Media Workshop
Digitalisation in Production and Logistics at Volkswagen

Thursday | 7 December 2017 | Wolfsburg

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Media Workshop
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09:15 am Welcome by Stefan Loth, Plant Manager Wolfsburg
09:30 am Presentation by Dr Martin Goede, Head of Technology Planning and Development of the Volkswagen brand
10:15 am Short introduction of competence centre for technology and innovation by Steffen Jaensch and Dr Markus Buschmann
10:30 am Project market “Digitalisation at Volkswagen you can touch and feel”
   1. Digital way / energy efficiency
   2. Vehicle identification and servicing materials positioning
   3. Fully automatic vehicle commissioning
   4. Human-robot collaboration
      • Automatic initial AdBlue® injection
      • Automatic mounting of coupling rod
      • Automatic mounting of alternator
      • Automatic side panel adhesive bonding
   5. Vehicle body construction robot cell
12:00 noon Discussion and light lunch
1:00 pm End of the workshop
The Volkswagen brand is facing one of the biggest revolutions in its history: Computers, robots and the internet penetrate all areas of work and life. Our environment has changed dramatically and rapidly in recent years – socially, politically and technologically. And this trend continues: Digitalisation and the internet will revolutionise the automotive industry. However, not only the product will be affected, but vehicle production will also be transformed in the future.

“With our innovative developments in efficient manufacturing technologies, flexible servicing materials and intelligently networked digitalisation, we are shaping the most productive factories of the future”, says Dr Martin Göde, Head of Technology Planning and Development of the Volkswagen brand.

Digitalisation is the start of a new industrial revolution – first we had the invention of the steam engine followed by traditional assembly line work and mechanisation. The next jump was the permeation of information technology in factories. Industry 4.0, considered the next development leap, now represents the fusion of production and IT. This involves intelligent networking of people, robots and IT systems across the entire industrial production value chain.

Faster information flows in production and logistics within the integrated production network increase Volkswagen’s resource efficiency and productivity. Real-time networking promotes transparency and unlocks potential to shorten response times, increase flexibility and optimise processes.

The media workshop on digitalisation in Volkswagen production and logistics provides insight into the innovative power and collaboration between Development, Planning and Production. It furthermore gives a glimpse of human-robot collaboration, fully automatic vehicle commissioning and other future topics.
Welcome to Wolfsburg

Dr. Stefan Loth

The Wolfsburg plant – The world's largest single car-manufacturing complex

Total area: 6.5 km² (~ Gibraltar)
Factory halls: 1.5 million m² (~ Monaco)
### Significance of the Wolfsburg plant

**Volkswagen AG**
- Group Board of Management
- Group functions

**Headcount**: ~ 3,500

**Wolfsburg plant**
- Vehicle production (S1 and S2)
- Components production
- Services

**Headcount**: ~ 25,000

**Volkswagen AG**
- Brand Board of Management
- Research & development
- Procurement
- Sales
- Planning

**Headcount**: ~ 32,000

**Companies**
- Autostadt GmbH
- Auto Vision GmbH
- Sitech Sitz GmbH
- Other

**Total headcount**: ~ 12,000

**Total headcount**: ~ 73,000

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### August 24, 2017: 150 million Volkswagen brand vehicles
22 September, 2017: 44,444,444 vehicles built at Wolfsburg plant

Wolfsburg plant (2106) – Facts & figures

- **Production**: ~ 800,000 vehicles/year
- **Team**: ~ 20,000 employees
- **Vehicle models**: 4
Model overview Wolfsburg plant

Segment 1
- Golf A7: Ø 1,500 units/day
- Golf SV: Ø 400 units/day

Segment 2
- Touran: Ø 500 units/day
- Tiguan: Ø 1,100 units/day

Production per day ~ 3,500 vehicles

Wolfsburg plant - Structure
New trends in vehicle production

Battery technology
CO₂ emissions
Automation
Climate change
Digitalization
Demography
Sustainability
Autonomous driving
E-mobility
Man-machine collaboration
Connected car
Industry 4.0

Wolfsburg plant - Structure

Assembly
End of line
Body shop
Press shop
Body shop
Body shop

Segment 1  Segment 2
Wolfsburg plant – Digitalization path

1. automatic spare parts store
2. Perceptron Unit
3. Paint shop: digital visualization and FIS-eQS
4. Condition Monitoring
5. Laser macrogeometry unit
6. RFID: Radio Frequency Identification
7. EDES Energy management system
8. FIS control station: system-supported production control
9. PWG-S: virtual tryout production and powerwall
10. Plant railway tracks
11. HRC: Human-robot collaboration
12. Wheel assembly
13. Logistics headset
14. Marriage
15. Windscreen bonding
16. check-up stalls

Implementation at the Wolfsburg plant

Scientific environment/Brand
Site planning
Series production

Innovation
Need for innovation
Competence Center for Technology and Innovation (KTI)

The bridge to series production.

