



# Software development

Implementation of algorithms as a software module in your target system

## 1 Software development

In addition to developing algorithms, we also offer pure software development for our customers. This enables us to integrate the algorithms we have developed directly into your target system and to validate them based on the prototype implementation. We can also take into account technical software requirements during the algorithm development and design the algorithms accordingly.

We create individual software solutions that are precisely tailored to the requirements and needs of our customers from a wide variety of industries.

Knowtion offers software development according to defined standards and processes in order to guarantee a high level of software quality and functional safety - and thus freedom from errors. This includes all phases of the software development process, from the recording of requirements through to maintenance.

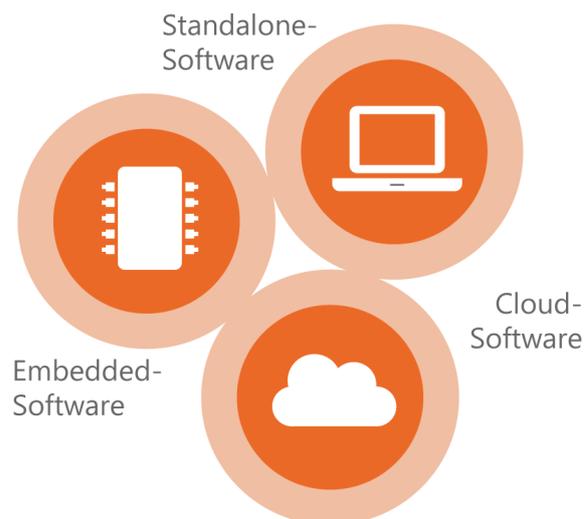
## 2 Range of services

Our goal is to achieve 100% customer satisfaction and from our perspective this requires that we create individual software solutions that are precisely tailored to the requirements and needs of our customers from a wide variety of industries. Our range of services extends from embedded software to scalable server architectures based on different platforms, development environments, technologies and standards. Knowtion supports you with individual software modules or takes over the development of entire software products.

**We implement the algorithms as software modules on all levels**

**-> from embedded to the cloud**

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## 3 Software quality

To ensure software quality, we use, among other things, the following techniques:

- Software development according to documented processes and standards (e.g. V-Modell XT)
- Tool-aided development
- Traceability of all created artifacts over the entire product life cycle

- Regular execution of project audits
- Verification and tracing of requirements throughout the complete development process (Verification Cross Reference Index)
- Division of development process into two phases (development and test phase)
- Reviews of all development documents (4-eyes principle)
- Processes to support functional safety (e.g. ED-153) and failure mode and effects analysis (FMEA)

## 4 Development process

Depending on the specific project, there can be major differences in our development process, but they all have in common that this process is coordinated, aligned and documented with you in advance. Our software development services cover the entire development process, from the re-

**We develop software modules according to defined industrial processes and international standards**

recording of customer-specific requirements, through software development and quality assurance, to the installation and commissioning of the application in the target environment.

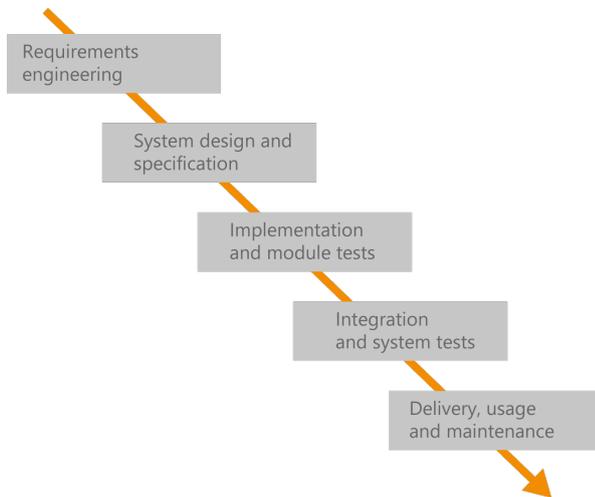
The optimal choice of the development process in consultation with you depends on the following aspects:

- Type, scope and duration of the development project
- Target environment of the software modules, for example on embedded or in the cloud
- Your own specifications, wishes and ideas

Using a suitable development process, we develop software modules that meet the relevant quality requirements and customer coding guide lines in the shortest possible time.

## Waterfall model

The waterfall model in software development is describing a linear process model that organizes the entire development process in successive project



phases. As by using the waterfall model, the results of each phase are always used as a binding specification for the next lower phase. For example, all requirements must be established before the design phase is started or the software must be fully implemented before it can be evaluated in the test phase. The documentation takes place at the end of each phase so that a high project quality can be ensured.

