CONTROL SOFTWARE DEVELOPMENT USING MATLAB TOOLCHAIN

MATLAB EXPO - 2019

Presented by:

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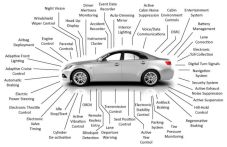
Agenda

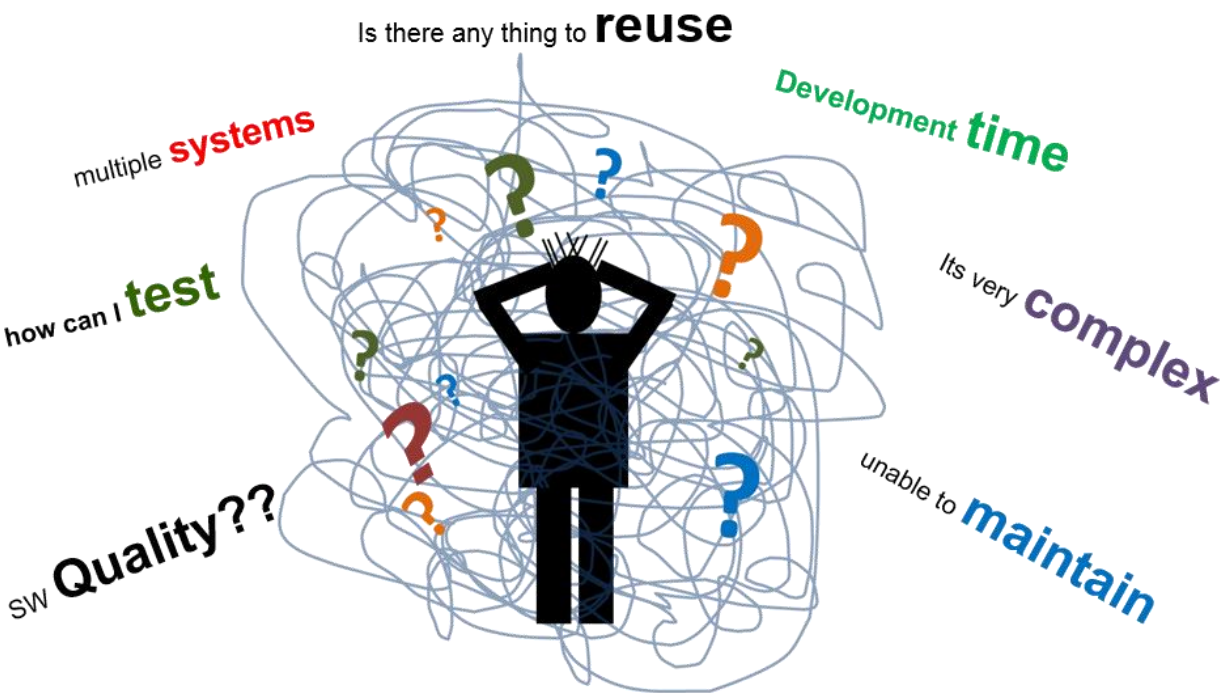
- **Development Challenges**
  - Need of Hour
- **Development Approach**
  - Software Architecture
  - Concept Generation
  - Software Development
  - Testing Methods
  - Benefits
- **Summary/Conclusion**

