Proposal for PLCopen Working Group

Metrics for Quality Assessment of PLC Software in Machine and Plant Manufacturing

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Introduction of a new PLCopen Working Group

Metrics for Quality Assessment of PLC Software in Machine and Plant Manufacturing

High control software quality that can optimally meet the challenges of complex, long-living, and evolving machines and plants has since long been one of the key enablers on the road to Industry 4.0. Software metrics are a proven means in computer science to objectively assess software quality. Recently, numerous approaches have emerged in research to transfer established metrics for PLC software in automated manufacturing systems, which are partly also implemented by PLC platform suppliers to enable an automated quality assessment. However, up to now, these approaches have barely made their way into industrial development practice in machine and plant manufacturing.

Therefore, this working group aims to develop guidelines on how a metric-based quality assessment of PLC software can be integrated into the daily industrial routine for different stakeholders in the software engineering workflow in machine and plant engineering. Existing approaches from research and tool support from platform suppliers will be used and enlarged to be applicable for various use cases and company-specific boundary conditions – with little effort in daily practice and at the same time greatest possible benefit.

We expect the guidelines to provide the following benefits for PLCopen members and their customers:

- Enable customers of PLCopen members to use available code analysis solutions in daily practice
- Increase of the satisfaction of customers of PLCopen members by an intuitive, low-effort integration of metrics-based code analysis into company-specific software engineering workflows for gut-level support
- Increase of the target group of available metrics and code analysis approaches provided by PLCopen members through workflow integration and use of the results for different stakeholders
- Support customers in saving time during development by systematic identification of target conflicts between software quality characteristics in early design phases

References:


Motivation: Platform suppliers offer comprehensive tool support to measure code quality, but barely used by customers in daily practice.

Goal: Guidelines to support customers of PLCopen members to optimally integrate existing metrics for code quality into the software engineering workflow to achieve the greatest possible benefit with little effort.

Idea and Organization

Phase I: Preparation with platform suppliers
- **Expected result:** Overview of what is already enabled by industrial tools and can be used as input for the guidelines.
- **Participants:** Industrial platform suppliers (ABB, Beckhoff, CODESYS, Phoenix Contact, Schneider Electric, Siemens, …)

Phase II: Guideline development with supplier feedback
- **Expected result:** Guidelines on how to use available metrics in the industrial software development workflow for concrete use cases (implemented as small example projects).
- **Participants:** Industrial platform suppliers

Optional: Feedback on the of guidelines from practitioners
- **Participants:** Industrial practitioners from machine and plant manufacturing.

Benefits for PLCopen Members:
- Increasing customer satisfaction by maximizing the applicability of existing solutions of PLCopen members
- Increase the target group of existing solutions through workflow integration and use of the results for different stakeholders

One coherent application example to explain the guidelines

Application Example for PLCopen Training on Motion Control: Warehouse

Aspects included in the guidelines **(to be discussed):**
- Workflow for quality assessment
- Selection of metrics and reference values
- Interfaces to existing tools
- Reporting format

- Initiator: TUM, Chair AIS
- Start: October 1st, 2022
- Bi-weekly meetings of the contributors to the guideline
- Request feedback from platform suppliers and practitioners on the interim status and finalized guidelines
Current state of research

Maturity measurement of evolving library elements and modules

Challenge: Application engineers and start-up technicians often hesitate to reuse mature modules from the library and rely on their own old projects.


Solution: Change-based metric to calculate the maturity of control software library modules → Objective maturity indicator to supplement the „gut feeling“ of software developers.
Current state of research
Integration of maturity measurement into industrial software development workflow

Use Cases in industrial software development
- Quality gates before library release
- Quality monitoring of library POUs across versions
- Evaluation of change scope before unit testing to estimate testing efforts