Quality Issue of the AGL Instrument Cluster

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Outline

- Background
  - What is Instrument Cluster Expert Group
  - Our Concept
- What is Issue
- AGL Instrument Cluster Development Process
- Conclusion

Introduction to Who I Am

- Name: Naoto Yamaguchi
- Company: AISIN AW CO., LTD.

- Career
  - Received Doctor of Informatics in 2007 (Shizuoka-University).
  - Automotive RTOS platform software engineer since 2007.
  - Automotive Linux platform software engineer since 2011.
- My history of Open Source Community
  - Joined to AGL in 2013.
  - Member of AGL Instrument Cluster Expert Group since 2019.
  - Joined to ELISA in 2019.

AUTOMOTIVE GRADE LINUX

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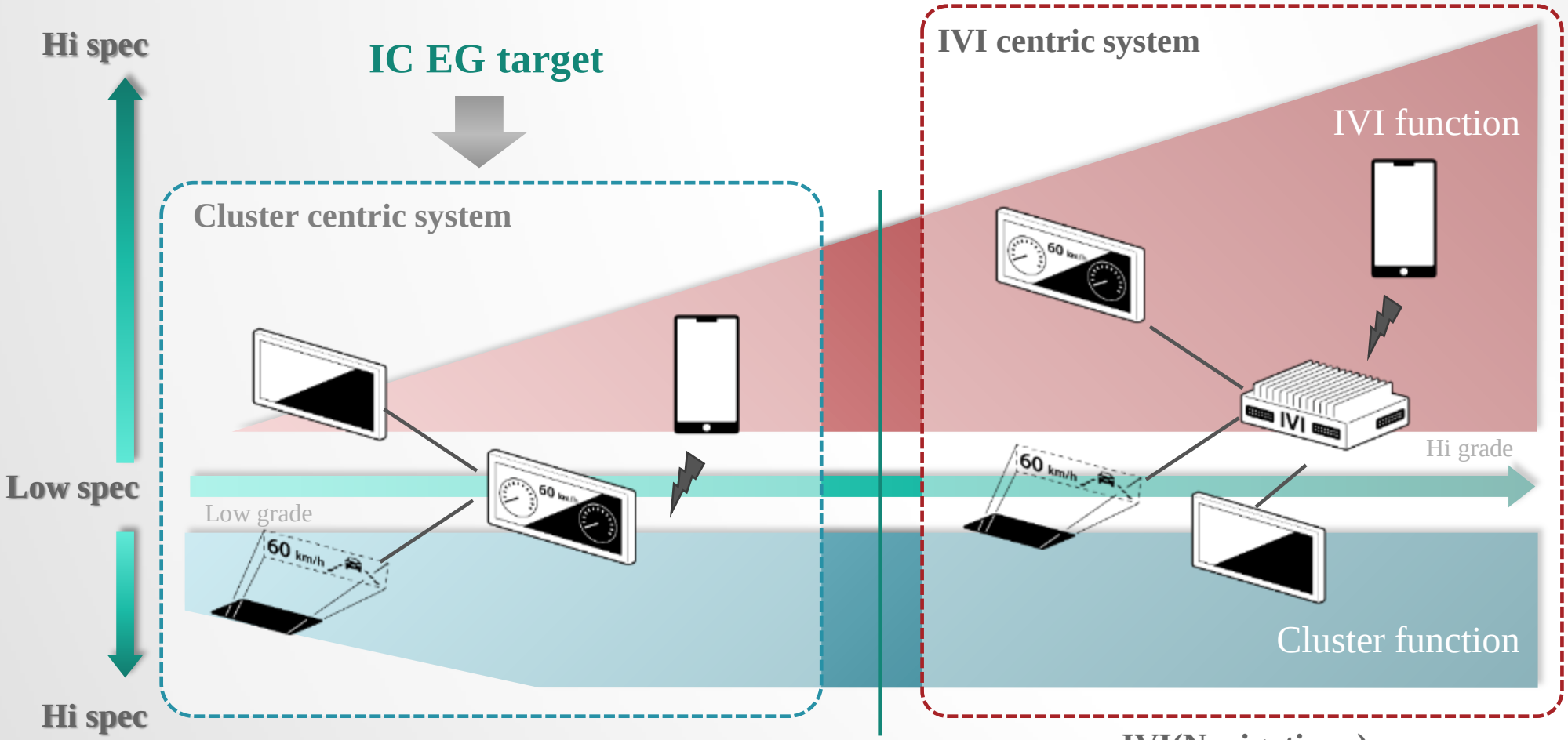
Instrument Cluster Expert Group

- Motivation
  - Create a base platform for instrument cluster by using Linux.
  - Solve some of the product development issues in AGL community.

- Members
  - Suzuki (Leader), Toyota, Honda, Mazda
  - Denso, Panasonic, Continental, Bosch, Nippon Seiki
  - Denso Ten, Aisin AW

EG scope and system image?



Cluster(HUD)
+
Smart phone connection(SDL..)
for small IVI function

IVI(Navigation..)
+
Cluster(HUD)
+
Smart phone connection(SDL..)

What are the development issues?

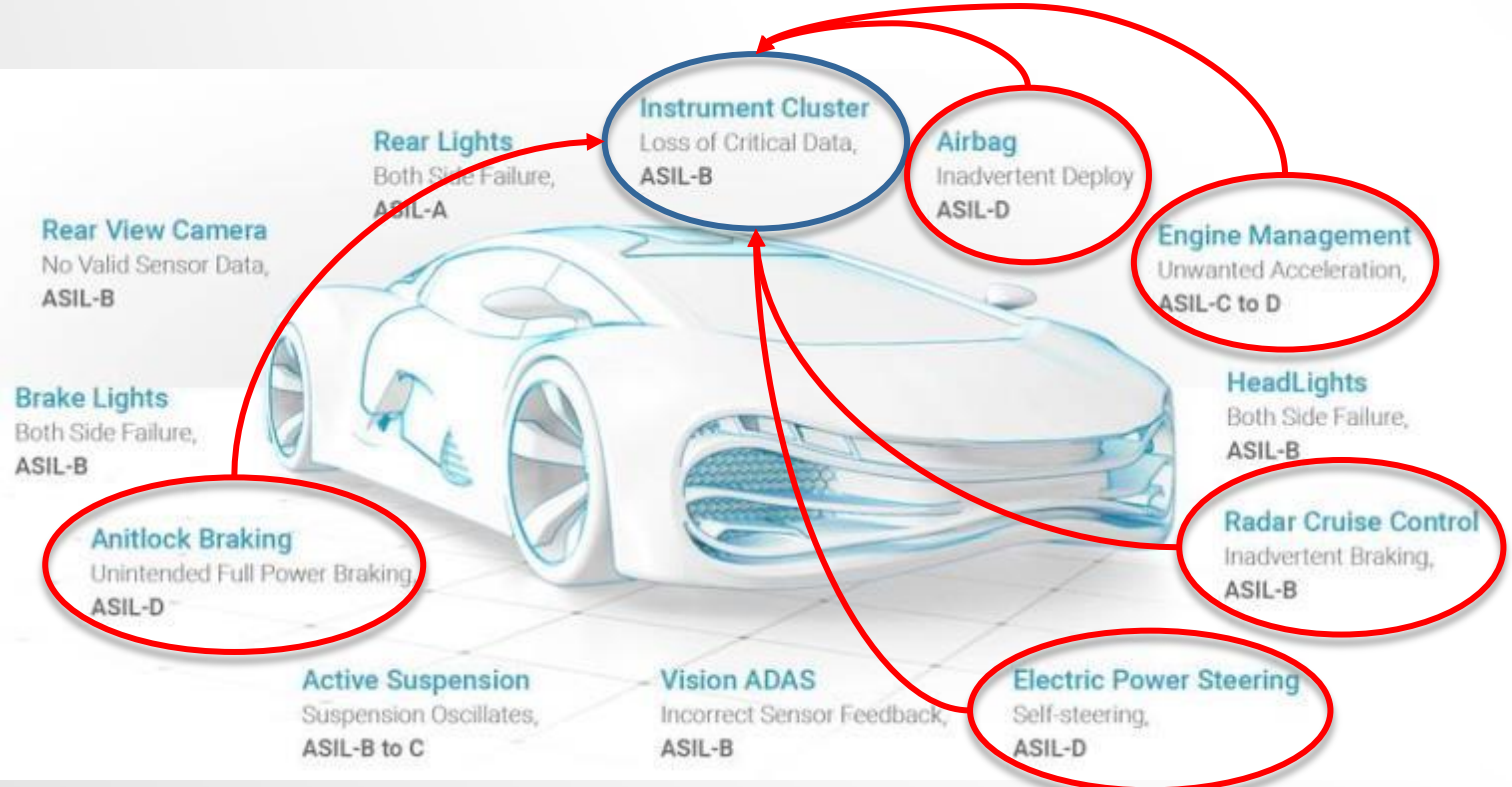
1. **Quality and Robustness**
   - Functional safety is required.
   - Quality management is required.

