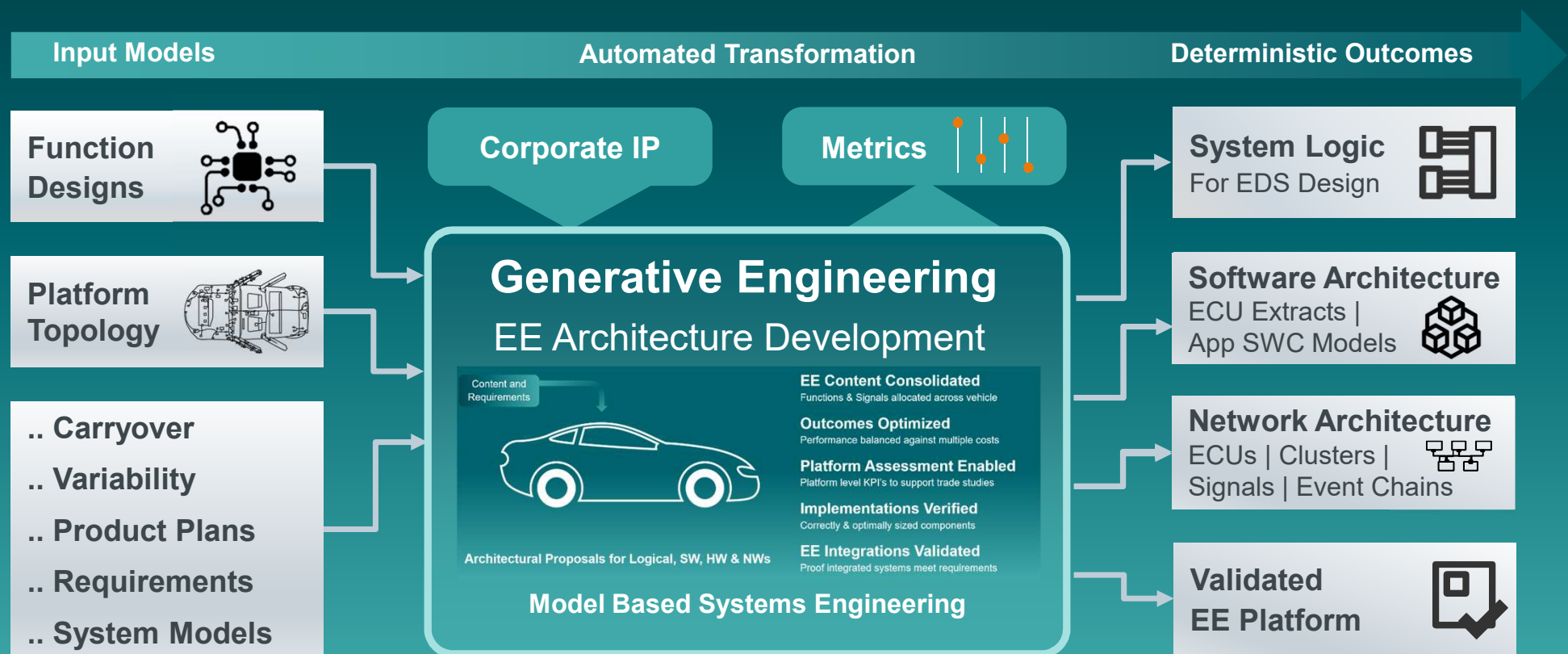
Proof integrated systems meet requirements