Development Challenges

- **Complexity**



- **Targets**

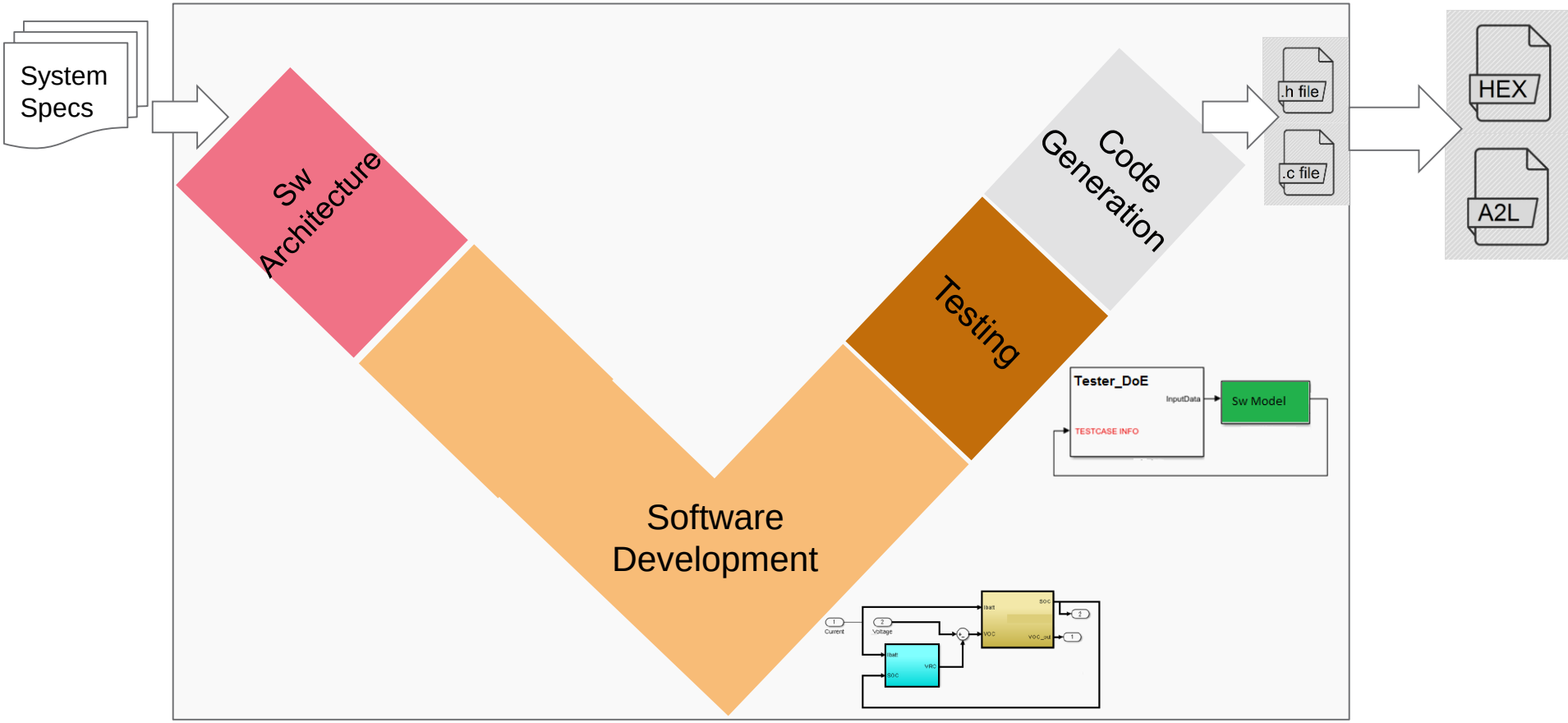


Development Challenges – *Need of Hour*

Front Loading Development Approach

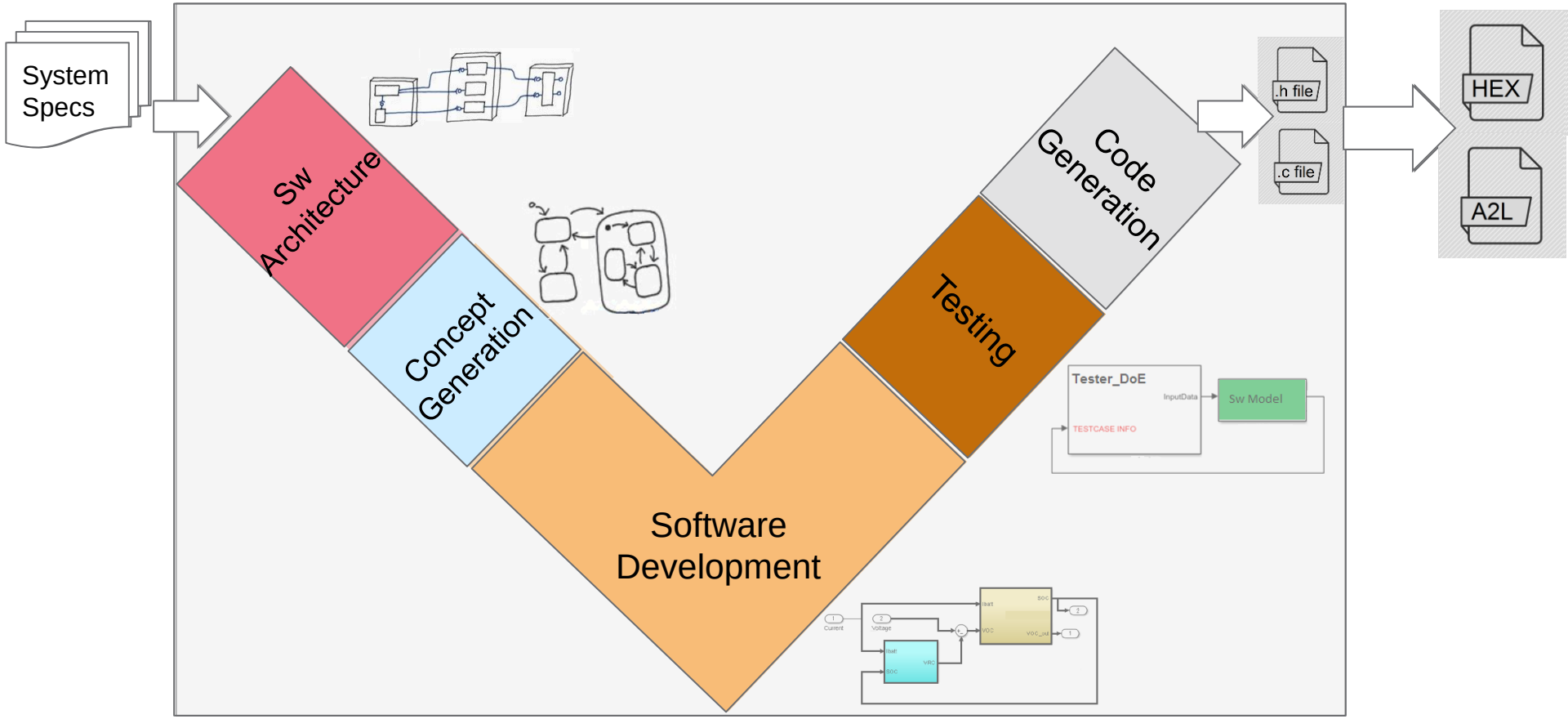
Development Approach

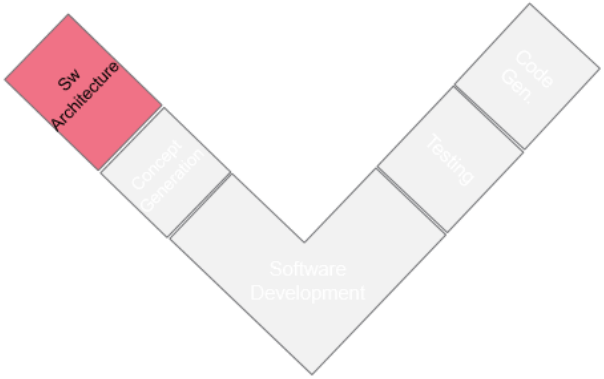
Conventional MBD Workflow



Development Approach