Focus in today's presentation

2. **Lightweight**
   - Constraints on boot time are severe.
   - Current AGL stack is heavyweight.

Why need Functional Safety

- Typically instrument cluster assigned ASIL-B.
  - Includes telltale function that is assigned ASIL-B.
    - ASIL-B was decomposed from other units.
  - Existing instrument cluster does not have ASIL from own functions.



Ref. https://www.synopsys.com/automotive/what-is-asil.html

Approach for Functional Safety

Main function is the very function of our system

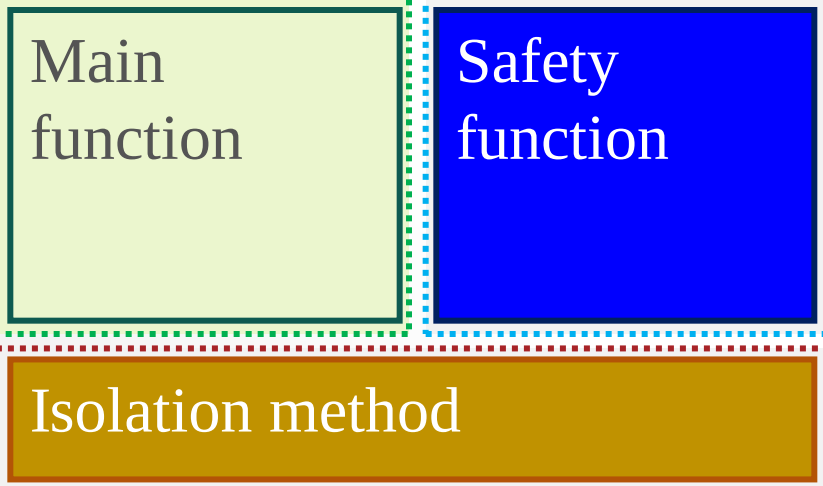
- Requires advanced quality management.
- Requires open innovation.
- Requires cyber security.
- Requires fast boot.
- Requires various functions.
- …

Main target of IC-EG

Safety function ensures vehicle safety

- What function does it include?
- Which OS do you use?
- Which communication method do you use?

Collaborate with other project.



Main function and safety function are isolated by isolation method.

- Hardware separation? Using hypervisor?

Collaborate with other project.

Puzzles in automotive quality management

- There are many puzzles in the automotive system (main function).

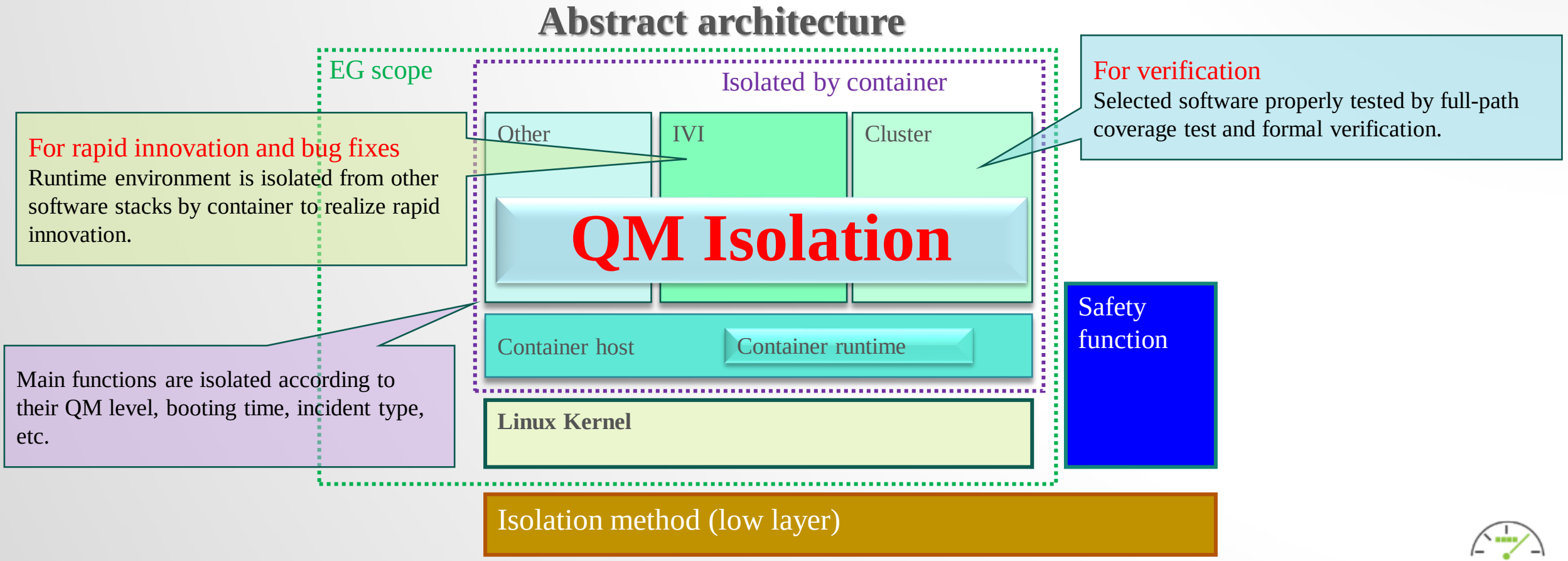
IVI	Instrument Cluster

• Rapid innovation
  • New features are added
  • Short-term development
  • Rapid bug fixes
	Puzzle
	• Advanced quality management
	  • Full path coverage testing
	  • Formal verification
	  • Careful bug fixes

• Various functions
  • Many pre-installed applications
  • Applications installed from store
	Puzzle
	• Selected functions
	  • Combinational verification
	  • Fast boot-up

QM Isolation

- Our answer to the puzzle issues is “one more isolation method" which takes one-more layer to isolate the functions by using Linux container technology.



What are the product development issues?

1. Quality and Robustness

- Functional safety is required.
  - **Collaborate with other project**
- Quality management is required.
  - **QM Isolation**

2. Lightweight

- Constraints on boot time are severe.
- Current AGL stack is heavyweight.

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Background for development process

- IC EG proposed QM Isolation architecture.
  - This architecture allows to isolate each type of software stack.
    - The software for instrument cluster can be developed with the quality standards of the instrument cluster.
    - The software for IVI can be developed to the quality standards of the IVI.

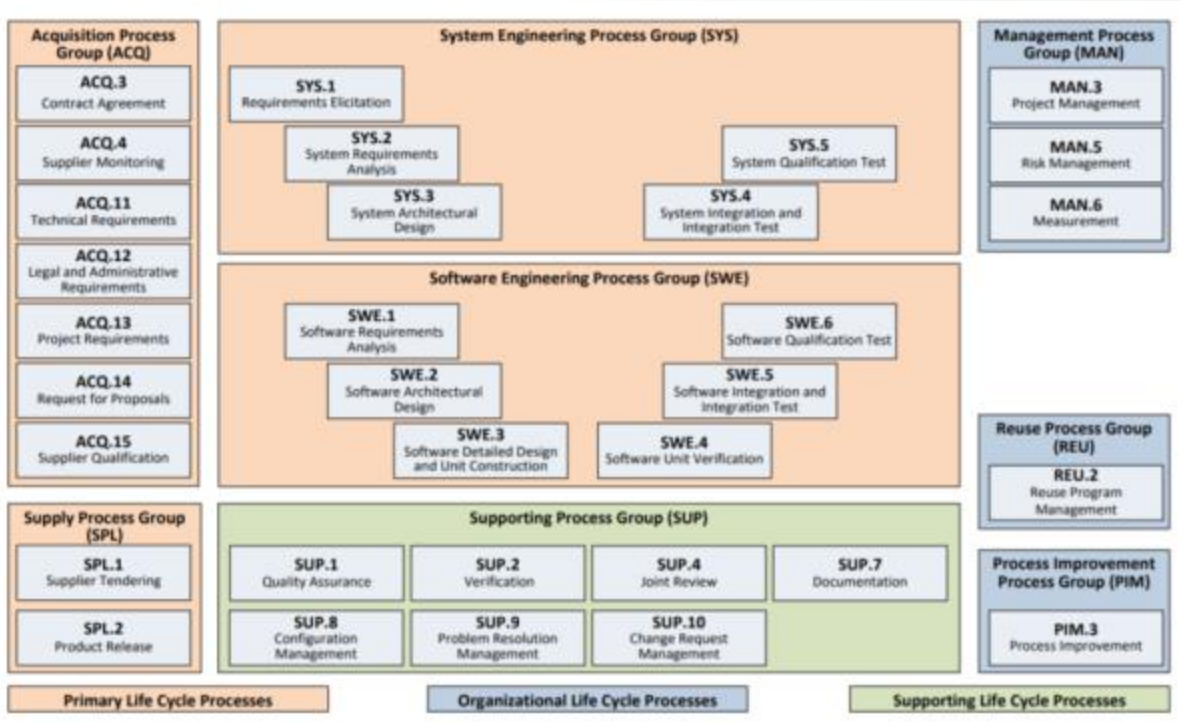
- This means that :
  - When AGL develops software for the instrument cluster, it must conform to the quality standards of the instrument cluster.
    - Automotive SPICE has been used in the development process for existing instrument cluster product.