# Capital – Generative Engineering

## Capital – 生成式工程设计

### EE Architecture Development / EE 架构开发



## Example: Logical architecture / 示例：逻辑架构



## Requirements & Features



## Downstream Engineering

# Platform – Level Model Based Engineering

平台级别的基于模型的设计

Seamless flow across Design Domains

跨越多个设计领域的无缝流程



## Capital Systems - Implementation Proposals

## Network & Software Implementation

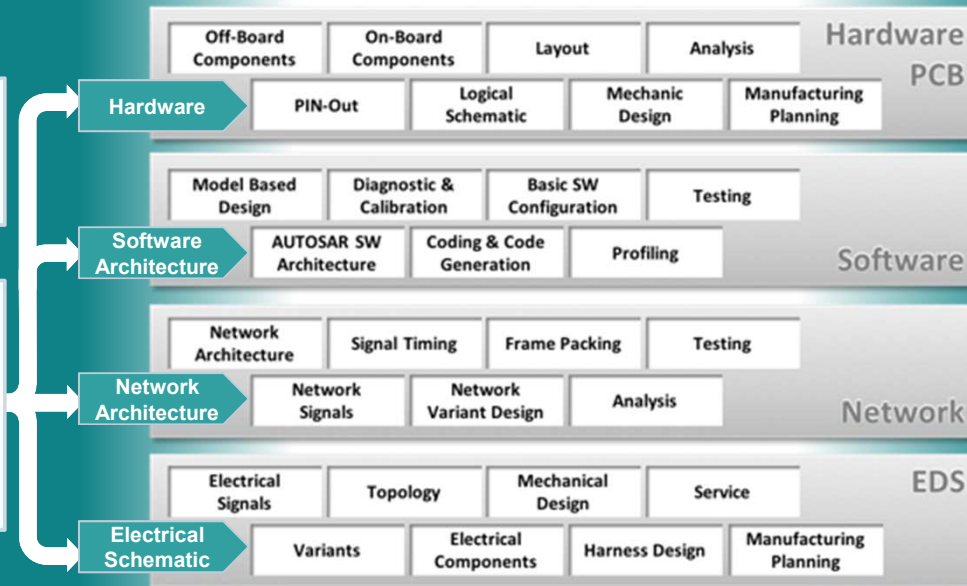


Functional Design Solution

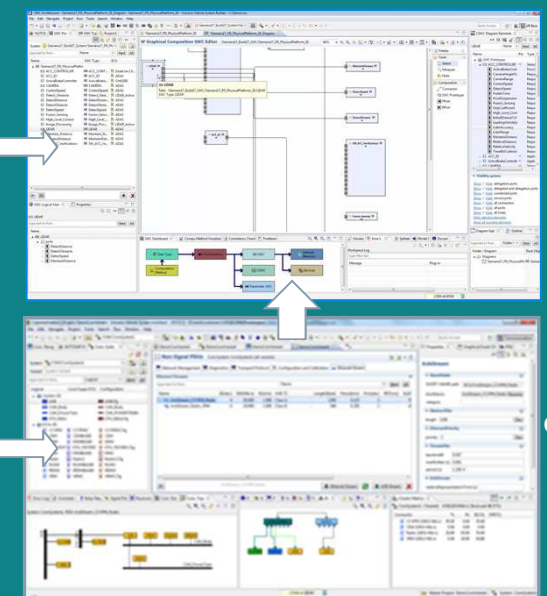
Capital Systems Capture



Capital Systems Architect



Volcano VSB, VSTAR & VSI



Capital Networks

Software and Network Design Solution



**Capital Flow**

**Capital 流程**

**A closer look**

**深入了解**

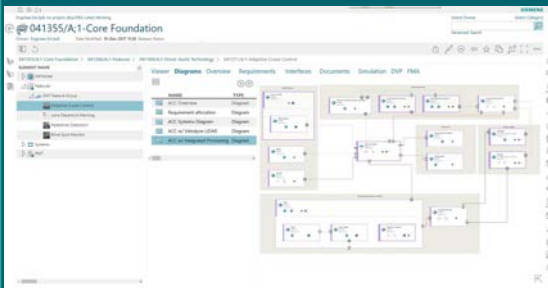
# Capital – Generative Engineering

## Capital – 生成式设计

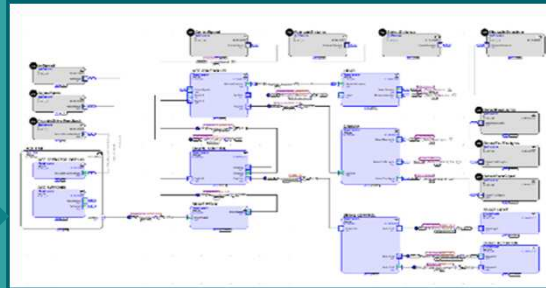
The “Front-End” of the flow / 流程的“前端”



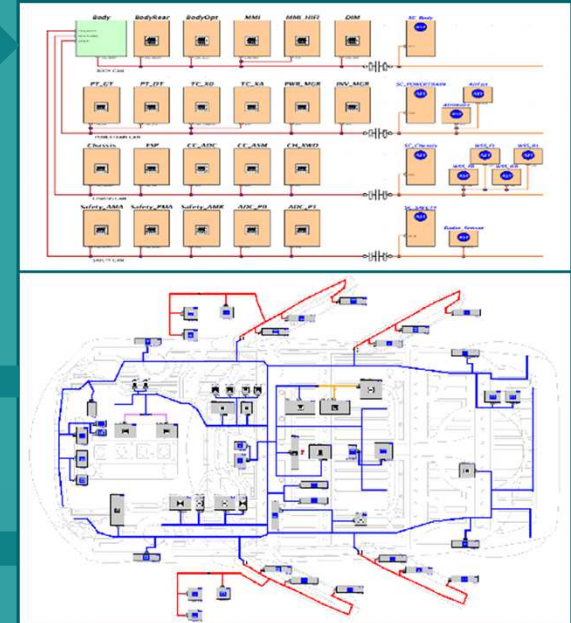
### Multi-Domain System Model



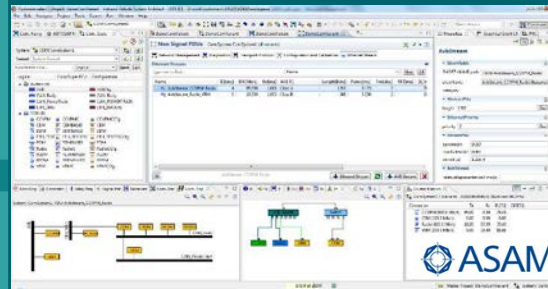
### E/E Function Architecture



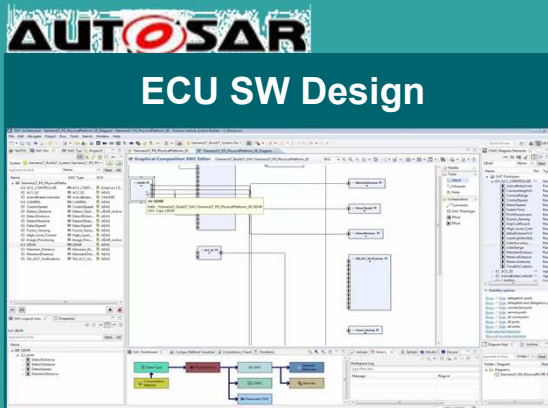
### E/E Platform Architecture



### Network Design



### ECU SW Design



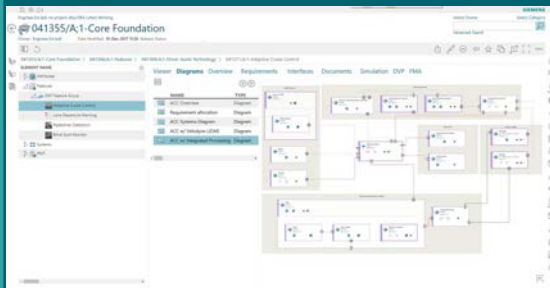
# Capital – Generative Engineering

## Capital – 生成式设计

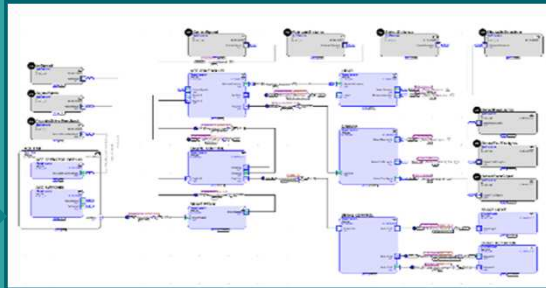
### E/E Architecture Development / E/E 架构开发