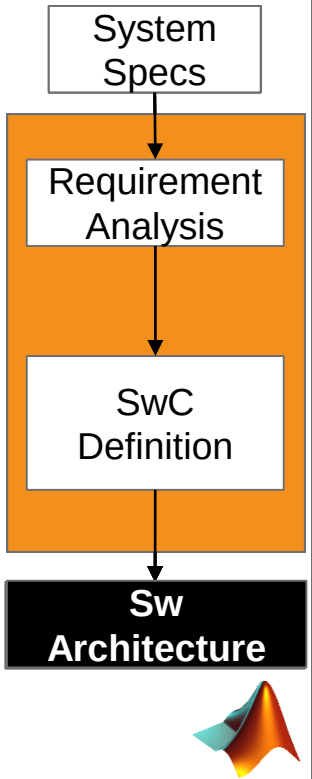
Integrated MBD Workflow





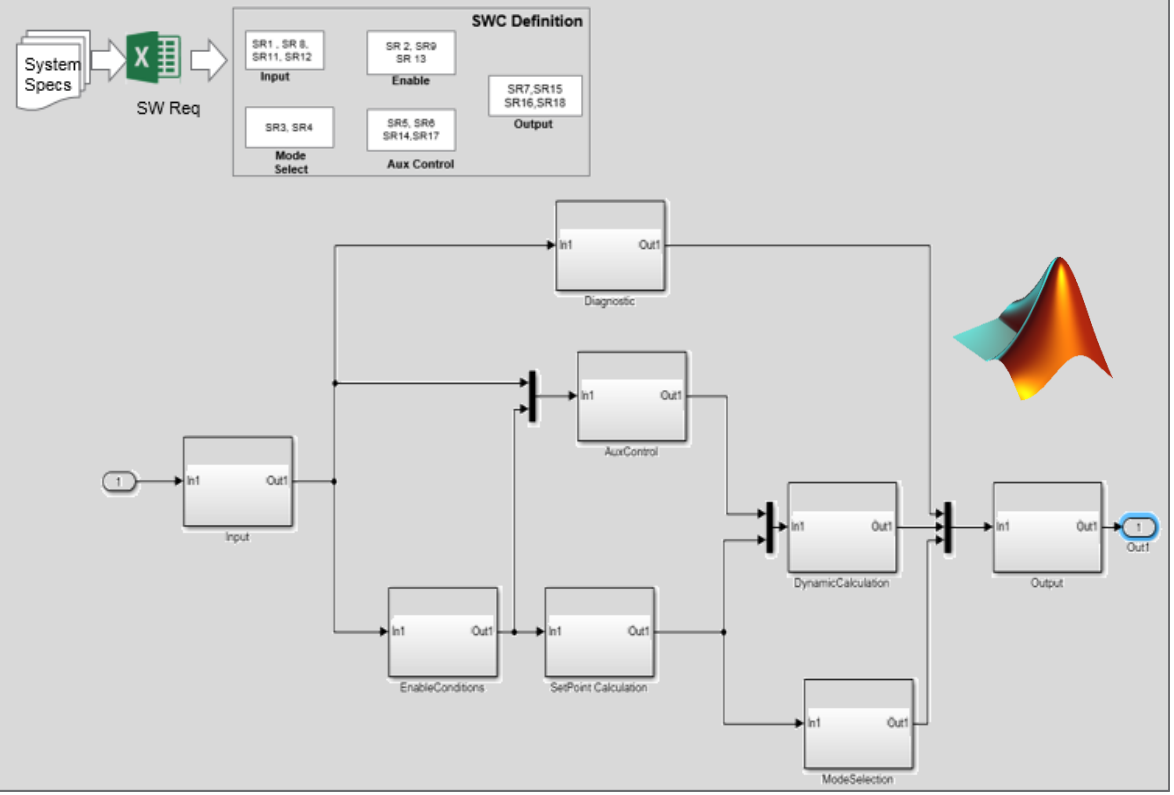
Development Approach

Sw Architecture



SWC Architecture

Architecture definition in MATLAB/SIMULINK



Challenges

Quality
- Concept Ambiguity
- Req Elicitation

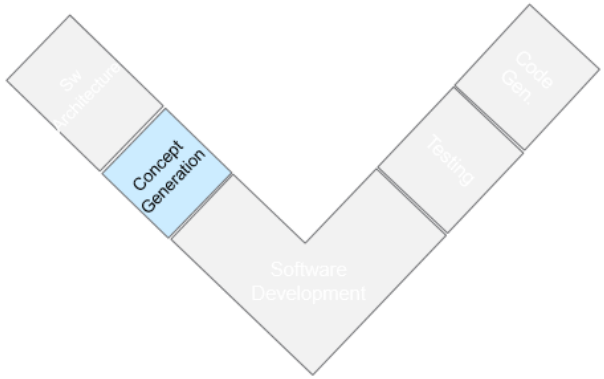
Time
- Architecture Def

Solution

Quality