What is Automotive SPICE

- Automotive SPICE is a domain-specific version of the Software Process Improvement and Capability Determination (SPICE).

- Automotive SPICE is a framework for the automotive software development process in the automotive industry.

- It defines to:
  - System Engineering Process
  - Software Engineering Process
  - Supporting Process
  - Etc…



Ref. Automotive SPICE Process Reference and Assessment Model RELEASE 3.1

What we aim

- We aim to change all OSS to the ASPICE compliant development.
  - We analyze the current development process of existing OSS.
  - We will reach to the existing OSS community to fill in the gaps.

- We will reach to change the existing OSS source code to conform to MISRA.

What we aim

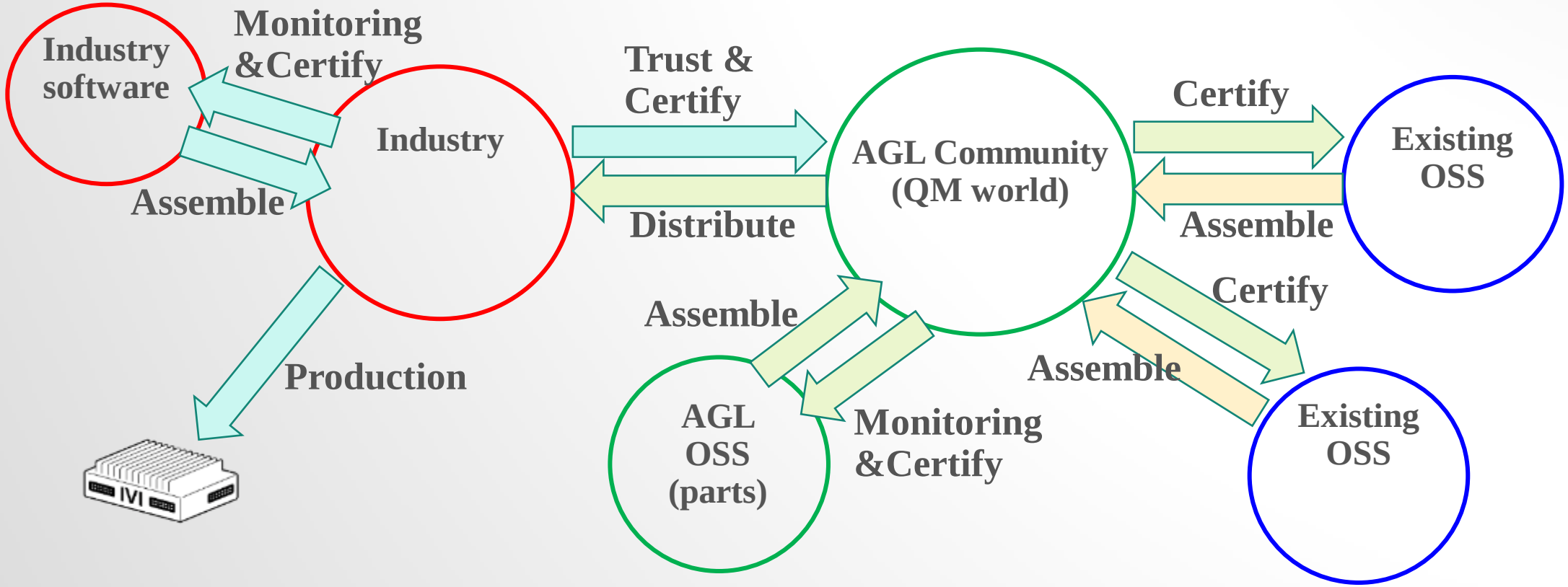
- ~~We aim to change all OSS to the ASPICE compliant development.~~
  - ~~We analyze the current development process of existing OSS.~~
  - ~~We will reach to the existing OSS community to fill in the gaps.~~

- ~~We will reach to change the existing OSS source code to conform to MISRA.~~

These are wrong approach.

What we aim

- We want to create workflow from open source development to product development.
  - Want to be able to certify that it has quality control.
  - Want to be able to embrace by open source community and industry.



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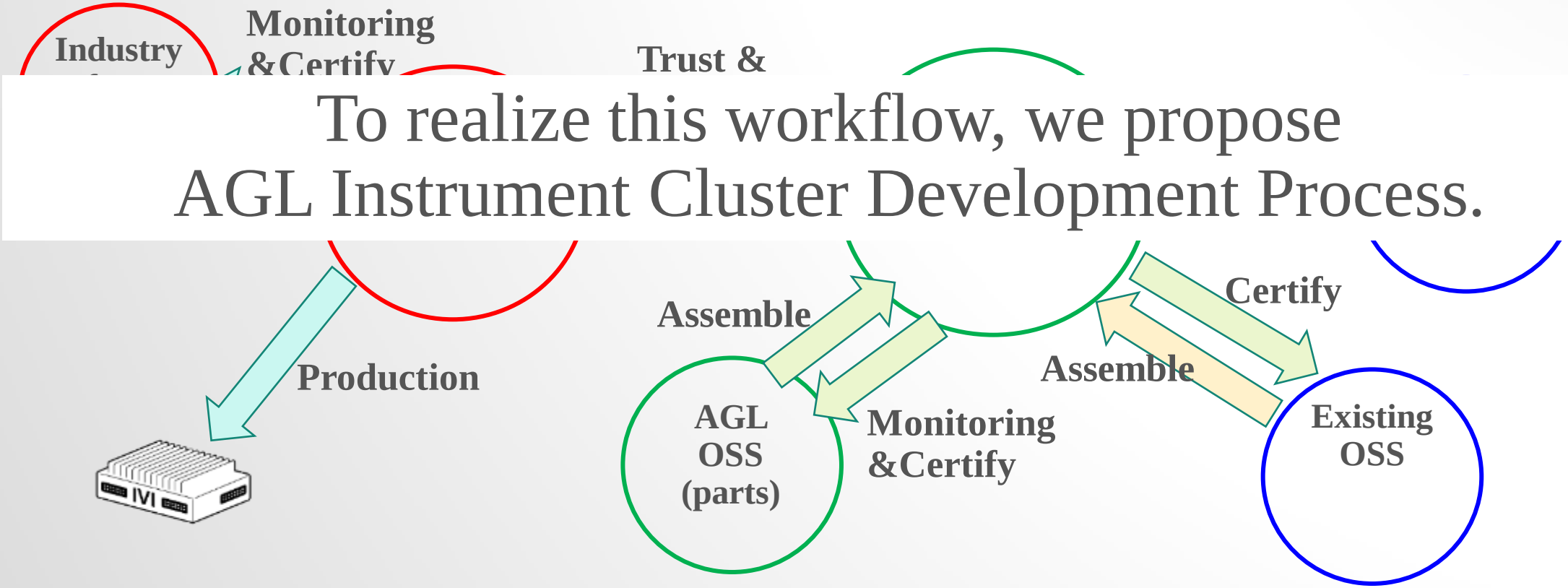

To realize this workflow, we propose
AGL Instrument Cluster Development Process.