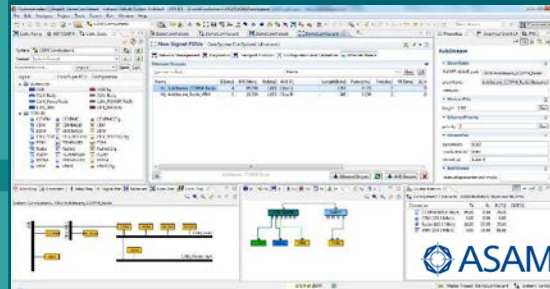
#### Multi-Domain System Model



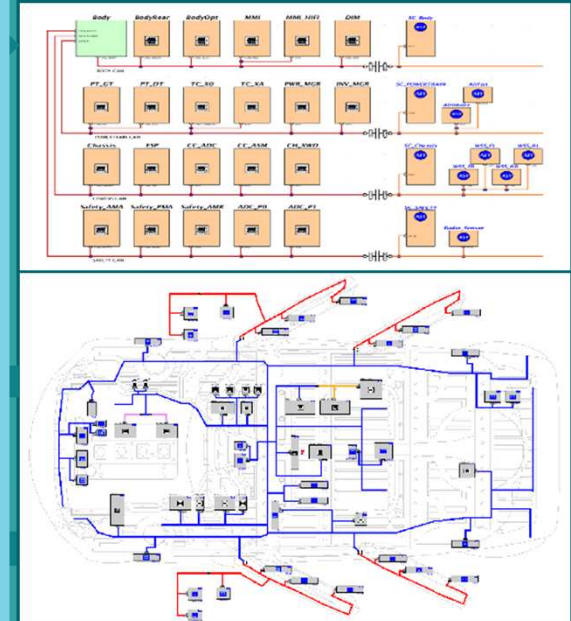
#### E/E Function Architecture



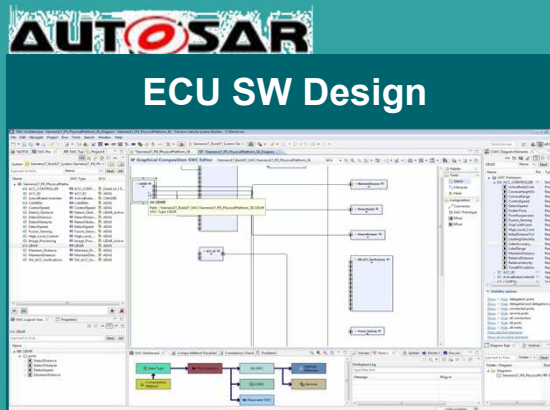
#### Network Design



#### E/E Platform Architecture



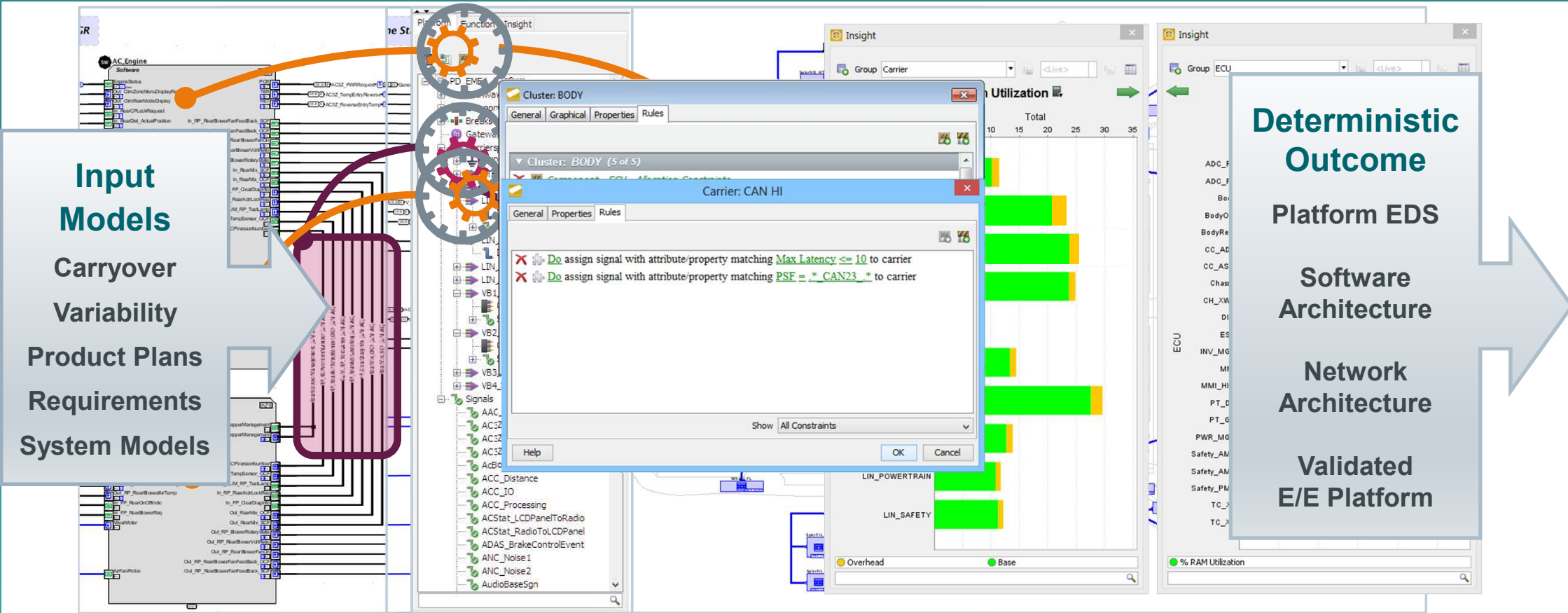
#### ECU SW Design



# Capital – Generative Engineering

## Capital – 生成式工程设计

### EE Architecture Development / EE 架构开发





# Capital – Generative Engineering

## Capital – 生成式工程设计

### EE Architecture Development / EE 架构开发



#### Input Models

Carryover

Variability

Product Plans

Requirements

System Models

#### Deterministic Outcome

Platform EDS

Software Architecture

Network Architecture

Validated E/E Platform

# Capital – Generative Engineering

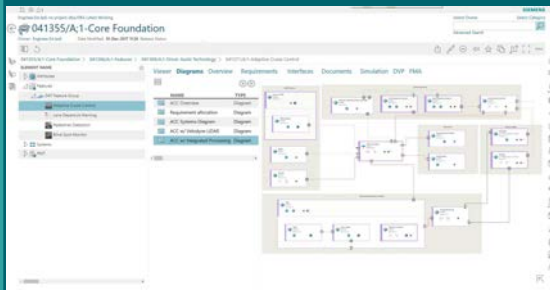
## Capital – 生成式设计

### Capital Networks – Network Design

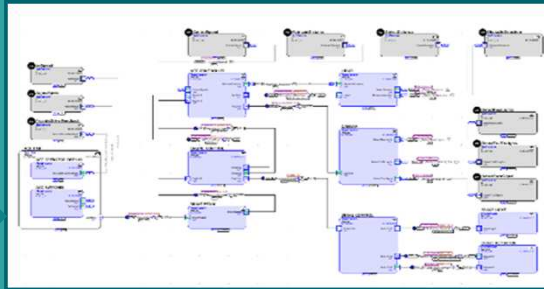
### Capital Networks – 网络设计



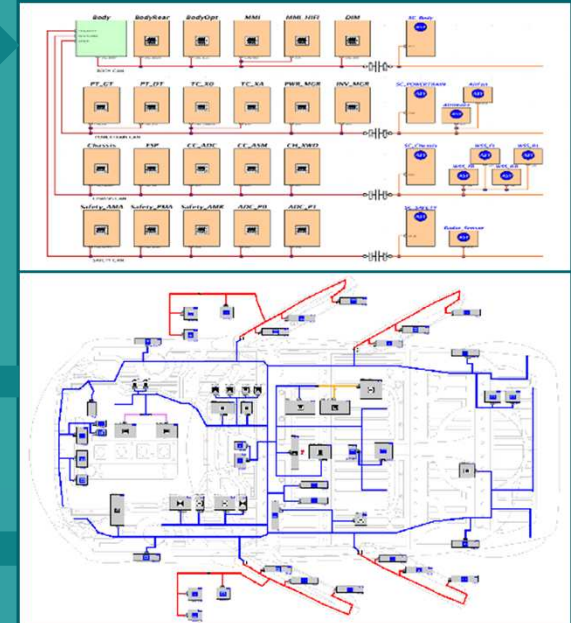
#### Multi-Domain System Model



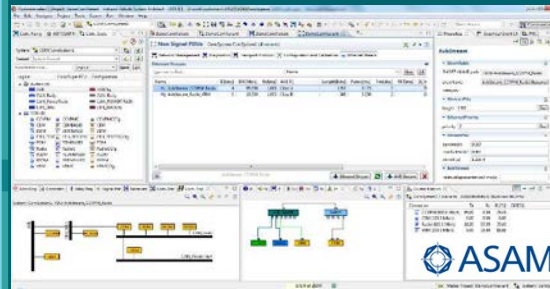
#### E/E Function Architecture



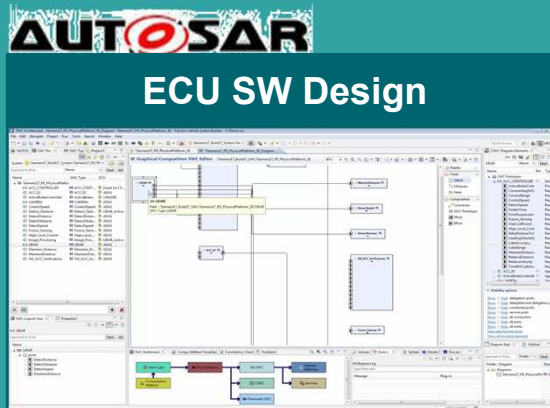
#### E/E Platform Architecture



#### Network Design



#### ECU SW Design



**Capital – Generative Engineering**

**Capital – 生成式工程设计**

**Capital Networks – Accelerating Network Design**

**Capital Networks – 加快网络设计**



### Logical

#### Architecture

ECUs | Clusters | Signals

### Communication

#### Needs

Published / Subscribed  
Signals

### Timing

#### Requirements

Delivery time | Allowed  
Delays | Jitter

### Synthesis

#### Settings

Id Ranges, Repacking Rules

## Synthesis



### Frame Packing

PDU's | Frames | Triggering

### Schedule

Job list | Schedule Table

### ECU

#### Configuration

Transmission Settings

### Cluster Configuration

Triggering | Settings

## Generative Approach Speeds Up Design Process



**Consistent Implementation  
Proposals Fulfilling  
Requirements**

# Capital Networks

## Network Cluster Configuration

### 网络集群配置



Network Cluster Configuration

Cluster properties

Task focused perspectives

Highlighting area's needing attention

Com Topology View

The screenshot displays the Vehicle System Architect (VSA) software interface, specifically the CAN Cluster Configuration window. The interface is divided into several panes:

