

Software Engineering for Industrial Applications

THINGS SMART



ABOUT US

We are your trusted partner for advanced software development – engineering next-generation solutions for smart machines, products and systems.

With over a decade of experience in developing tailor-made industrial software, we specialize in integrating AI-powered technologies into embedded and safety-critical environments. From predictive data analytics to intelligent failure detection, we bring smart capabilities directly into your machines, products, and control systems.

By combining deep domain expertise with cutting-edge innovation, we accelerate your product development, reduce time-to-market, and deliver a competitive edge for future-ready, high-performance industrial systems.

Highlights

14+ years of experience

125+ successful projects delivered

PhD & Master's only: highly skilled, hands-on engineers

Experts in AI, predictive analytics, sensor fusion & embedded devices

Agile scalable teams integrated into your development cycle



Our Expertise



Since 2011, we've been empowering the transformation to Industry 4.0 by developing intelligent software for products, machines, and systems. Our roots in manufacturing, combined with expertise from safety-critical fields like air traffic management and defence, allow us to engineer robust, high-performance embedded systems where innovation meets uncompromising reliability.

This unique cross-industry perspective fuels fresh thinking and future-ready solutions – bridging traditional industrial environments with the digital intelligence of tomorrow to make machines safer and more reliable.

From real-time analytics and sensor fusion to AI-powered predictive failure detection, we make machines smarter, operations more efficient, and systems more autonomous.

Whether it's deploying edge intelligence, integrating certified safety-compliant software, or scaling complex industrial systems – we build solutions that thrive in demanding environments: smart, reliable, scalable, and future-ready.

Our Typical Customers



Machine Builders



Producing Industry



High-Tech Start-Ups



Software Vendors



System Integrators & Solution Providers



Sensor & IoT Component Manufactures

Industry Standards

IEC 61508, ED-153, DO-178C, MIL-STD 882 & more

SERVICES



Smart Product Development



Software Optimization & Refactoring



Artificial Intelligence & Predictive Algorithms



Sensor Data Fusion & Analysis



Automated Fault Detection



Embedded & Edge Software



Industrial Data Analytics



System Architecture Engineering



Project & Technical Management

WHAT WE OFFER

ACCELERATE INNOVATION & DEVELOP SMART ASSETS – FASTER

Partner with us to develop next-generation products, machines or systems with intelligent features and a faster time-to-market.

Whether through full product development or strategic team augmentation, we can help you gain a competitive edge with solutions that are efficient, scalable, and future-ready.

- ▶ Software Development (embedded to cloud)
- ▶ Product Development from Concept to Deployment
- ▶ Product Optimization & Lifecycle Upgrades
- ▶ Automated Data Analytics & Insights
- ▶ Predictive Maintenance Solutions
- ▶ Smart Features & add-on Development

Let's bring intelligence and automation to your valuable assets.

- ✓ **SMART** Products
- ✓ **SMART** Factory
- ✓ **SMART** Maintenance
- ✓ **SMART** Systems
- ✓ **SMART** Energy

HOW WE WORK

We believe that great software begins with understanding – of your goals, your systems, and your challenges. Our end-to-end development approach ensures that every project is rooted in technical excellence, industry best practices, and a deep commitment to quality. While each project is unique, every engagement follows a structured and transparent process:

- ▶ Requirement analysis and specification
- ▶ Joint process alignment and documentation
- ▶ Architecture and module development
- ▶ High quality assurance
- ▶ Installation and deployment in your target environment

We place the highest emphasis on quality and compliance through comprehensive quality assurance techniques:

- ▶ Adherence to documented development standards (e.g. V-Model XT)
- ▶ Full traceability of artifacts throughout the product lifecycle
- ▶ Continuous audits and formal reviews (4-eyes principle)
- ▶ Structured verification via Verification Cross Reference Index
- ▶ Integration of safety standards like ISO 26262, IEC 61508, ED-153
- ▶ Failure Mode and Effects Analysis (FMEA)

End-to-End Software Engineering for Industrial Intelligence

We develop end-to-end software solutions for industrial systems - from signal acquisition and system modeling to embedded deployment and intelligent automation. This involves a combination of proven engineering principles and advanced data-driven methods. Depending on the system, data, and goals, we select, adapt, and integrate the most suitable techniques - always with a focus on robust, scalable, and industrial-grade software.