### Advantages:

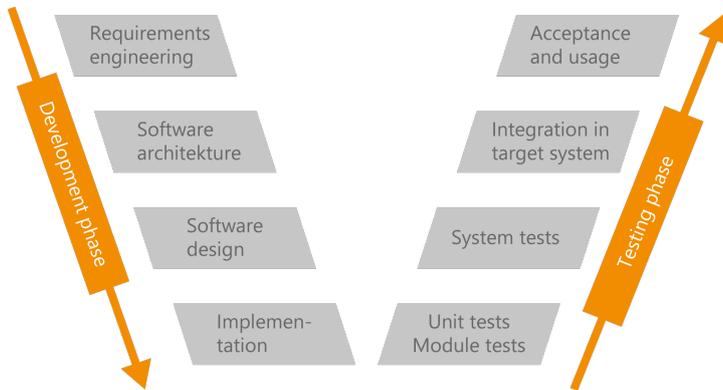
- All requirements for the software are set up and formulated clearly and unambiguously before development begins.
- Each phase is completed within a specified period of time and the next phase is followed. This gives the project a certain degree of planning security.
- Since this is a linear process model, it is easy to set.
- The resources required to implement this procedural model are minimized.
- The documentation is carried out after each phase and this ensures a high quality of development.

### Challenges:

- For complex tasks errors and problems in a phase are never completely resolved in this phase and occur after a phase has been completed. This often leads to a poorly structured system.
- Changes to the requirements during the project period can no longer be taken into account in the current development.

## V-Model

In contrast to phase-oriented process models such as the waterfall model, only activities and results are defined in the V-Model and no strict time sequence is required. The development does not take place in single li-



near axis, instead the levels rotate upwards again after the coding phase is completed. This development process allows software developers and testers to work in a structured manner as parallel teams. For example, based on the existing requirements, the test first version of the specifications are prepared at an early project phase.

### Advantages:

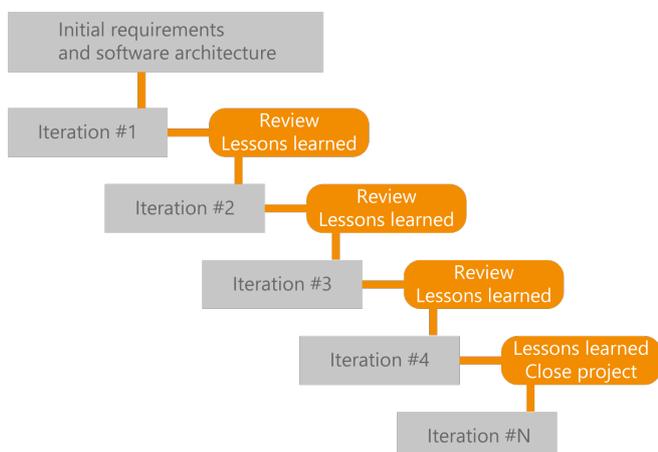
- Offers the same advantages as the waterfall model.
- Software testers are already involved in creating the requirements. This achieves a high test coverage rate and thus high reliability and quality of the software.
- Changes to the requirements are possible during the project term.

### Challenges:

- The main challenge of the V-model is that it is very stiff and the least flexible.
- If something changes during the course of the project, not only the requirements documents but also the test documentation have to be updated.
- With many changes during the project period and the need for reviews, consistent documentation requires a great deal of effort.
- This procedural model is not suitable for short-term projects, as reviews and checks are required in every phase.

## Agile development (Scrum)

In agile software development, attempts are made to increase transparency and flexibility and to use the developed systems more quickly in order to minimize the risks in the development process. Small increments of



executable and useful software is thus quickly and continuously delivered to the customer as part of releases and thus, in addition to minimizing risk, leads to higher acceptance and satisfaction. The most important characteristic of all agile approaches are self-organizing teams and an iterative and incremental approach. The best-known and widely used representatives of agile software development are Scrum and Extreme Programming.

### Advantages:

- The most important benefit of agile methods is the ability to respond to the changing requirements of the project.
- Solutions can be found for tasks for which an exact description of the solution path is not possible at the beginning of the project.
- There is no need to make guesswork between the development team and the customer as communication is face-to-face and continuous input from the customer.

### Challenges:

- The original assessments are constantly being exceeded or not achieved.
- Whether the agile approach leads to products being developed quickly, well, cheaply or of high quality depends on how the knowledge gained is applied.