- Left Pane:** A tree view showing the project structure, including 'Clusters' and 'ECUs'. The 'Clusters' pane is expanded, showing a list of clusters with their respective ECU assignments.
- Top Pane:** The 'CAN Cluster Configuration' window, which includes a 'General' tab and a 'Frame' tab. The 'General' tab shows the cluster name, ID, and other properties. The 'Frame' tab shows a list of frames with their respective IDs, lengths, and periods.
- Bottom Pane:** The 'Com Topology View' window, which shows a graphical representation of the communication network. It includes a 'Consistency Check' button and a 'Signal Path' button.

The 'CAN Cluster Configuration' window is the primary focus, showing a detailed view of the cluster properties and frame data. The 'Com Topology View' window provides a visual overview of the network topology, highlighting areas that need attention.

# Capital Networks

## Timing Analysis & Generative Frame Packing 时序分析和生成式帧封装



Network Cluster  
Configuration

Frame Periods  
adjusted

Timing now meets  
required Maximum  
Age

The screenshot displays the Volcano Vehicle System Architect (VSA) interface. The main window is titled "CAN Cluster Configuration" and shows a table of CAN frames with columns for ID, Lbit, Publisher, TxMode, Period(ms), Offset(ms), mRTI(ms), NoR, RPer(ms), ACD(ms), Arb(ms), WCL(ms), and CCD(ms). The table lists various frames from publishers like CHASSIS, ADAS, LIDAR\_Active, and ESP. A summary box on the right shows utilization at 4.32% and a calculated Com.Delay of 39.540 ms. Below the main window, the "Errors" pane shows a list of errors, including "Period cannot be calculated to frame (%s). ECU (%s) has invalid Com Processing Period." and "The selected object has no model changes history...".

ID	Lbit	Publisher	TxMode	Period(ms)	Offset(ms)	mRTI(ms)	NoR	RPer(ms)	ACD(ms)	Arb(ms)	WCL(ms)	CCD(ms)
64	64	CHASSIS	Periodic	30.000	0.000					1.920	2.540	39.540
64	64	CHASSIS	Periodic	30.000	0.000	1.000						
8	8	Published	Published									
64	64	ADAS	Periodic	20.000	0.000					0.960	1.580	
64	64	ADAS	Periodic	20.000	0.000	1.000						
16	16	Published	Published									
64	64	ADAS	Periodic	20.000	0.000					1.600	2.220	29.220
64	64	ADAS	Periodic	20.000	0.000	1.000						29.220
16	16	Published	Published									
64	64	LIDAR_Active	Periodic	50.000	0.000					0.640	1.260	50.260
64	64	LIDAR_Active	Periodic	50.000	0.000					0.620	0.940	57.620
64	64	LIDAR_Active	Periodic	50.000	0.000					0.320	0.940	57.940
64	64	LIDAR_Active	Periodic	100.000	0.000					1.280	1.800	108.900
64	64	MMI	Periodic	2.000	0.000					2.240	2.860	<Undefined>
64	64	MMI	Periodic	2.000	0.000					2.240	2.860	<Undefined>
64	64	MMI_Panel	Periodic	2.000	0.000					2.240	2.540	<Undefined>
64	64	ESP	Periodic	20.000	0.000					0.000		<Undefined>
64	64	ESP	Periodic	40000.000	0.000					0.000		<Undefined>

Summary Box (Right):

- Utilization: 4.32%
- Time Before Tx.(ms): 31.000
- Arbitration(ms): 1.000
- Frame Time(ms): 0.320
- WC Latency(ms): 2.540
- Time After Rx.(ms): 6.000
- Calculated Com.Delay(ms): 39.540

Error Log (Bottom):

- Consistency Check: errors: 193, warnings: 60, info: 0 (no configured message limit, Profile: Full Consistency Check VSAX 4.0 [VSAX 4.0])
- Error Code: E800125
- Description: Period cannot be calculated to frame (%s). ECU (%s) has invalid Com Processing Period.
- Path: /Project/ADAS
- Error Code: E800125
- Description: Period cannot be calculated to frame (ActiveBrkCtrl). ECU (ADAS) has invalid Com Processing Period.
- Path: /Project/ADAS
- Error Code: E800125
- Description: Period cannot be calculated to frame (LIDAR\_Active). ECU (ADAS) has invalid Com Processing Period.
- Path: /Project/ADAS
- Error Code: E800125
- Description: Period cannot be calculated to frame (AccReqCtrl). ECU (CHASSIS) has invalid Com Processing Period.
- Path: /Project/CHASSIS
- Error Code: E800125
- Description: Period cannot be calculated to frame (PB\_TIRE1). ECU (ESP) has invalid Com Processing Period.
- Path: /Project/ESP
- Error Code: E800125
- Description: Period cannot be calculated to frame (PB\_TPRD). ECU (ESP) has invalid Com Processing Period.
- Path: /Project/ESP
- Error Code: E800125
- Description: Period cannot be calculated to frame (LIDAR\_Active). ECU (LIDAR\_Active) has invalid Com Processing Period.
- Path: /Project/LIDAR\_Active
- Error Code: E800125
- Description: Period cannot be calculated to frame (LIDAR\_Active). ECU (LIDAR\_Active) has invalid Com Processing Period.
- Path: /Project/LIDAR\_Active