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Current AGL issues

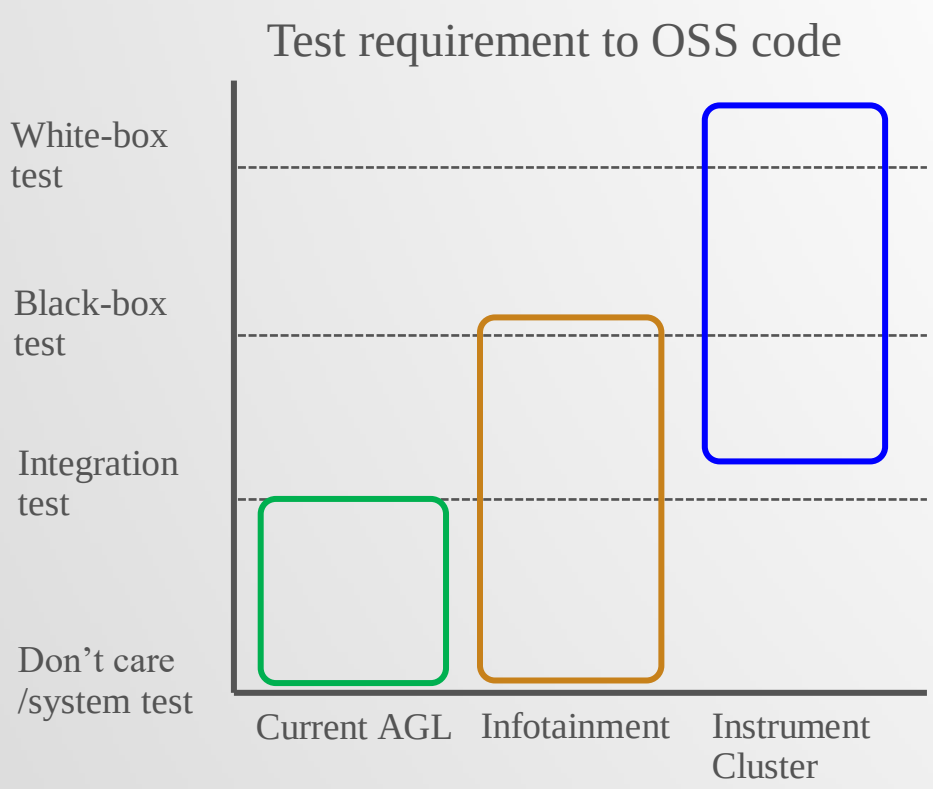
- Why need AGL Instrument Cluster Development Process ?
  - IVI and clusters are different in terms of requirement.

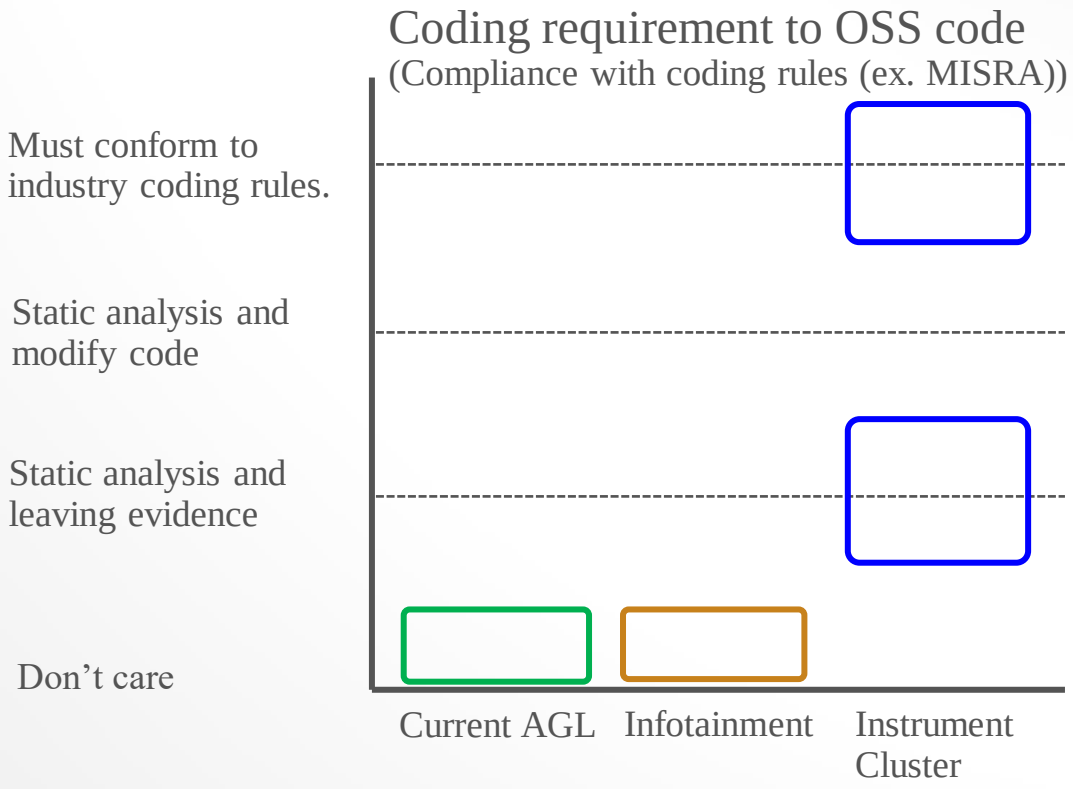
- Many automotive industries are using famous OSS in infotainment system.
  - This mean part of existing OSS development process is already accepted by automotive industry in infotainment system quality requirement.
    - Such as linux, glibc, openssl, genivi dlt, android and etc..
    - AGL specific OSS? It’s good question.

- But automotive industries use only limited OSS in instrument cluster systems.
  - This mean existing OSS development process is not match in instrument cluster quality requirement.

What is gap between infotainment and Instrument cluster

- What acceptance method do you use OSS in industry development process?
  - Current AGL is including existing OSS such as glibc, weston, etc…
  - No big gap between current AGL and Infotainment.
  - On the other hand big gap between current AGL and instrument cluster.
  - This information based on Taguchi-san (member of IC EG) excellent work.