- Deliberation
- Cascaded

Time
- Modular Architecture

Development Approach



Concept Generation

Sw Arch System Specs

Algo Dev

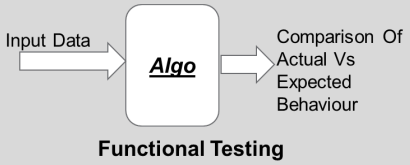
- Concept
- IO Mapping
- Tags
- Test case

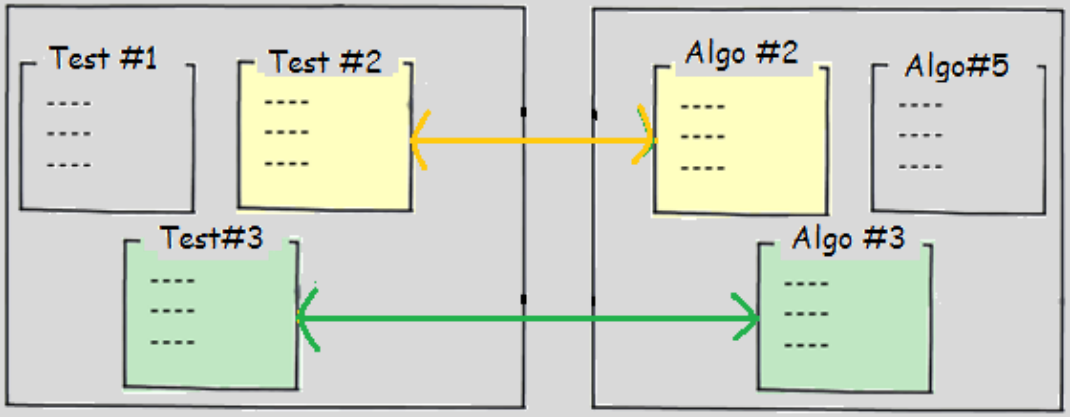
Sw Concept

Functional Test Point & Tagging

Functionality Test Requirement (Coverage)