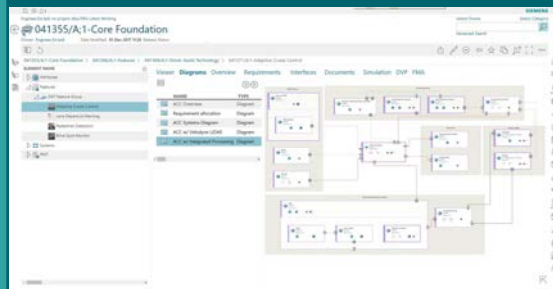
# Capital – Generative Engineering

## Capital – 生成式设计

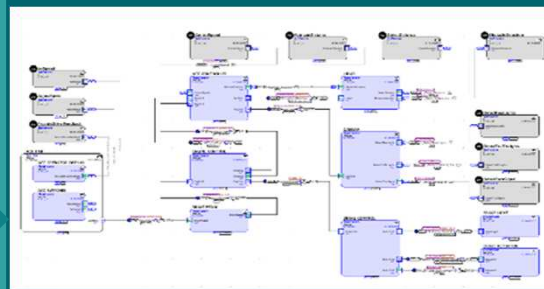
### Volcano – Software Design / Volcano – 软件设计



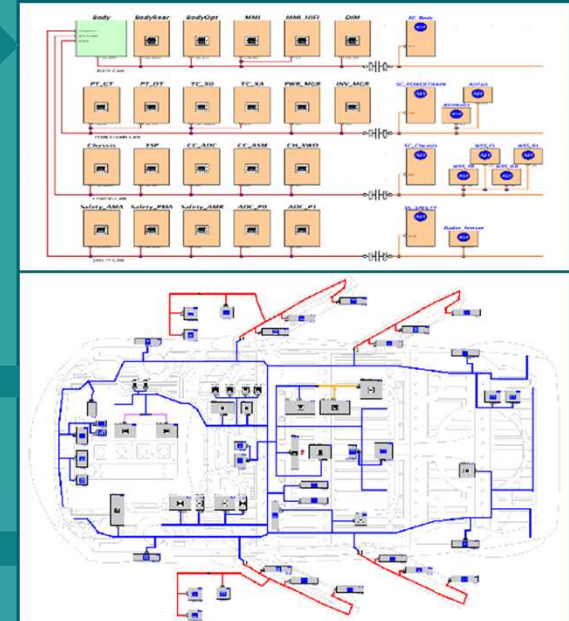
#### Multi-Domain System Model



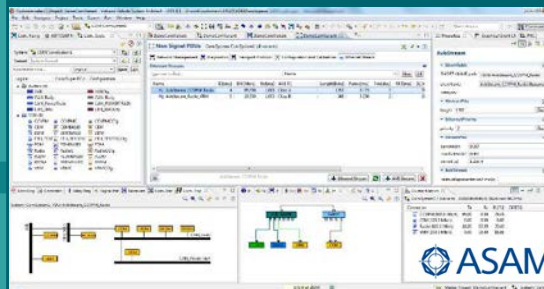
#### E/E Function Architecture



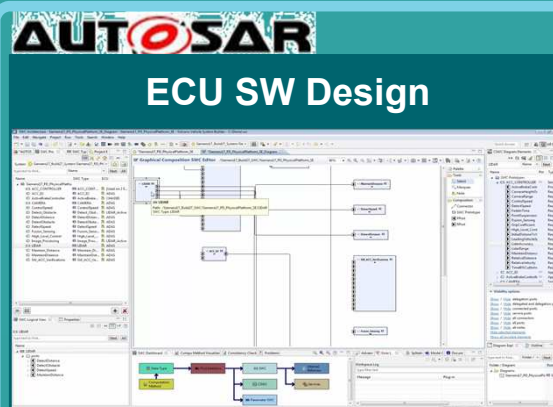
#### E/E Platform Architecture



#### Network Design



#### ECU SW Design



# Volcano Virtual System Builder System Editor 系统编辑工具

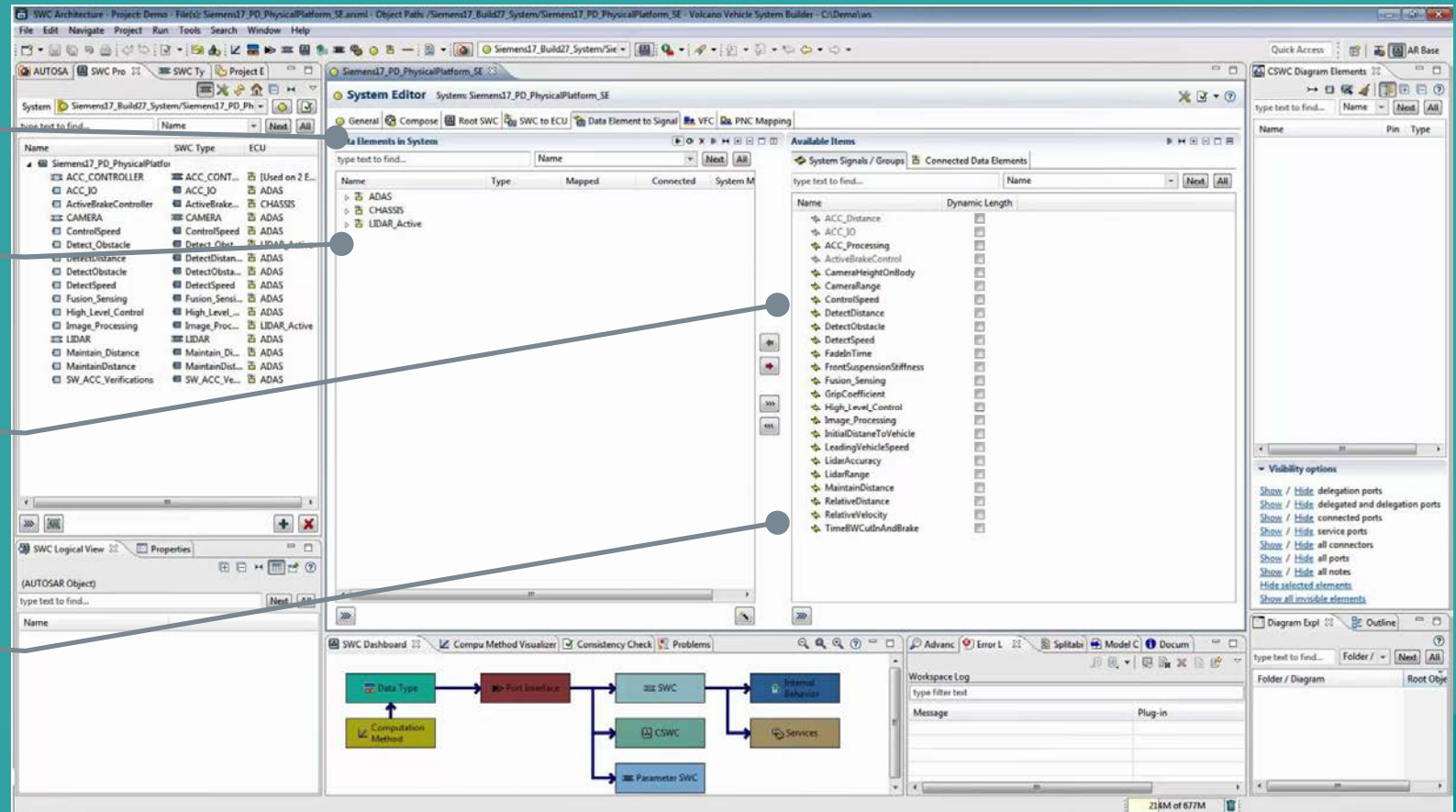


System Editor

Data Elements in  
System

Available Elements can  
be added/removed from  
this System

Ease of configurability  
with pre-populated  
default values



# Volcano Virtual System Builder

## Generate template .h and .c files

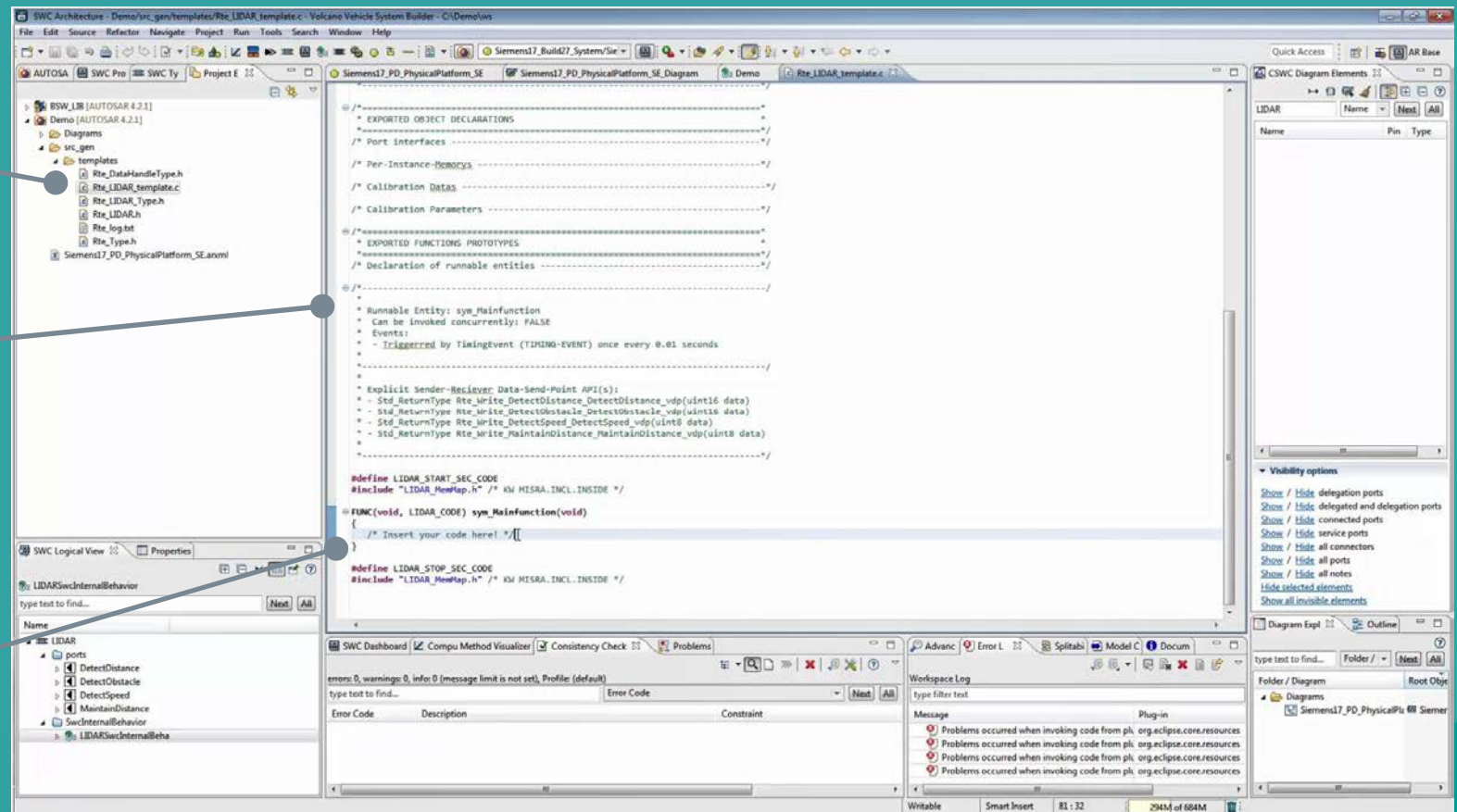
