Securing the Testing Process for Industrial Automation Software

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Problem & Motivation
The software testing process represents an attractive attack target:
- Risk of software piracy & theft of IP
- Covert attacks based on know-how gained via stolen artifacts (cf. Stuxnet)
- Means to conceal injected malicious code
- Potential damages to physical systems during test execution

Conducting security analyses (e.g., as per the VDI/VDE 2182 [7] guideline) of the testing process is challenging:
- Requires expert security know-how
- Is complex and effortful to perform
- Insufficient tool support available

Need: Framework to (semi-)automate security risk assessments with flexible assessment scope

Semi-Automated Security Analysis Framework

Contribution [1]: Provides the capabilities to conduct security analyses of an organization's software testing process for industrial automation software in a semi-automated manner.

Generic Software Testing Process as the Target of Inspection
- Investigated state of practice
- Performed unstructured interviews with employees of an Austrian-based systems integrator to design a generic testing process
- Reviewed the process together with a software quality consultancy

Overview
- Framework supports the VDI/VDE 2182 [7] guideline
- Ontological modeling approach
- Flexible assessment (scope)
- Combination of STRIDE [6] and attack-defense trees (ADTrees) [4]
- Automated generation of ADTrees
- Open-source prototype: https://github.com/sbaresearch/adtgenerator

Security Modeling Approach
- STRIDE: Categories of security threats used to build threat trees [6] that are included in the knowledge base
- ADTrees [4]: Attack trees extended by defense measures
- Description and formalization of various threat scenarios
- Automated generation of ADTrees, which can be imported into ADTool [3]
- Development of SPARQL queries to extract valuable security information from knowledge base (e.g., STRIDE threats to assets)

Evaluation
- Two-step process: Tool selection step according to [5] and tool evaluation
- Considered 10 tools, two of which were extensively evaluated
- Results: Provides valuable support for security analyses, but needs to be improved to facilitate the structure analysis

Conclusion
- Designed a generic software testing process for industrial automation applications to define the target of inspection
- Proposed a framework that enables a flexible, semi-automated security analyses
- Adaptation to other engineering activities possible
- Developed a prototype: ADTGenerator (generation of ADTrees)
- SPARQL queries and ADTool [3] further support the analysis

Outlook
- Automating risk identification based on engineering data
- Security modeling extension for AutomationML (AMLsec)
- Detection of vulnerabilities in plant structure (e.g., attack graph generation), consequences of potential attacks, business impact analysis
- Dynamic security risk analysis methods for CPSs
- Digital-twin-based attack simulation for risk analysis

References:

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