& *Tagging (Traceability)*





Tagging

Challenges

Quality
- Concept Coverage
- Traceability
- IO Mapping

Time
- Algo Def

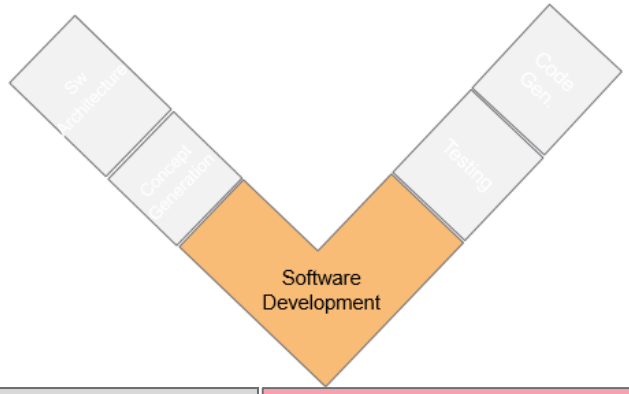
Solution

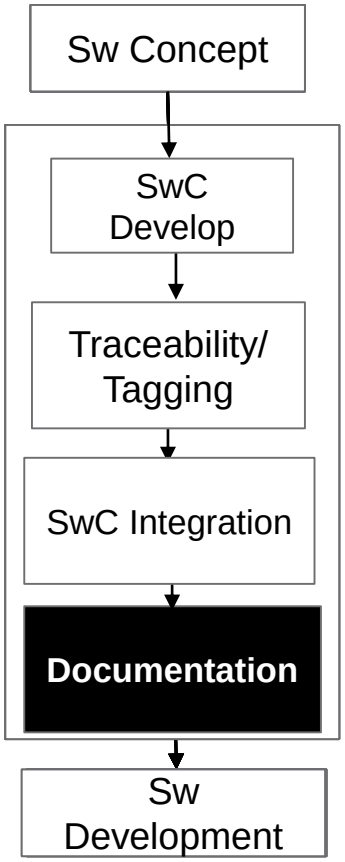
Quality
- Better Coverage
- Better Traceability

Time
- Robust Algo

Development Approach

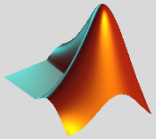
Sw Development

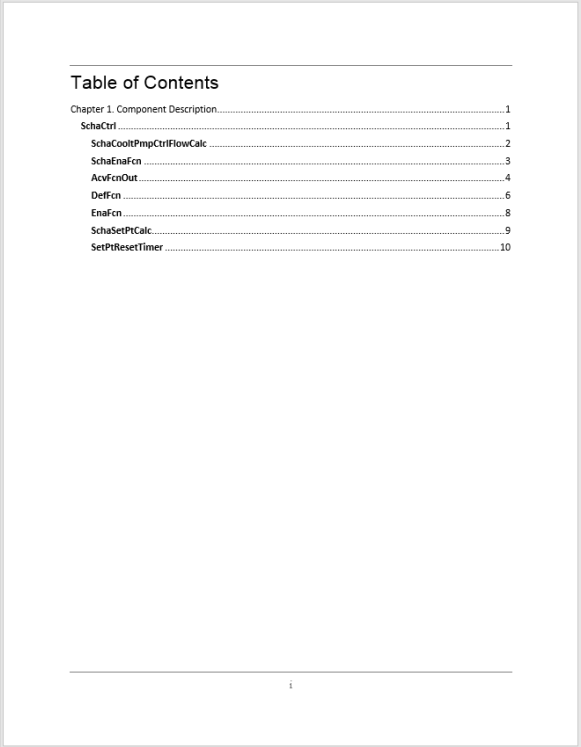




Documentation

Automated Documentation





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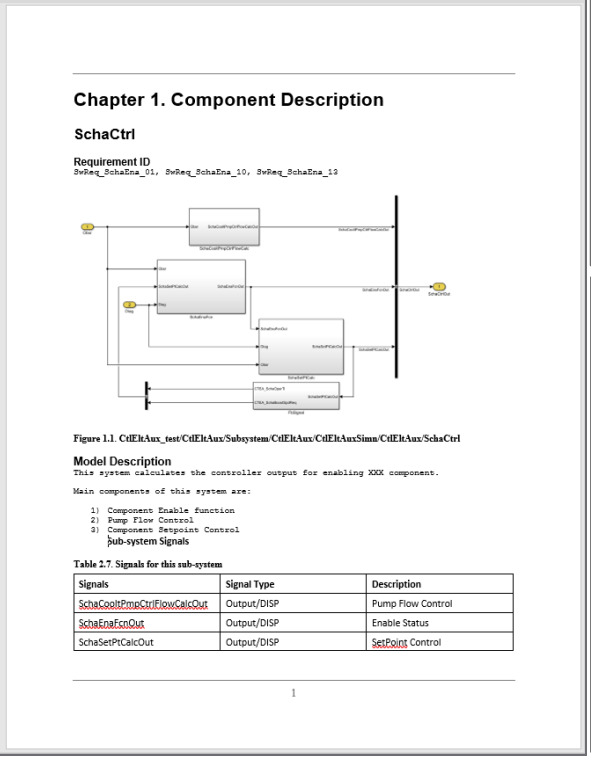


Chapter 1. Component Description

SchaCtrl

Requirement ID
SwReq_SchaEna_01, SwReq_SchaEna_10, SwReq_SchaEna_12

Figure 1.1. CtlEltAux_test/CtlEltAux/Subsystem/CtlEltAux/CtlEltAuxSimn/CtlEltAux/SchaCtrl

Model Description
This system calculates the controller output for enabling XXX component.