## 生成模板 .h 和 .c 文件



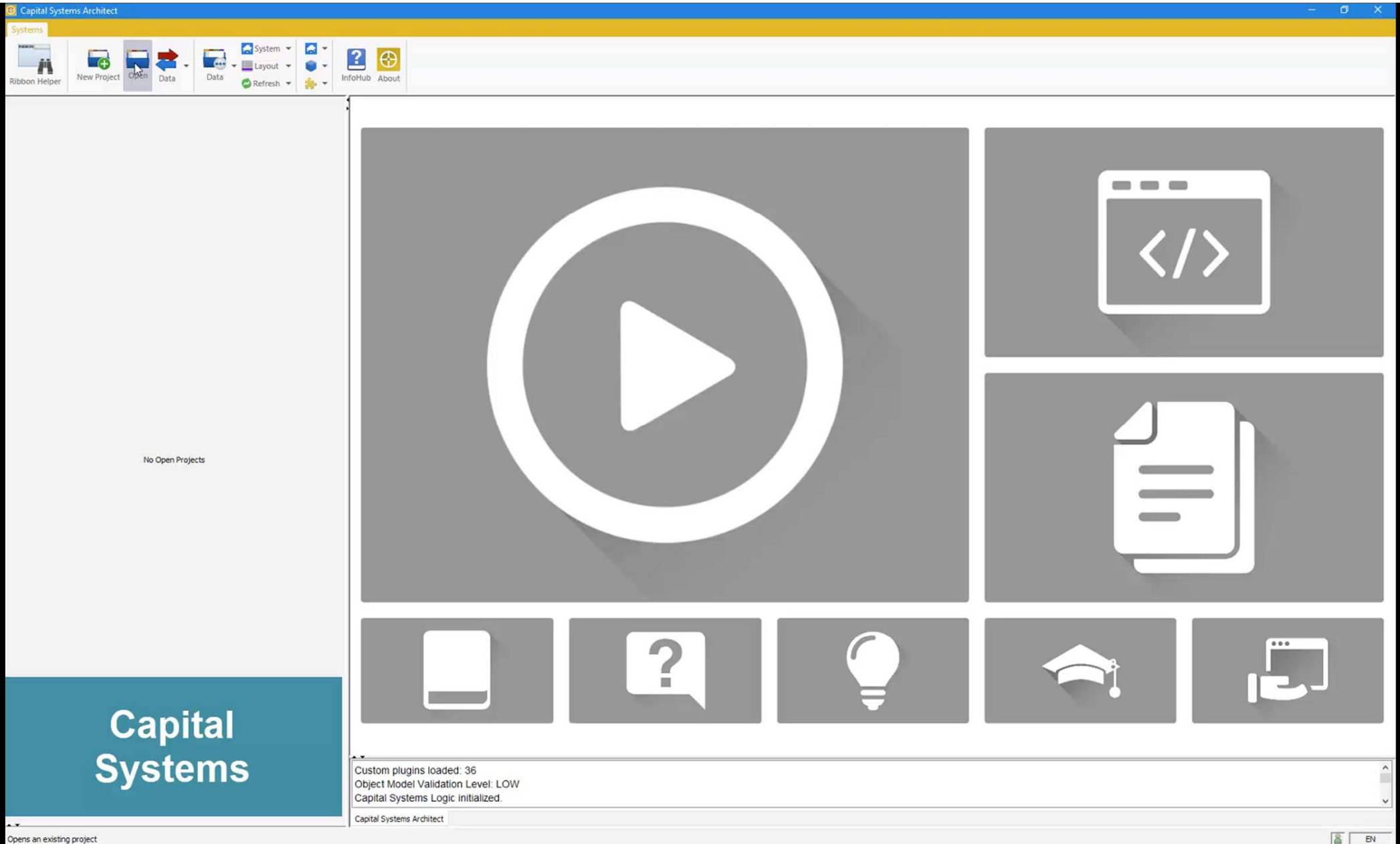
Output template .h & .c

Ready to compile and run on target ECU


Add application code



# Capital Flow Capital 流程 Demonstration 演示







# Summary & Conclusion 总结和结语

## Electrification

**200+ by 2022**  
electric / hybrid models  
+Emerging Start-ups



Source: McKinsey

## Autonomous

**\$21m by 2035**  
annual sales of  
autonomous vehicles



Source: IHS

## Connected

## Shared Services

**\$6b by 2030**  
forecasted ride share  
passenger miles



Source: ReThinkX

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Source: ReThinkX



**Industry disruption is not benign – There will be winners and losers**

**E/E Architecture sets the foundation for your products**

**MBSE principles, widely applied, are a must**

**Siemens' Capital is your choice – be a winner**

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Source: McKinsey

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passenger miles



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The background of the entire image is a vibrant nighttime cityscape. It features a mix of warm orange and yellow light trails from moving vehicles on a highway, and cooler blue and teal digital overlays that suggest a smart city or data network. These overlays include glowing lines, circular patterns, and a triangular warning sign with a car icon. The city buildings are visible in the background, their lights contributing to the overall urban glow.

# Realize LIVE

GREATER CHINA

**SIEMENS**  
*Ingenuity for life*