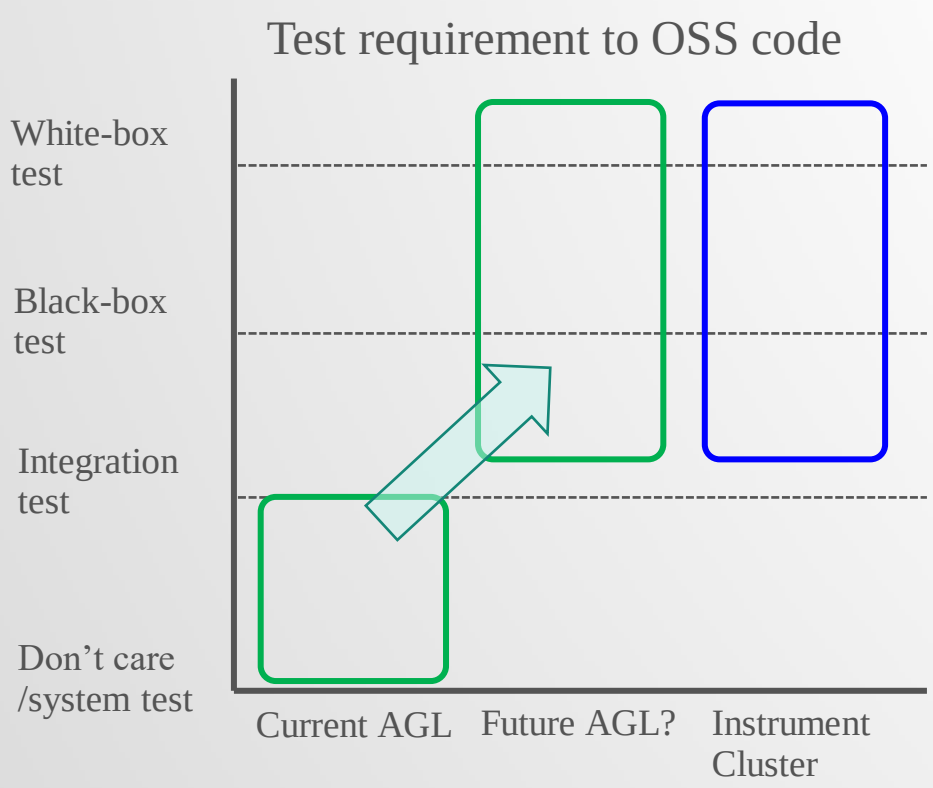


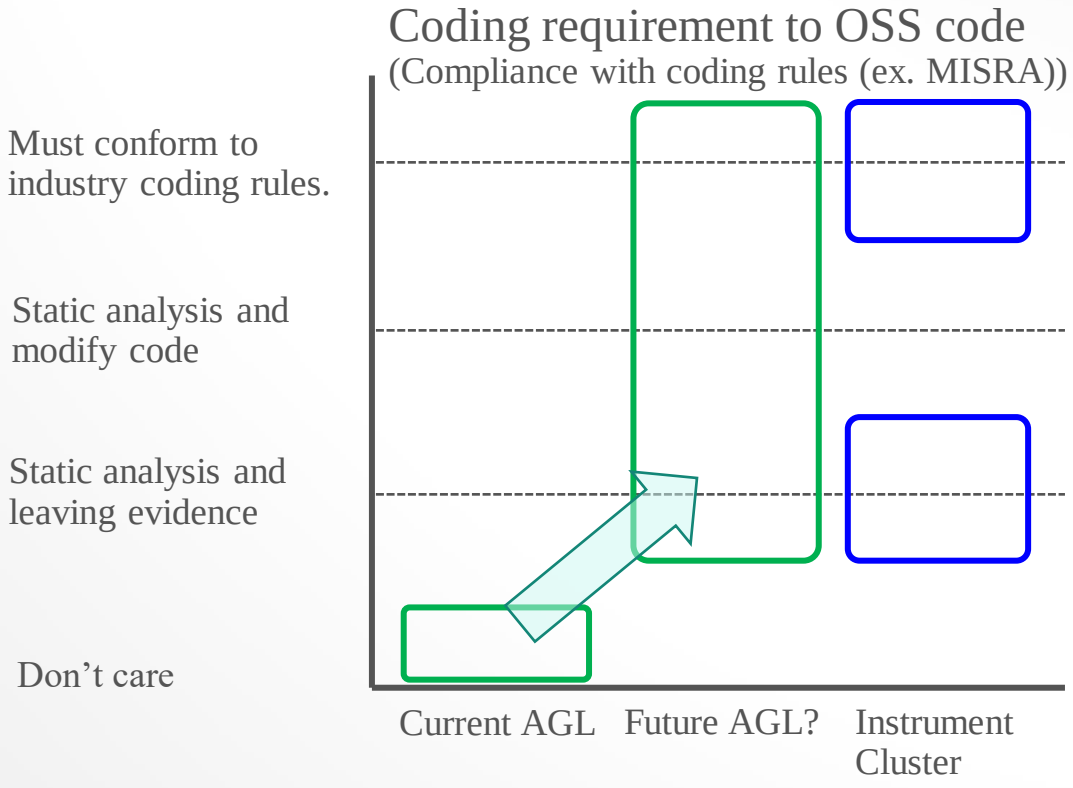


What is gap between infotainment and Instrument cluster

- What do we aim to achieve ?
  - Test coverage will grow to real product development level ?
  - Coding rule will adopt to real product development level ?

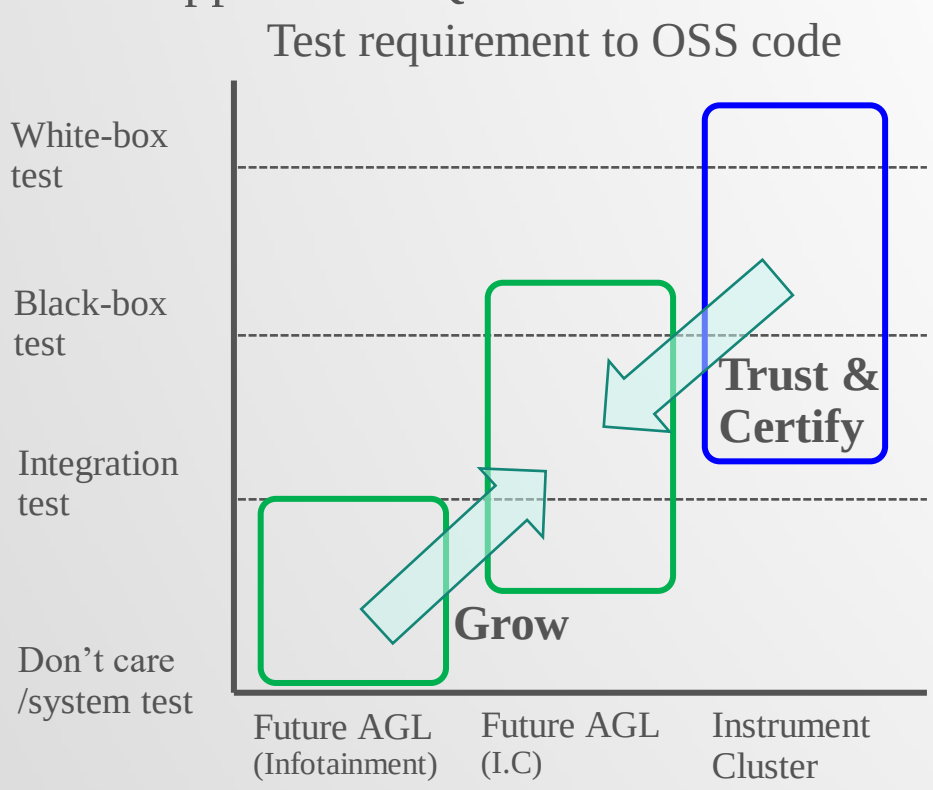
These are wrong approach.

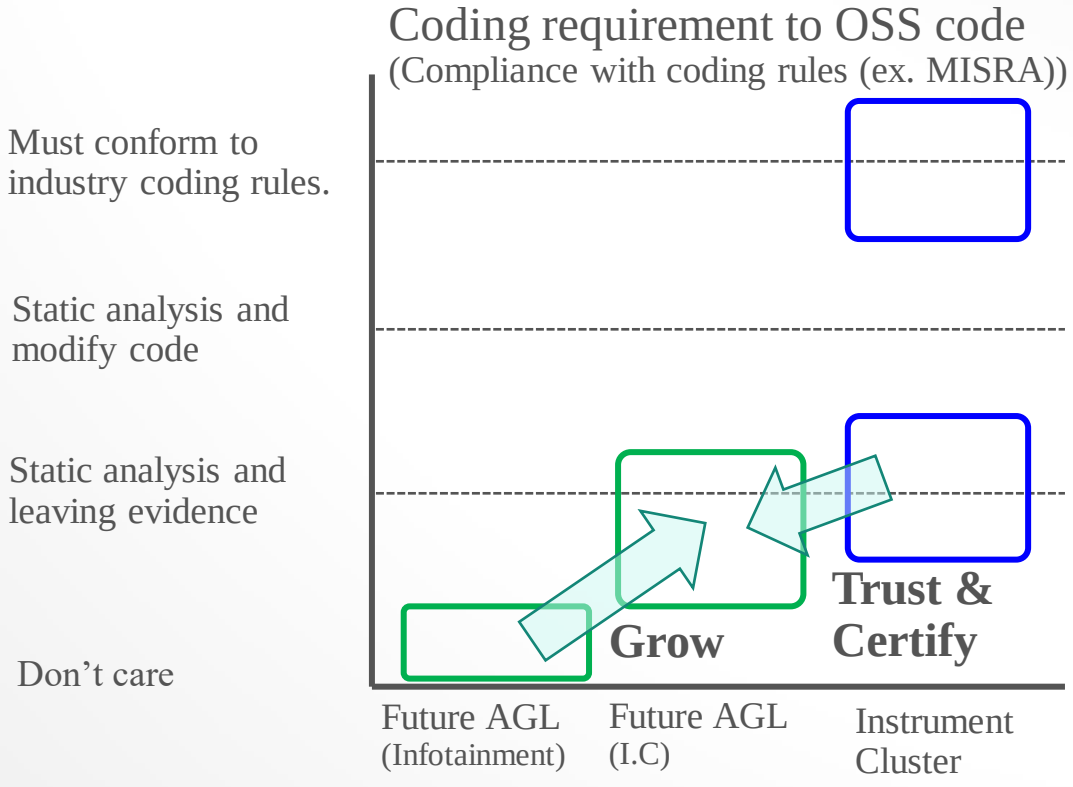




What is gap between infotainment and Instrument cluster

- What do we aim to achieve ?
  - Test coverage will grow to more higher level. Industry will trust and certify to AGL.
  - Coding level will upgrade. Industry will trust and certify to AGL.
- Possible?
  - These challenge are limited to the software stack for the instrument cluster.
  - It's approach of QM Isolation.