Main components of this system are:

1) Component Enable function
2) Pump Flow Control
3) Component Setpoint Control

Sub-system Signals

Table 2.7. Signals for this sub-system

Signals	Signal Type	Description
SchaCooltPmpCtrlFlowCalcOut	Output/DISP	Pump Flow Control
SchaEnaFcnOut	Output/DISP	Enable Status
SchaSetPtCalcOut	Output/DISP	SetPoint Control

Challenges

Quality
- MDL Consistency
- Traceability
- Future Adaptation

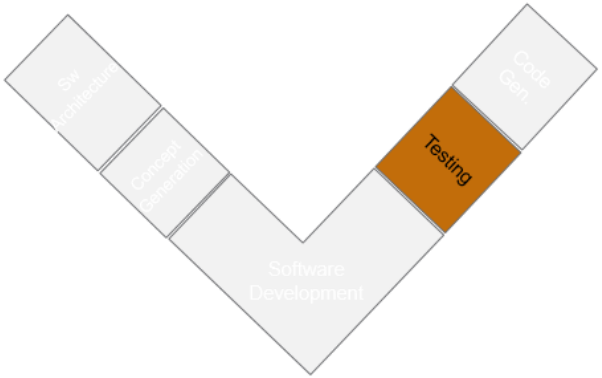
Time
- Short Dev Time

Solution

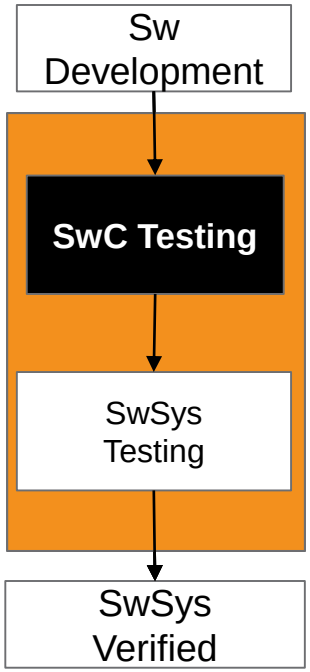
Quality
- Robust Model
- Sys→ Model Traceability
- Modular/ Reuse

