Fraunhofer
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Fraunhofer Institute for Open
Communication Systems FOKUS

Quality Engineering Business Unit

System quality from from the start

Development and quality assurance of safety-critical software

Increasingly interconnected, software-based systems pose special challenges for their development, quality assurance, standardization and interoperability. We offer the right methods and tools for this.

Dipl.-Inform. Andreas Hoffmann Director Business Unit Quality Engineering

The Quality Engineering division offers methods, processes, and tools for safeguarding, evaluating, and optimizing the quality of software-based systems. These systems, such as the ones used in public infrastructures, vehicles, or factories, are becoming increasingly networked. This poses particular challenges for system development, especially when safety-critical functions need to be guaranteed. If such systems fail, there is a high financial risk, and even human lives could be at risk. With the increasing use of artificial intelligence (AI) and, in the future, quantum computers, additional challenges arise in the development process of software-based systems.

Fraunhofer FOKUS employees aim to develop reliable, secure, and trustworthy systems and to guarantee their functionality, performance, security, and robustness. To ensure that such systems are always fault-tolerant and fail-safe, even in unforeseen situations, they work on system quality and cyber security throughout the entire development process, from requirements analysis, architecture, development, and testing to certification.

Range of services

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- Requirements analysis
- Optimizing system architectures
- Model-based development and testing
- Tool integration
- Model management and quality confor-
  mance, interoperability, performance and
  security tests
- Data analysis and quality
- Product qualification and certification
  support
- Training and consulting for development,
  test and quality assurance teams
- Application and further development of
  AI methods

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We ensure system quality and cybersecurity throughout the entire development process"

Dipl.-Inform. Andreas Hoffmann,
Director of the Quality Engineering business unit

Improving the development processes of software-intensive systems

In the field of "Optimization of development processes", the scientists support their customers in developing software-intensive systems. The aim is to improve the entire development process, including specific individual steps. They focus primarily on technologies for model-driven software development, which make it possible to integrate various tools for efficient software development and generate code and test cases dir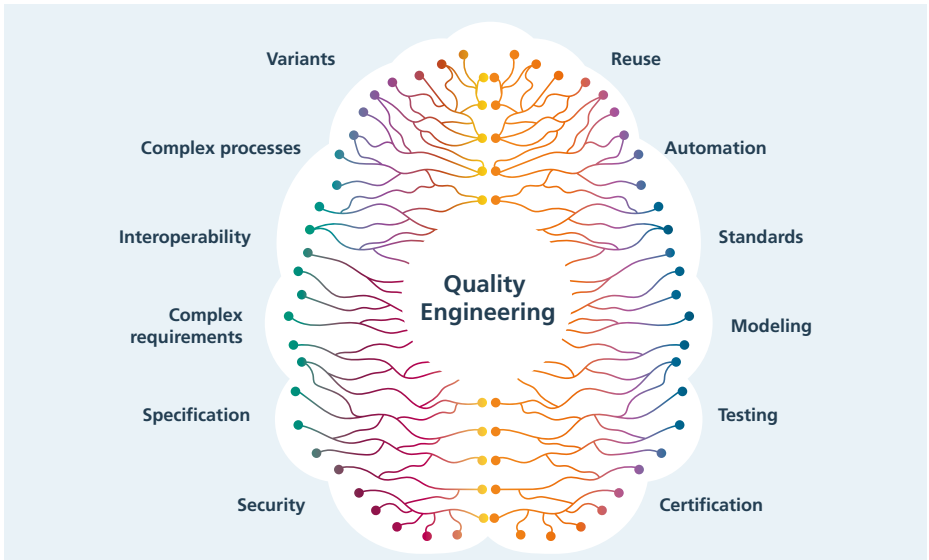ectly from a model. They also use low code to increase data quality. For their customers, this results in improved efficiency, reduced development and maintenance costs, and increased overall quality. In addition, scientists offer methods and tools for requirements management, traceability, model transformation, and code and document generation, which play a decisive role, particularly with regard to possible certification.

Development and quality assurance for safety-critical software

Complex systems, like transportation, cloud services, or critical infrastructures, must run error-free to ensure social processes' smooth functioning. In the "Development of Critical Systems" research area, Fraunhofer FOKUS works on designing, developing, and testing software architectures and applications specifically for critical application areas.

The focus here is on the definition of architectures, communication infrastructures, exchange formats, processes for the automotive industry, the definition of security architectures, the systematic implementation of risk analyses, and risk-based security tests in and for critical infrastructures.

Challenges and solutions in quality engineering with artificial intelligence

Variants
Reuse
Complex processes
Automation
Interoperability
Standards
Complex requirements
Modeling
Specification
Testing
Security
Certification

Quality Engineering

Urban information and communication technologies and quantum computing

Urban information and communication technologies are becoming increasingly important as the population grows. For cities to better adapt to the needs of every individual, while being fast, cost efficient, sustainable, and ecologically correct, the scientists in the "Quality Engineering for Urban ICT" department are developing architectures for information and communication technologies in the smart city. In these smart cities, quantum computers will play a crucial role in the future, solving complex calculations such as optimizing traffic forecasts, facilitating cashless payments, and managing supply chains between urban and rural areas. The "Quality Engineering for Quantum Computing" research area is therefore developing hardware-independent middleware for quantum computers and adapting algorithms to the requirements of such computers. The topic of "quantum computing as a service" – i.e., the provision of quantum-based services via a cloud – is also a focus of the researchers' work. They pay particular attention to such applications' security, privacy, and data protection.

Software-based systems are increasingly interconnected today

Detecting errors in the development process and saving costs for development and maintainance

Testing is one of the most essential and well-proven means of quality assurance for systems. In the field of "Testing", Fraunhofer FOKUS has over 20 years of experience using testing techniques. By applying test design and test execution techniques early on, developers can detect errors faster in the development process and therefore save costs. The scientists are working on the automation of test design and test execution, the improvement of test management through models, and the development of their own tools and testbeds. Parallel they are researching fuzz testing technologies and using them to increase cyber security. The aim is to improve the quality of products by optimizing development processes. Also, the safeguarding and certification of AI-based systems is becoming increasingly important. They contribute the experience they have gained to standardization committees, such as the European Telecommunication Standards Institute (ETSI) or the Object Management Group (OMG).

Sectors

Our customers come from the automotive, automation, railroad, medical and information technology sectors as well as from government agencies. In addition, we have industry expertise in the fields of aerospace, telecommunications, smart cities and quantum computing.

Data analysis

Using data from various sources to provide new services and generate knowledge is an increasingly important topic. For example, AI-based transformation and digital data curation can yield valuable knowledge and new insights for company decisions and actions. In the field of "Data Analytics and AI", scientists work on knowledge-based processing and distributed analysis of large volumes of data (big data and smart data). They focus, in particular, on the real-time processing of data streams and combining technologies from data analytics, artificial intelligence, and knowledge management.

Contact

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