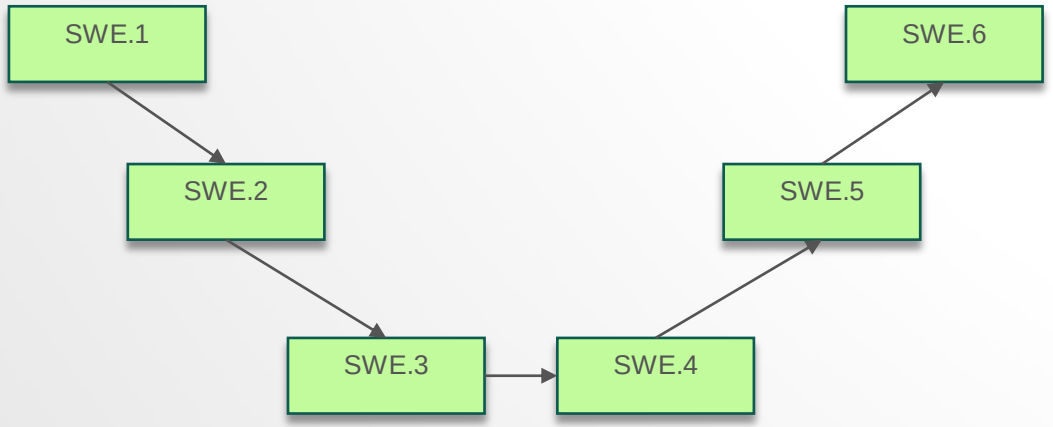




How to arrange of development process?

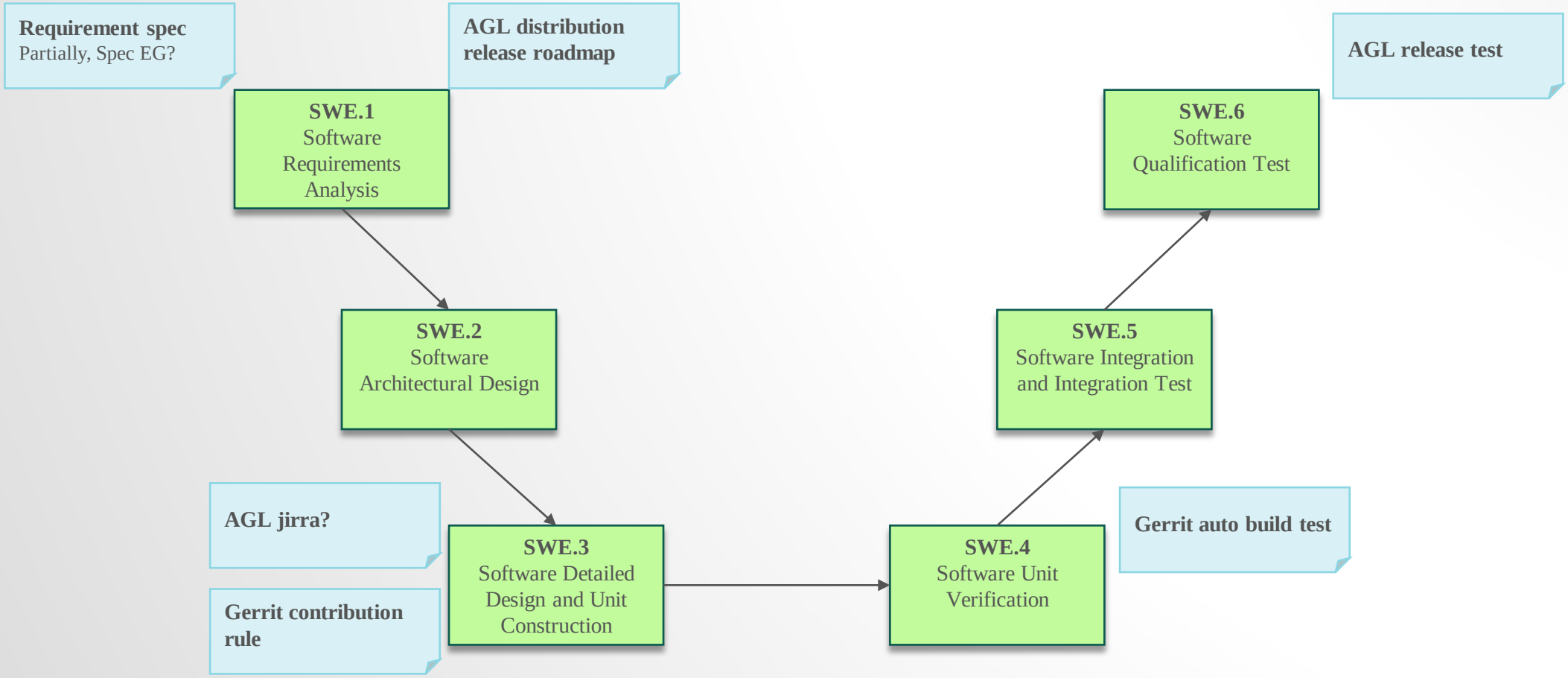
- Automotive SPICE based software development require to V-model development.
  - SWE.1 Software Requirements Analysis
  - SWE.2 Software Architectural Design
  - SWE.3 Software Detailed Design and Unit Construction
  - SWE.4 Software Unit Verification
  - SWE.5 Software Integration and Integration Test
  - SWE.6 Software Qualification Test

- How to arrange of development process both OSS and industry?
  - It's big issue.



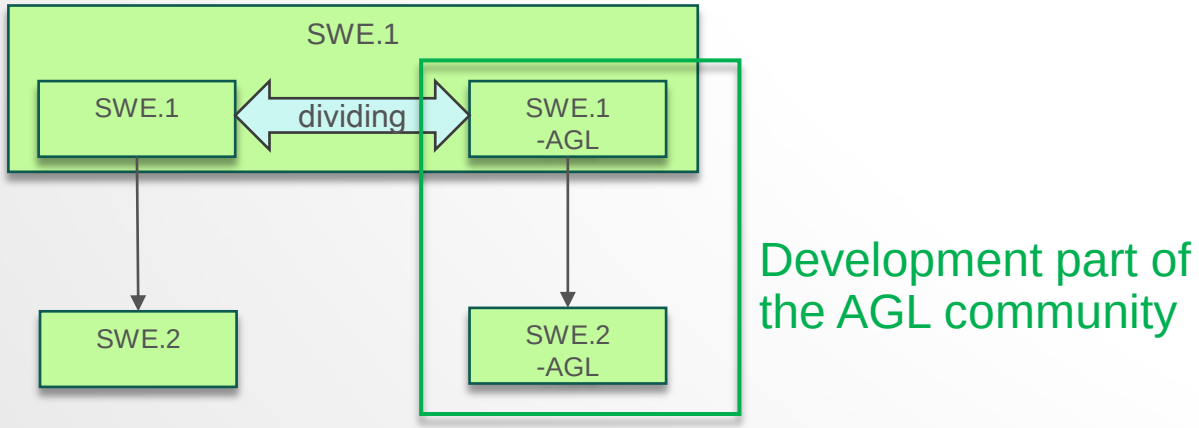
What is the current AGL gap with future?

- Comparison of the current AGL development process with the V model.



SWE.1 Software Requirements Analysis

- When we use AGL platform in product, software requirements can divide to two parts. One part is AGL distribution part, another part is proprietary part.
- Industrial point of view
  - We have to analyze system requirement. And we have to know what requirement achieve by AGL platform.
  - We have to define the verification criteria to test at SWE.6 phase.
  - The work products of SWE.1 must be performed by us (industry).



SWE.1 Software Requirements Analysis

- How to trust AGL community?
  - ACQ.4 is define the supplier monitoring process.
- Community point of view
  - We are not a supplier !!
- Our opinion
  - ACQ.4 requires to collaborative work and common agreement with customers and suppliers.
  - If the industry members collaborate in AGL community, we can obtain ACQ.4 requirement.
    - It’s current AGL IC-EG situation.

ACQ.4.	BP1	Agree on and maintain joint processes
	BP2	Exchange all agreed information.
	BP3	Review technical development with the supplier.
	BP4	Review progress of the supplier.
	BP5	Act to correct deviations.

SWE.1 Software Requirements Analysis

- What work products are required of the community?
  - ASPICE requests these work products.
  - But AGL platform is provided "AS IS" by the community.
- Our opinion
  - AGL community should provide blue work products.
  - Other work products don't require in "AS IS" case.