Time
- Quick Development

Development Approach



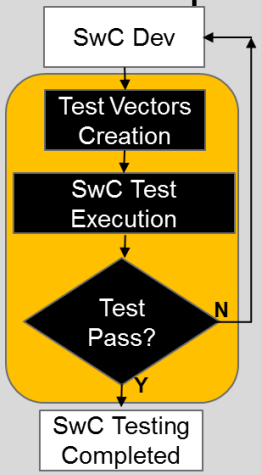
Testing Methods

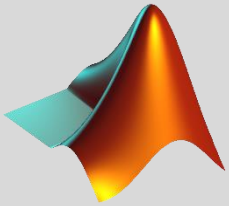


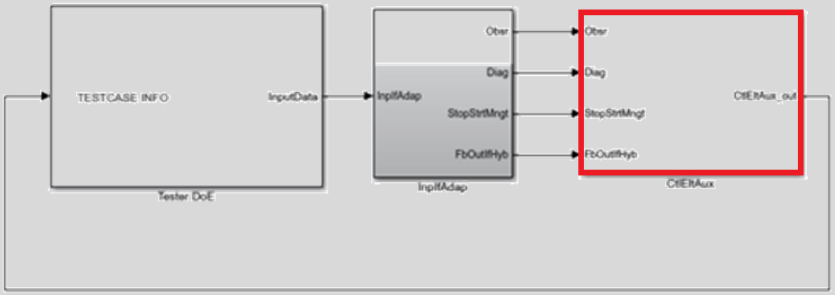
SwC Testing

Open Loop Testing

Sw component →Functional, Coverage







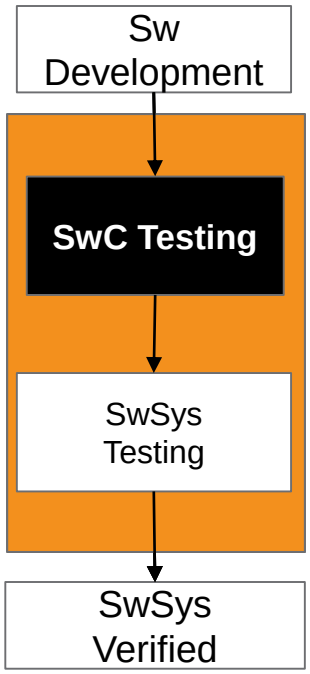
Challenges

Quality
- Test Coverage
- Acceptance
- Testing Phase

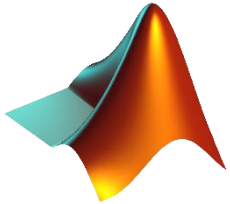
Time
- Model Complexity

Development Approach

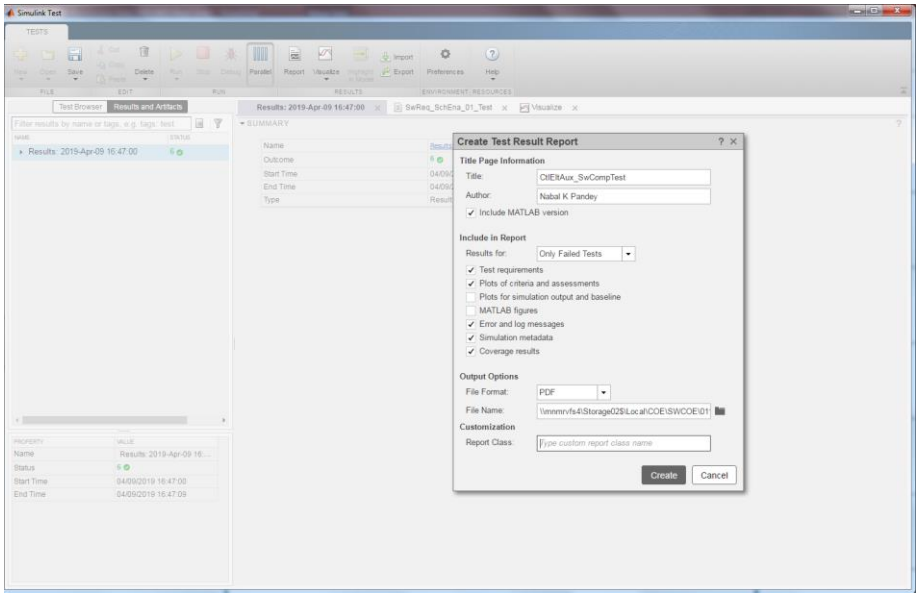
Testing Methods

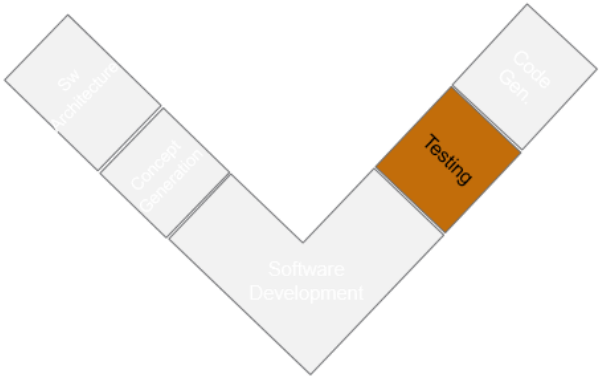


Simulink Test



Test Reporting



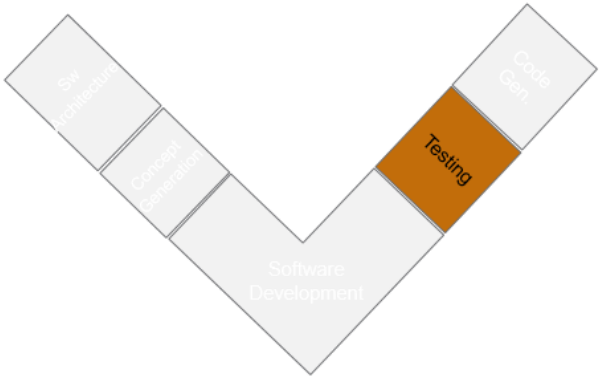


Challenges

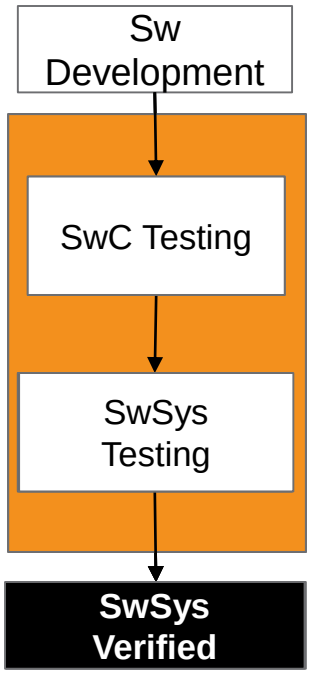
Quality
- Test Coverage
- Acceptance
- Testing Phase

