Usage of digital product models for product development, production and service

Marco Liesegang, EY Advisory Service
IoT / I4.0 Team Lead GSA
EY Company Overview

A global services organization of 230,000 professionals

- We are a global company consisting of business consultants, tax experts, auditors, mergers and acquisitions advisors, and lawyers.
- Our services and expertise help companies succeed in their business and support economies across the globe.
- Our main asset is our people. We build highest-performing teams for each customer project who focus on delivering highest-quality results.

- We have a Global Advisory practice of 50,000 professionals with sector-specific skills in Strategy, Supply Chain, Sales & Marketing, Finance, IT, Risk & Cyber Security.
- Within Advisory, we have a dedicated IoT Centre of Excellence and a global network of 200+ IoT experts.

We are 230,000 people based in 700+ offices in over 150 countries. Our global turnover is US$28.7bn

- **EMEIA**
  - People: 102,000
  - Regions: 12
  - Countries: 99
  - Revenue: US$11.8bn

- **AMERICAS**
  - People: 56,000
  - Regions: 10
  - Countries: 30
  - Revenue: US$12.7bn

- **ASIA PACIFIC**
  - People: 31,000
  - Regions: 5
  - Countries: 22
  - Revenue: US$3.1bn

- **JAPAN**
  - People: 7,500
  - Offices: 33
  - Revenue: US$1bn
I guide you on your digital journey

IoT platforms, Data Analytics & Process Optimization

M2M communication & retro-fitting

IoT lab & workshops

Industrial Augmented Reality

Marco Liesegang
Senior Manager
Industrie 4.0 / IoT Lead GSA
EY Advisory Service
Smart Connected Products + Product Clouds are the foundation of Digital Product Twins

- State/Condition Monitoring Services KPIs
- Remote control Predictive Maintenance Optimizations Automation
- Data, Services
- Usage Condition, State Quality Process Data
- Parameters New Functions S/W-Updates Authorization
- Smart, Connected Product

Product Cloud
Digital Twin
A connection between the Physical and the Digital World

Source: PTC
Digital Product Twin gives insights along the whole product lifecycle

- **Digital Twin**
  - Requirements
  - Systems Engineering
  - Detailed Design
  - Integration & Test
  - Maintenance
  - Usage
  - Sourcing Production Logistics

**Usage**
- Used Instances
- Used Service

**Usage Data**
- Production Data
- External Data Sources
- User Data
- Environment Data

**Digital Production**
- Produced Instances
- Produced Service

**Product/Production Data**
- Supplier/Logistics Data
- Quality Data

**INTEGRATION & TESTING**
- Product Model
- Product/Production Data

**DESIGN**
- New Requirements
- Systems Engineering
- Detailed Design

**SERVICE**
- Service Data
- Usage Data
- Production Data
- As-maintained

**DIGITAL PRODUCTION**
- Service Data
- Usage Data
- Production Data
- As-maintained

**DIGITAL PRODUCTION**
- Service Data
- Usage Data
- Production Data
- As-maintained

**Usage**
- Used Instances
- Used Service

**Usage Data**
- Production Data
- External Data Sources
- User Data
- Environment Data

**Digital Twin**
- Requirements
- Systems Engineering
- Detailed Design
- Integration & Test
- Maintenance

**Usage**
- Used Instances
- Used Service

**Usage Data**
- Production Data
- External Data Sources
- User Data
- Environment Data

**Digital Production**
- Produced Instances
- Produced Service

**Product/Production Data**
- Supplier/Logistics Data
- Quality Data

**INTEGRATION & TESTING**
- Product Model
- Product/Production Data

**DESIGN**
- New Requirements
- Systems Engineering
- Detailed Design
Adjusted Systems-engineering approach for a digital world

Sequential, “mechanics-first“ product development

Simultaneous, systems-based product development
Creation, Usage, and Service of Digital Twins in the Physical and in the Virtual World

**Physical World**
- **Creation**
  - Product Design & Engineering
  - PLM-Systems / Single Source of Truth
- **Usage**
  - Production
  - ERP-Systems / MES
- **Service**
  - Maintenance, Repair, Replacement
  - Optimization
  - Replacement, Retrofit

**Virtual World**
- **Creation**
  - Simulation, Systems Engineering
  - Software Engineering
- **Usage**
  - Consumer Usage of Goods
- **Service**
  - Big Data Analysis
  - Collaboration
  - Technical Services, Consulting
  - Business Communities
  - Applications
  - Sensors, Data Collection
  - Condition Monitoring