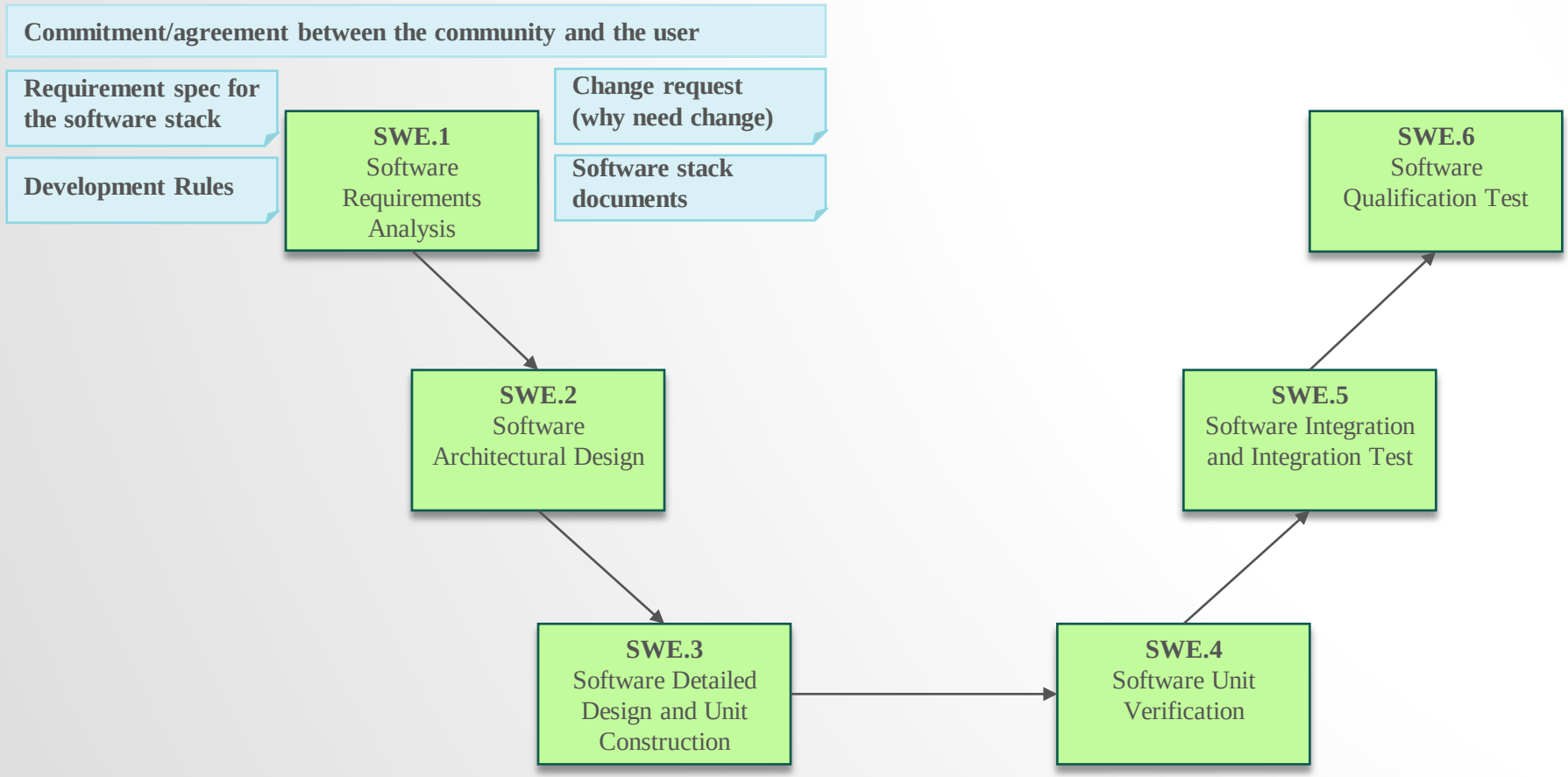
ACQ.4.	**02-01**	**Commitment/agreement**
	13-01	Acceptance record
	13-04	Communication record
	13-09	Meeting support record
	13-14	Progress status record
	13-16	**Change request**
	13-19	**Review record**
	14-02	Corrective action register
	15-01	**Analysis report**

SWE.1 Software Requirements Analysis

- What should we do?
  - Create reference spec to show our vision.
    - It has to be able to break down to software architecture.
    - It doesn't have to be perfect, but it needs to cover the required area to determine the direction.
  - Define development process to show our rule.
    - Contribution rule.
    - Design rule.
    - Documentation rule.
    - Coding rule.
    - Review rule.
  - Describe "why and what it's changed".
  - All records are open to track and assess the AGL community.

What is it need?

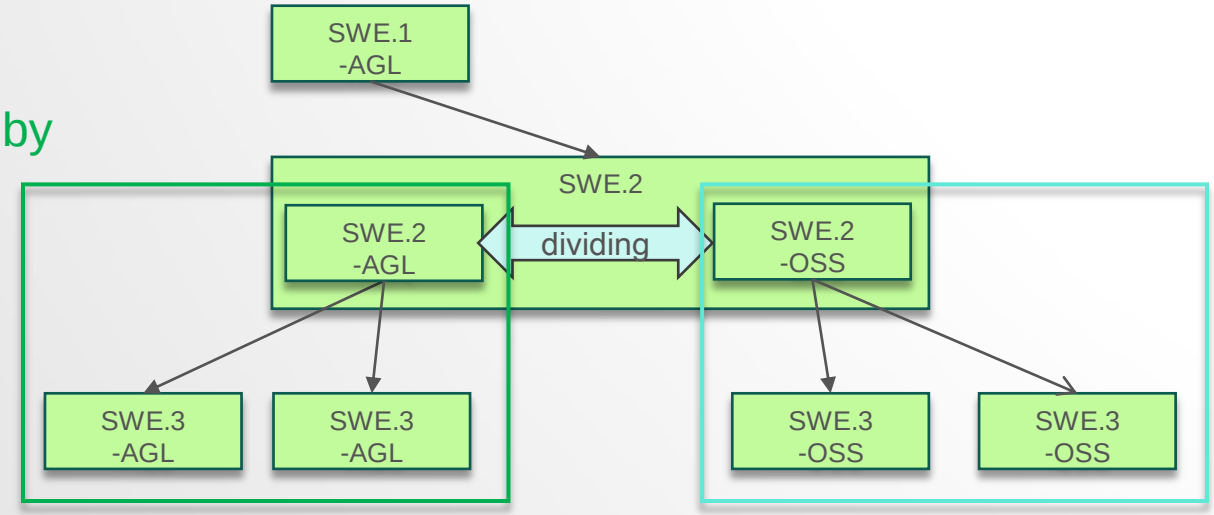
- IC-EG development process SWG are proposing this work.



SWE.2 Software Architectural Design

- In this phase, we have to
  - Identify which software requirements are to be allocated to which elements of the software.
  - Evaluate the software architectural design against defined criteria.
- This mean we should to analyses to :
  - Which requirements need to develop by AGL community.
  - Which requirements assign to which OSS.

Need to develop by AGL community



Use existing OSS

In case of develop by AGL community

- How to trust AGL community?
  - Community point of view
    - We should to do the activities outlined in the BPs.
      - It's including incompatible activities with open source development.
      - In typical open source development does not defined final product environment. It's no problem.
      - We would better to define one or more reference environments to share a common performance standard in our development.

SWE.2.	BP1	Develop software architectural design.
	BP2	Allocate software requirements.
	BP3	Define interfaces of software elements.
	BP4	Describe dynamic behavior.
	BP5	**Define resource consumption objectives.**
	BP6	Evaluate alternative software architectures.
	BP7	Establish bidirectional traceability.
	BP8	Ensure consistency.
	BP9	Communicate agreed software architectural design.

In case of develop by AGL community

- What work products are required of the community?
  - ASPICE requests these work products.

- Our opinion
  - AGL community should to describe architectural design document, discussion and review record.
    - Current AGL does not have standardized document format and review record format.
      - We should to resolve this issue as soon as possible.
      - It is not needed for demo only software.

SWE.2	04-04	Software architectural design
	13-04	Communication record
	13-19	Review record
	13-22	Traceability record
	17-08	Interface requirement specification

In case of requirements assign to existing OSS

- When in case of requirements assign to existing OSS, we have to trust these OSS.
  - That means AGL community have to certify existing OSS.

- Our opinion
  - We should use REU.2 (Reuse Program Management).

REU.2.	BP1	Define organizational reuse strategy.
	BP2	Identify domains for potential reuse.
	BP3	Assess domains for potential reuse.
	BP4	Assess reuse maturity.
	BP5	Evaluate reuse proposals.
	BP6	Implement the reuse program.
	BP7	Get feedback from reuse.
	BP8	Monitor reuse.

