Production2036

Well-defined

Value network modelling for the software-defined resilient production of the future

Project Leader: Manuel Zürn
Mail: manuel.zuern@isw.uni-stuttgart.de

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Motivation and Research Focus

Motivation
- Static supply chains, static product models
  - Non-resilient supply chains – Market Shock
  - Conflicting Objectives (e.g. manufacturing process) are chosen once and forever
  - No tech push possible
- Proprietary, sometimes manual interfaces between organisations
  - Low reusability
  - Consistency problems due to different models
  - Limited flexibility

Research Focus
- Platform for controlling a value chain (Value Chain Execution System)
- Associated modelling of the semantics and validation on demonstrators
Vision and project objective

Vision

- Sustainable, cost-effective and self-optimized production
- Creation of resilient value networks to minimize delivery failures
- Resilience on the shop floor by increasing the security and availability of resources
- Humans as central decision-makers in the distributed, highly complex value creation network

Project objective

- Establishment of a value network with a Value Chain Execution System (VCES) consisting of three interconnected individual physical demonstrators
- Comprehensive communication of the individual demonstrators via the VCES with secure communication between the demonstrators using Catena-X
TP 1: Data model and specification requirements for Industry 4.0 as a Service and products
David Dietrich (ISW)

TP 2: Adaptive Value Chain Execution System for flexible Industry 4.0-as-a-Service orchestration
Werner Lober (DXC)

TP 3: Construction of a model factory for the assembly of an electric steering system
Oliver Romoser (Bosch)

TP 4: Production of an adaptable car body component
Anwar Al Assadi (IPA)

TP 5: Shared safety for autonomous and self-sufficient AGVs in flexible environments with changeable safety zones
Florenz Graf (Bär)
Motivation
- Rigid value chains with a lack of resilience
- Proprietary and inconsistent interfaces between organizations

Objective
- Data model of a value network for the representation of production systems and flexible products
- Specification for Industry-4.0-services to describe a standardized application profile for the orchestration of value networks

Work packages
- WP1: Value chain data model
- WP2: Specification of Industry 4.0 services
- WP3: Enabling the human being
- WP4: Flexible product modeling
- WP5: Validation
TP 2: Adaptive Value Chain Execution System for a flexible Industry-4.0-as-a-Service Orchestration

**Motivation**
- Increasing interconnection of participants on the market without overarching control
- Distributed concepts of production require standardization of information structures and services

**Objective**
- Setup of an adaptive VCES system as evaluation platform to control the overall value chain
- Flexible combination of production services based on changing targets and criteria

**Work packages**
- WP1: Requirement and conceptual design of the VCES
- WP2: Setup of infrastructure
- WP3: Development of adaptive VCES
- WP4: Research on flexible methods
- WP5: Validation by means of use-cases
Motivation

• Overall optimized control of a production facility that is part of an overarching value chain.

Objective

• Design and implementation of an existing assembly line as a model factory
• Design and implementation of interfaces and data models

Work packages

• WP3.1 Analysis of the existing assembly line
• WP3.2 Modeling of derived Industry 4.0 services
• WP3.3 Implementation of Industry 4.0 services
• WP3.4 Inspection station for quality control and qualification
• WP3.5 Design of human-centered coevolutionary processes
• WP3.6 Integration into overarching material flows
• WP3.7 Evaluation of sustainability-optimized control
• WP3.8 Validation and evaluation, documentation
TP 4: Production of an adaptable car body component

Motivation
- Component changes and model maintenance measures cause effort in robot programming
- Information gap between the CAD-CAM process chain and robot programming (assembly)

Objective
- Provision of component design and integration of change management
- Development of an adaptive CAD-CAM process chain including robot programming
- Learning robot programs in the simulation

Work packages
- Definition of requirements and concept for production
- Development of an adaptive CAD-CAM process chain based on interlinked production modules
- Component-dependent placement and assembly processes in a clamping device
- Flexible robot-based assembly automation of car body components
- Validation of the flexibilization processes and profitability analysis
TP 5: Shared safety for autonomous and self-sufficient AGVs in flexible environments with changeable safety zones

**Motivation**
- Security measures must be configured manually on an individual basis. Cost-intensive safety elements must be provided in every AGV.
- Inflexible docking options to systems.

**Objective**
- Situation-dependent safety aspects of a mobile system in a changing production environment.
- Simplification and flexibilization of docking processes to production facilities.
- Software and hardware interface development for AGV orchestration.

**Work packages**
- WP1: Conception of a standardized interface for AGVs for the adaptable transfer of functions.
- WP2: Hardware-neutral safety.
- WP3: Integration into the value chain.