Analysis of established processes regarding automated driving
In which steps do the established development and safety processes need to be extended to enable the development and safeguarding of automated driving functions?

The V-model is a process model originating from the software development that has established itself as well for the development of complex safe-critical systems in the avionics and automotive domain.

The first step is to specify the requirements for the complete product (which is the vehicle here) from the perspective of the stakeholders.

For the final approval it is examined whether the complete product satisfies the requirements of the stakeholders.

The remaining part of the left branch of the V covers the design of the system on multiple levels of abstraction finally resulting in a technical implementation.

The right branch of the V describes the verification and validation of the developed system. For this purpose for each abstraction level test obligations are defined that need to be satisfied for a successful product development.
The ISO 26262 is a standard for safeguarding electric and electronic (E/E) systems in passenger cars. Based on the V-model, the standard defines a process to prove the safety of such systems before putting them into operation. This process was and still is successfully applied for both vehicles that are exclusively operated by human drivers and advanced driver assistance systems (ADAS).

After defining the functional specification of the system under development, a hazard analysis and risk assessment is performed. Based on these results, the system is designed, and a safety concept is developed. The hardware and software development then takes place in further parallel runs of the V-model.

On the right branch of the V, integration tests for the developed components are performed, and a validation of the safety goals (safety validation) takes place as well as a functional safety assessment of the complete vehicle against the functional specification.
New Challenges that arise with the introduction of automated driving functions and the resulting extensions of the development and safeguarding processes:

- Interaction with other human traffic participants (mixed traffic)
- Takeover situations between human driver and automation
- Operation in highly complex and hardly predictable environments (open world)
- Loss of human driver as fallback level (fail-operational instead of fail-safe)
- Changing safety-critical functional requirements during product life e.g. extension of the range of functions and the operational environment, respectively
- More intensive use of machine learning techniques in software modules

Diagram showing the V-Model and process analysis with various stages and processes like requirements, functional specification, hazard analysis and risk assessment, system design, system tests, acceptance tests, and technical implementation.