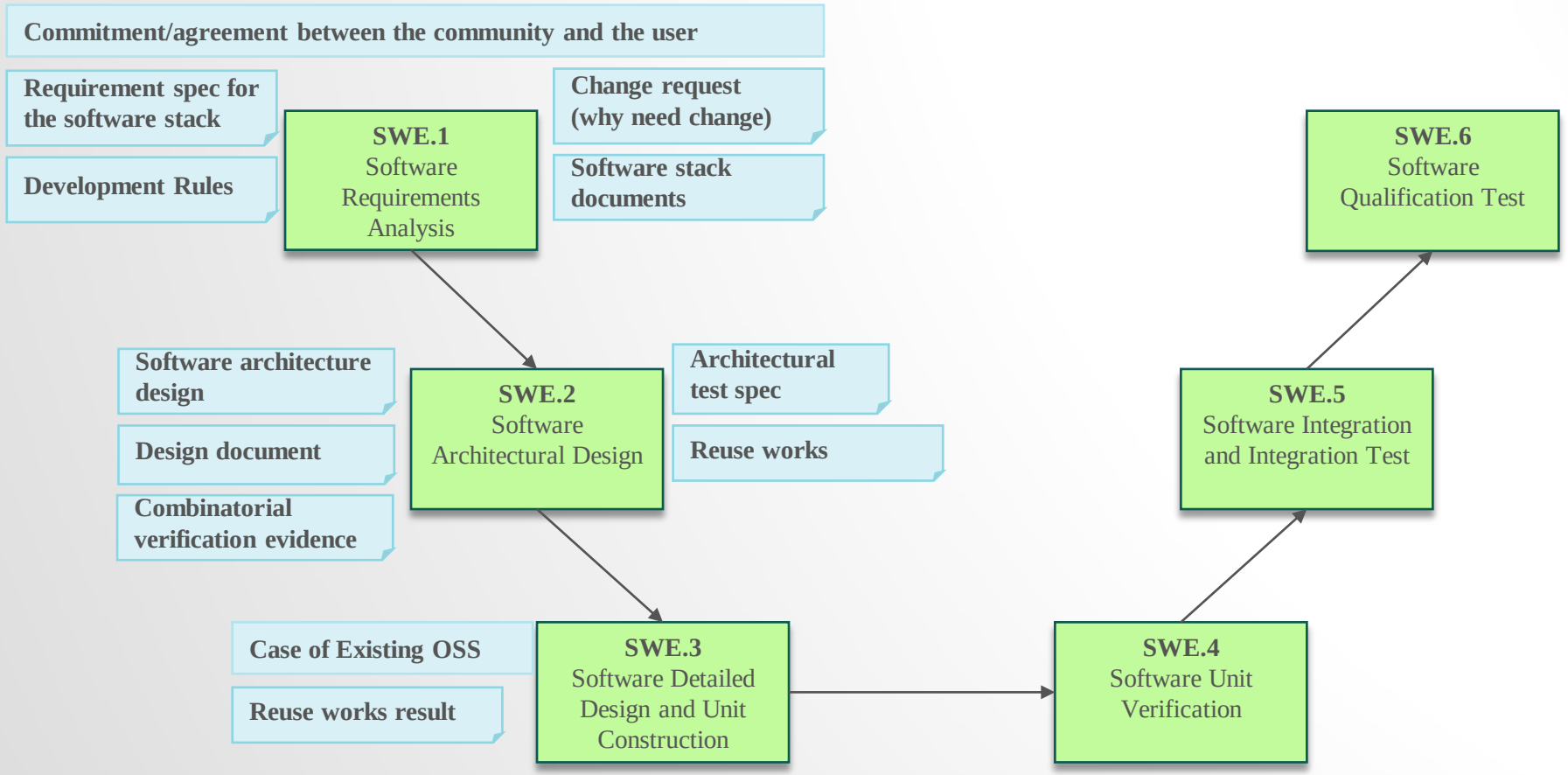
In case of requirements assign to existing OSS

- What work products are required of the community?
- Our opinion
  - AGL community should to create these work products.
  - Current AGL does not have this strategy. Need to define it.
    - Such as code quality assessment using static analysis tool.

REU.2.	04-02	Domain architecture.
	04-03	Domain model.
	08-17	Reuse plan.
	09-03	Reuse policy.
	12-03	Reuse proposal.
	13-04	Communication record.
	15-07	Reuse evaluation report.
	15-13	Assessment/audit report.
	19-05	Reuse strategy.

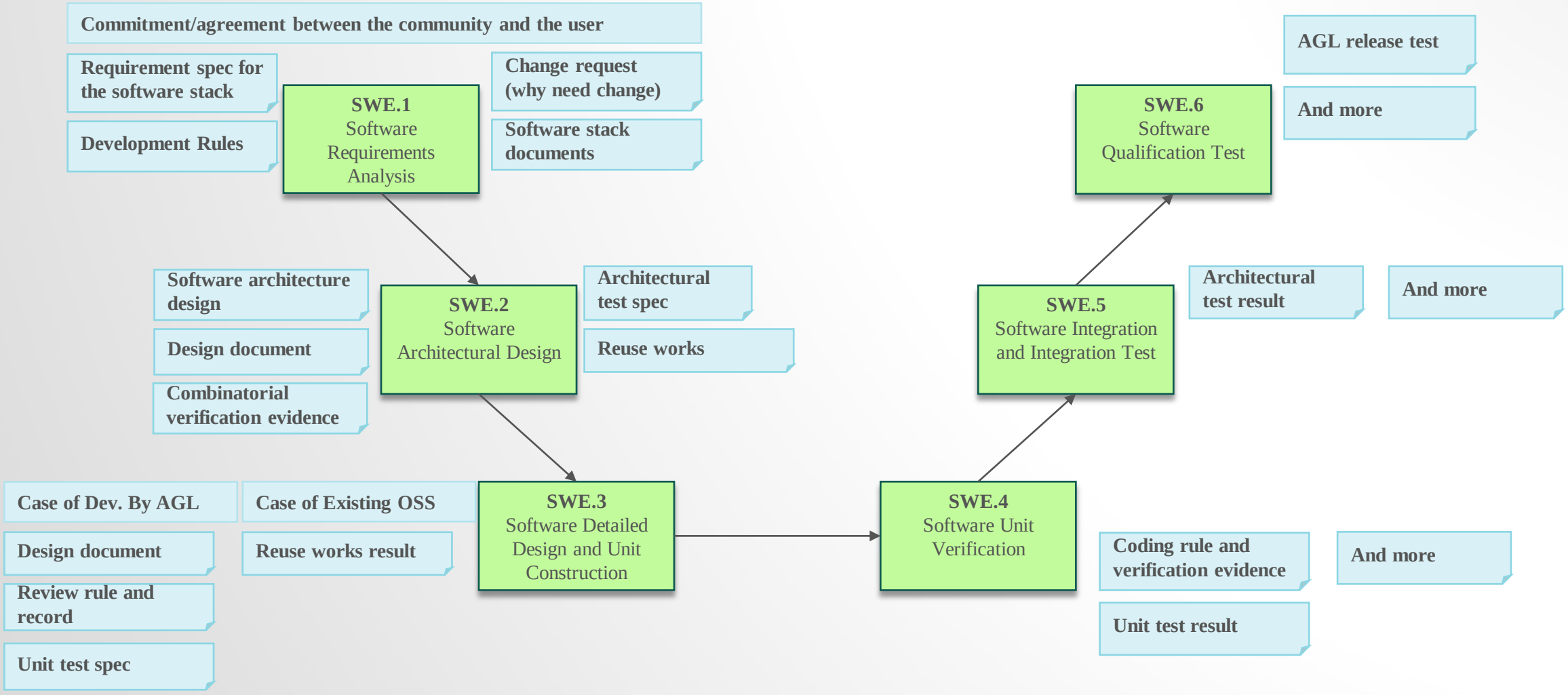
What is it need?

- IC-EG development process SWG are proposing this work.



What is it need?

- IC-EG development process SWG are discussing more work to realize AGL Qualified distribution.



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Conclusion

- In this presentation:
  - We shared the issue of instrument cluster development in AGL.
    - The existing AGL rules are sufficient for the innovative development of IVI.
    - New rules are needed for the quality oriented development of instrument cluster. That is AGL Instrument Cluster Development Process.
  - We shared the status for the AGL instrument cluster development process.
    - This process is discussing by the development process sub working in AGL.
      - Ref. https://confluence.automotivelinux.org/display/IC/
- Next step:
  - We will define more detail and test/evaluation criteria with community members.