**Integrations**
- **Consumer**
  - Social Networks
  - Big Data Analysis
  - Service Portals
  - Intelligent Connection of Machines and Personnel
  - Horizontal & Vertical Integration
  - Sensors, Big Data Collection
  - Automation of Processes
  - Condition Monitoring
  - Adaptability, Robustness, Flexibility of Production System
  - Applications
  - Sensors, Data Collection
  - Condition Monitoring
Example: Insights into usage and failure patterns based on operational data of 18,000 combine harvesters
Link insights into usage patterns and failure modes with design decisions, configuration options, test cases, …
Augmented Reality
Digital Twin & Augmented Reality

3D Model + Physical Product = Digital Twin

Augmented Reality
- Work instructions in-context (mobile, wearable)
- Real-time state of equipment and quality metrics
- Operational KPIs in-context
- Maintenance/failure codes in-context
- Overview of large number of equipments / products in real-time

Source: PTC
Augmented Reality enhances images of physical objects by additional information to enable new operational processes.

Live direct or indirect view of a real-world environment which is then ‘augmented’ by computer generated sensory input.

Areas of industrial application include:

- Overlaying live feeds with digital information i.e. highlighting parts to be changed
- Additional viewers through wearer’s eyes i.e. remote service
- Leveraging virtual reality technology for simulations
- Highlighting localization and positioning of objects

Augmented Reality offers context based digital information right where you need it.
AR technology can be applied to all value chains
Current AR use state in manufacturing industry

<table>
<thead>
<tr>
<th>Supplier perspective</th>
<th>Consumer perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D</td>
<td>Marketing/Sales</td>
</tr>
<tr>
<td>Manufacture</td>
<td>After Service</td>
</tr>
</tbody>
</table>

**Introduction background**
- Difficulty in Real-size, Mock-Up production
- Limits on car design information delivery
- Test and evaluation with 3D Mock-Up design model
- Referencing work guideline increases possibility of task error and lowers efficiency
- Detailed procedures for each process steps are displayed on HMD screen
- Impossible to exhibit every car models in showroom
- Retrievable vehicle information through AR Configurator
- Car detail requiring Needs exists online
- Increase of customer complaint due to service latency occurred from simple repair request

**Application fields**

**Expectation**
- “Secured product launching timeliness”
- “Able to make quick design related decisions”
- “Can provide detailed vehicle information”
- “Can decrease required time and cost”

- “Work efficiency enhancement”
- “Decreases vehicle error rate”
- “Improves customer satisfactory”
- “Improves customer satisfactory”
Various data input as foundation for industrial Augmented Reality applications

Input

- CAD Model (“Digital Twin”)
- Process data
- Circuit diagrams
- Automation information (e.g. software coding)
- Product documentation
- Plant configuration data
- Operations data

AR Engine
Generic IoT & Augmented Reality infrastructure

AR experience modelling tools

CAD, PLM, etc.

Modelling

Mobile device App

AR scene

Thing Properties /Services

IoT data & product cloud

Cloud / On premise Applications

Database

ERP
MES
SCADA

Cloud platforms

It Systems

Machine and process parameter from PLC or additional sensors

PLCs & Sensors

CAD, Properties/Services
## Selected areas of application for Augmented Reality

<table>
<thead>
<tr>
<th>Product Development</th>
<th>Production</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development Constructi on</td>
<td>Visualization of asset conditions</td>
<td>Remote Service</td>
</tr>
<tr>
<td>Virtual prototype simulation</td>
<td>Visualisation of hard access equipment</td>
<td>Digital manual for service and repair</td>
</tr>
<tr>
<td>Digital manual creation</td>
<td>Step-by-step guidance</td>
<td>Diagnosis</td>
</tr>
<tr>
<td>Technical training support</td>
<td>Quality assurance</td>
<td>Cyber Physical system log</td>
</tr>
</tbody>
</table>
Get in contact with me:

**Marco Liesegang**
Senior Manager EY Advisory Service
Industrie 4.0 / IoT Lead GSA

Tel   +49 30 2547 12679 5
Mobil +49 160 939 26795
Email marco.liesegang@de.ey.com
About EY

EY is a global leader in assurance, tax, transaction and advisory services. The insights and quality services we deliver help build trust and confidence in the capital markets and in economies the world over. We develop outstanding leaders who team to deliver on our promises to all of our stakeholders. In so doing, we play a critical role in building a better working world for our people, for our clients and for our communities.

EY refers to the global organization, and may refer to one or more, of the member firms of Ernst & Young Global Limited, each of which is a separate legal entity. Ernst & Young Global Limited, a UK company limited by guarantee, does not provide services to clients. For more information about our organization, please visit ey.com.

© 2016 EYGM Limited.
All Rights Reserved.

EYG no.
BACS 1001732

ED None

This material has been prepared for general informational purposes only and is not intended to be relied upon as accounting, tax, or other professional advice. Please refer to your advisors for specific advice.

ey.com