OPTIMUM

Ground-breaking results in the smart factory domain

EXECUTIVE SUMMARY
Focusing on distributed control, localisation, cyber-security and 3D engineering & visualisation, the ITEA project OPTIMUM (OPTimised Industrial IoT and Distributed Control Platform for Manufacturing and Material Handling) offers greater efficiency, safety and usability in future smart factories.

PROJECT ORIGINS
In today’s factories, machines such as cranes are typically operated manually using heterogeneous hardware. These are usually not interoperable and diverse control environments are in use; static machine configurations also make evolution hard to achieve. In a global market with strong competition, Industry 4.0 concepts like greater software modularity, interoperable frameworks and Industrial Internet of Things (IIoT) must be embraced to enable truly smart factories.

OPTIMUM envisions a clear link between real-time machine-to-machine (M2M) communication utilising distributed control, localisation awareness and 3D engineering & visualisation for smart factory applications. To avoid 2D layout tool limits, the project has enhanced design processes and solution validation using 3D models, simulation and supervision. Application design and development is supported via a common IIoT platform and a distributed control platform (DCP). Integrated context and location awareness enable better control and assistance. These results have now been validated with 15 demonstrators across four countries.

TECHNOLOGY APPLIED
Regarding 3D engineering and visualisation, the project aimed to utilise TARAKOS’ 3D engineering tool for complete product lifecycles. From an engineering perspective, this can be used to visualise the manufacturing location to which machinery will be added and subsequently optimise material flow solutions (i.e. by simulating effects of cycle time versus cost). An important innovation was the introduction of a DCP which integrates secure elements and location awareness capabilities, allowing location-dependent assistance functions. This has been built on top of suitable real-time communication and interfaces an IIoT platform. Information is fed back to the 3D engineering tool to close the loop and further optimise future lifecycle management.

From this starting point, OPTIMUM addressed many additional targets, including Human-Machine-Interfaces (HMIs), wearables for operator localisation and 5G technology application. Unlike a typical cascaded approach, control modules are distributed so that each actor – human or machine – can be located within the process in real time, enabling collaborative assistance functions. The 15 demonstrators effectively serve as showcases for the project’s diverse technical results. Those implemented as prototypes include DCPs (IFAK), embedded boards (NXP), IIoT (University of Rostock, ERSTE), indoor localisation (COMNOVO), wearables (THORSIS & University of Rostock) and high-level assistance functions (DEMAG, ERMETAL, ETRI, MAGTEL).

In terms of cyber security, the project conducted a detailed STRIDE analysis to identify risks and vulnerabilities. For HMIs, a multi-level authentication concept was implemented to...
request authentication for different access levels. M2M communication is secured by Secure Elements (SE) used for encryption in the OPC Unified Architecture (UA) protocol and DCP. Collaboration between cranes, hoisting devices and machines requires interoperability but existing standards for cranes are not yet ready for Industry 4.0 and human-machine collaboration. OPTIMUM therefore also established cross-company working groups to prevent a lack of standards from becoming a roadblock to exploitation. Work has begun on a companion specification for OPC UA, which is an essential step towards crane component interoperability.

MAKING THE DIFFERENCE

Thanks to high levels of collaboration within the consortium and the support of ITEA, OPTIMUM has overachieved in various ways. For technical outputs, a clear highlight is the development and implementation of five DCPs across 15 machines (versus a target of three machines), including cranes, automated guided vehicles and forklifts. Runtime visualisation has been created and contextual awareness is another unique, ground-breaking result. Against an initial goal of developing the project’s results, including the OPTIMUM consortium is highly committed to further developing the project’s results, including transforming five patent ideas into marketable outputs. This spirit of collaboration is set to increase efficiency, competitiveness, safety and security and reduce manufacturing waste for many years to come.

MAJOR PROJECT OUTCOMES

Dissemination
- Project presentations at Customer Day & Open House at DEMAG in 2019.
- 16 Publications for IEEE Xplore.

Exploitation (so far)
- 18 ERTPs published and 38 Exploitation targets from a short-, mid- and long-term prospective.
- 15 Demonstrators in four countries.

Standardisation
- VDMA cross-company working group on OPC UA companion specification for cranes & hoists.
- Initiation of FEM cross-company Task Force on future safety regulations for cranes & lifting equipment when utilising innovative assistance functions (collaborative processes).
- Contribution to GTA API for IIoT Devices (SE API) - IEC 30168 / DIN: NIA 41-02 AK / NWIP: ISO IEC JTC1 SC41 WG3 (Cyber Security).
- Contribution to ISA99/IEC 62443 - ISO/IEC 62443-3-3 and 62443-4-2 related standardisation activities (WG4 TG2 of ISA99).

Patents
- 5 Patent applications in preparation (8 partners from Germany & Turkey).

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