Signal Preprocessing & Feature Extraction

Preparing raw sensor data for further analysis

→ FFT, filtering, normalization, interpolation, outlier removal

State Estimation & System Modeling

Estimating internal system states and modeling physical behavior

→ Bayes filters, Kalman filters, autoregressive models

Localization & Condition Monitoring

Tracking position and detecting system state changes

→ SLAM, probabilistic mapping, multi-sensor fusion

Machine Learning & Pattern Recognition

Identifying patterns and learning behaviors from data

→ SVM, neural networks, PCA, ensemble models

Anomaly Detection & Event Classification

Detecting deviations and assigning them to meaningful events

→ Autoencoders, clustering, self-organizing maps

Deployment & Optimization for Embedded Systems

Bringing intelligence to the edge under real-world constraints

→ Embedded C, quantization, runtime optimization



SUCCESS STORIES

Embedded Intelligence for Smart Energy

Sensor Optimization for Wind Turbine Applications

PROJECT GOAL

As demand for renewable energy rises, so does the need for smarter, more reliable sensor technology. **TWK-Elektronik GmbH** developed the **NBT-D/S3 rotor hub sensor** – a compact, MEMS-based innovation that combines inclination and rotation rate sensing. Its design enables high-precision rotational speed measurement without a direct shaft connection, offering a cost-efficient, easy-to-integrate alternative to traditional sensors – especially for wind turbines.

To unlock the sensor's full potential, **TWK collaborated closely with us**: TWK engineered the hardware, while our team developed, validated, and implemented the intelligent system core. This joint effort produced a highly accurate, robust, and cost-effective sensor system, maintaining precision even under challenging environmental conditions and ready for large-scale deployment

OUR SOLUTION

- ▶ Custom Algorithm Design & Optimization
- ▶ Embedded Software Implementation
- ▶ Testing & Validation
- ▶ Knowledge Transfer & Enablement

Benefits

- ✕ On-time project delivery under a tight development schedule
- ✕ Close collaboration with TWK through shared repositories and regular reviews
- ✕ Full integration of the embedded software ready for deployment
- ✕ Temperature-stable performance maintained across fluctuating conditions
- ✕ Competitive advantage enabled through intelligent algorithm-based differentiation
- ✕ Fulfillment of all precision and functional safety requirements

Embedded Intelligence for Smart Maintenance

Embedded AI for Production Line Optimization

PROJECT GOAL

The **Schaeffler Group** has been driving forward groundbreaking inventions and developments in the field of motion technology for over 75 years. It is constantly working to improve the efficiency and precision of its production processes. In particular, the timely detection of tool wear and the automatic adjustment of process parameters are of great importance in order to guarantee the quality and reliability of its products. In addition, maximum security must be guaranteed with respect to internal production data.

As part of the **KI-MUSIK4.0** initiative, Schaeffler Group aimed to predict tool wearout, automate the adaptation of process parameters and to minimize downtimes. Our contribution in this joint project was the development of highly specialized AI algorithms designed to run directly on embedded systems, combining model-based and streaming techniques for fast learning and reliable state recognition.

OUR SOLUTION

- ▶ Sensor Integration
- ▶ Data Collection & Analysis
- ▶ AI Model Development
- ▶ Embedded Implementation

Benefits

- ✕ Early detection of tool wear enabling proactive maintenance
- ✕ Instant and automated adjustment of process parameters without intervention
- ✕ Local, on-device AI ensuring maximum data security without cloud dependencies
- ✕ Reliable condition recognition with 99.8% accuracy reducing interruptions
- ✕ Increased machine uptime and reduced asset downtime
- ✕ Lower energy consumption and reduced waste across manufacturing lines
- ✕ Improved and consistent product quality through optimal process control

Embedded Intelligence for Smart Products

Real-Time Diagnostics in Commercial Machines

PROJECT GOAL

A globally leading manufacturer of commercial machines – such as those used in industrial kitchens, laboratories, or process facilities – operates a large international service fleet. Until recently, maintenance was entirely reactive, resulting in frequent repeat visits, extended downtimes, and high service costs.

In this project, we developed a tailor-made, embedded **predictive maintenance solution** for the commercial machines of the global manufacturer with clear goals: prevent unplanned outages, enhance customer satisfaction, and create a more efficient, sustainable service model.

OUR SOLUTION

- ▶ Installation of intelligent sensors on critical machine components
- ▶ Real-time condition monitoring using the machines' Wi-Fi infrastructure
- ▶ Development of machine learning algorithms for failure detection
- ▶ Activation of automated alerts for proactive service actions
- ▶ Integration of predictive diagnostics with existing infrastructure
- ▶ Component-level fault detection and precise service planning

Benefits

- ✕ Faster repairs, as technicians know in advance which parts are needed
- ✕ Proactive maintenance schedule prevents disruptions to daily operations
- ✕ Spare parts are pre-positioned based on predicted demand
- ✕ Reduced repeated service visits, leading to less downtime
- ✕ Reduced machine downtime through early fault detection
- ✕ Efficient use of service fleet through optimized planning and fewer emergency calls
- ✕ Fewer emergency deployments reduce service trips and emissions.

Let's develop

SMART THINGS TOGETHER



Follow us

ON LINKEDIN

Knowtion GmbH
Amalienbadstr. 41 Bau 52
76227 Karlsruhe, Germany

team@knowtion.de