Time
- Model Complexity

Development Approach



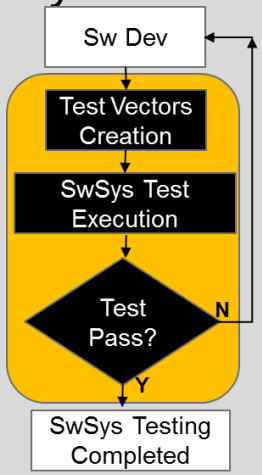
Testing Methods

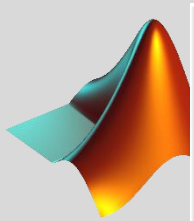


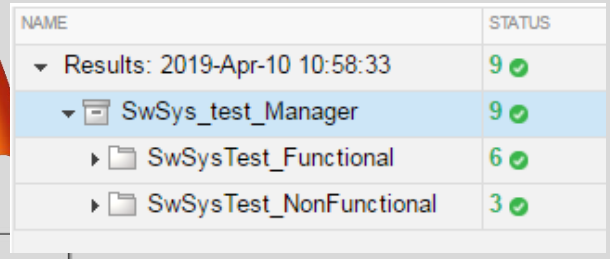
SwSys Testing

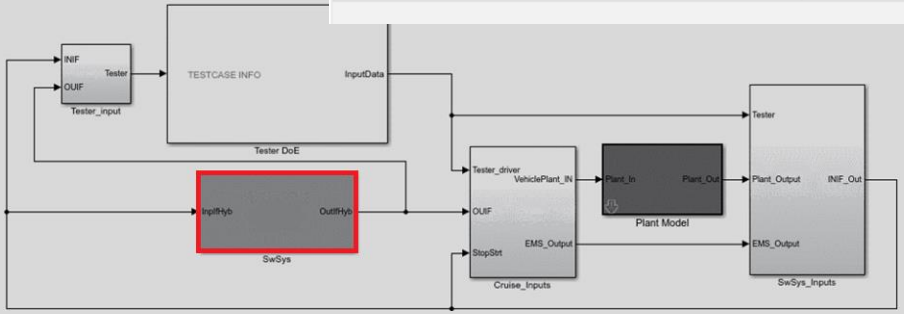
Closed Loop Testing

Sys Level →Functional, Non- Functional









Challenges

Quality
- Test Coverage
- Acceptance
- Testing Phase

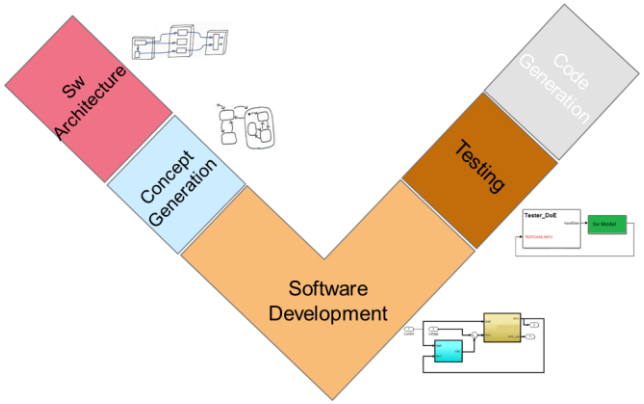
Time
- Model Complexity

Solution

Quality
- Better Coverage
- White box/ Black box Testing

Time
- Early Reliability
- SwC/SwSys Test

Development Approach



Benefits

Conv MBD Process					***Integrated MBD Process***	
Time	QC Point	**Development Phase**			QC Point	Time
5x		**Sw Architecture**	*Req Analysis*	**Sw Architecture**		4x
	-		*Sw Component Definition*			1x
2x			*Sw Architecture*		Qc1	1x
5x		**Software Development**	*Algorithm Development*	**Concept Generation**		4x
	-		*Sw Concept*		Qc2	3x
10x	Qc1		*Software Component Development*	**Software Development**	Qc3	5x
			Traceability/ Tagging			1x
2x			*Sw Component Integration*		Qc4	1x
5x		**Testing**	*Sw Component Testing*	**Testing**		4x
4x	Qc2		*SwSys Testing*		Qc5	3x
3x		***Rework***				1x
36x	***Overall Development Time***					**28x**

14%
18%
22%
67%
22%

- ✓**More QC point, better Software Quality**
  - ✓Rework time is reduced by 67%.
  - ✓Higher Coverage.
- ✓**Overall Development time is reduced by 22%.**

Summary

S.No.	Approach Outcome	Impact Parameter		
		Time	*Cost*	*Quality*
1	Reduced Complexity	✓	✓	✓
2	Bidirectional Traceability	✓		✓
3	Higher Testing Coverage			✓
4	Robust Algorithm/ Model	✓		✓
5	Modular Structure	✓	✓	
6	Higher Ease of Maintenance	✓	✓	
7	Quality Checkpoints		✓	✓
8	Automated Documentation	✓		✓

Thank You

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