Thank you
Digitization of manufacturing technologies for production of the future

Challenges for vehicle manufacturing of the future
Complexity increase of competition-relevant requirements

- Model variety and drive variants
- Demand of innovations through new competitors
- Environmental awareness and sustainability
- Complexity of partner and supplier networks
- Big data as business model and data security
- Intelligent equipment and production services
- Generation change and customer needs
- Complex and fast-paced software landscape
Challenges for vehicle manufacturing of the future
Complexity increase of competition-relevant requirements

- Model variety and drive variants
- Demand of innovations
- Environmental awareness
- Complexity of partner and supplier networks

- Drive electrically
- Steer autonomously
- Network globally

- Connect digitally
- Support personally
- Share commonly

E-mobility in volume segment

- VW Käfer
  21.5 mio. units
- VW Golf
  > 32 mio. units
- VW "ID"
  ? mio. units
Product architecture today

Product architecture of the future
Product architecture of the future – next generation

Autonomous taxi drone
From 2018 in Dubai in use

Autonomous mobile supermarket
Tests are running in Shanghai

Challenges for vehicle manufacturing of the future
Change of added value

New technologies and higher customer requirements change the PRODUCT.

- Innovative product design
- Modular product design

Use of BIG DATA to control business processes and new business cases

- Data driven business models
- Production as a service

Autonomically controlled PROCESSES for efficient production and logistics

- Consistent optimization

Customers are involved as new PLAYERS in value creation and optimization.

- Open Innovation

Plants are organized and optimized as a PRODUCTION NETWORK via a platform.

- Flexible product works
- Value creation platform
Digitally connected vehicle production of the future
Change of processes in vehicle construction

Factories of the future
Digital connected production
Conventional production

Life cycle
Technology leaps

“Weißbuch” standard factory

Conventional production

Factories of the future

Digital connected Production at Volkswagen
Key factors

**Digital Process Chain**
Continuous data supply and use in the production network leads to efficient value chains.

**Flexible Production**
Modular manufacturing systems enable flexible, agile production.

**Internet of Things**
Self-optimizing systems, reduced integration effort and permanent information.

**Human Empowerment**
Digitally supported decision processes and coexistence of human and machine.

**Big Data & Smart Analysis**
Plant monitoring and self-control increase availability and reduce maintenance.

**Artificial Intelligence**
Independently operating systems, self-learning systems and assistants relieve the strain on people.
Key factors – Digital Process Chain
Consistent development, planning and production

Current Factory and planning processes (2016)

Disruptive change

Factory and planning processes of the future (2025)

Key factors
Digital Process Chain
Consistent development, planning and production

- Autonomous and universally usable systems of the future with independent implementation of the production steps.
- Scenario management instead of detailed layout and Plant planning (including process simulation and flexibility, quality and cost assessment)

New processes require new planning systems

Key factor Human Empowerment
Complexity control by digital assistants

Analogous
Computer-based
System supported
Connected
Mobile
Intuitive

We bring technology closer to the people.
Key factor - Big Data und Smart Analysis
Performance increase through intelligent machines and systems

- Press shop with self-controlling processes by coupling innovative technologies
- Reduced machine downtime
- 100% testing
- Reduction waste

Active components
- Capture of component characteristics in the production plant
- Active readjustment without interruption of the process operation
- Predictive Maintenance

Materials testing
- Central data acquisition
- Data processing, situations & context-related

Press shop 4.0
- Inline quality control
- Optical inspection, multi-camera system and image processing algorithms
- Providing measurement results
- Connection central control

Key factor – Artificial intelligence
Performance increase through intelligent software and machines

Smart Personal Assistant
Chatbots do simple tasks:
- Home-automation
- Task lists
- Opel: Test drive
- BMW: Home & Car

Automated Speech Recognition
Chatbots recognize natural language
- Use in schools / universities
- Control of software
- Convert error description into standard text

Neural Machine Translation
Detection and translation of different languages
- Loss of communication limits
- Cultures are approaching
### Key factor – Artificial intelligence
Performance increase through intelligent software and machines

<table>
<thead>
<tr>
<th>Classic construction</th>
<th>Optimisation by simulation</th>
<th>Automated design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design according to the experience of the designer</td>
<td>Design according to simulation loops</td>
<td>Design and construction according to genetic algorithms, production by 3D printing</td>
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<tr>
<td>• Weight:</td>
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<td>• Cost:</td>
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</table>

- Key factor – Flexible production (Gripper)
Concept "moving screwing module" for flow operation (VW Tiguan) - Volkswagen Osnabrück

Potentials of new production technologies
Generative production of tools and components

1. Extended design freedom
   - Advanced design options
   - Functionalization

2. Individualisation and variant variety
   - Individualization
   - Complexity

3. Accelerated development cycles / Time-to-market

There are high potentials for the automotive industry
Potentials of new production technologies
Generative production of plastic components

<table>
<thead>
<tr>
<th>Series production today</th>
<th>Series production tomorrow</th>
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</thead>
<tbody>
<tr>
<td>Flashing blue light holder, Duplicate part R-GmbH</td>
<td>Flashing blue light holder, 3D printing, SLS-method</td>
</tr>
<tr>
<td>Weight: 687 Gramm (steel)</td>
<td>Weight: 137 Gramm (plastic PA12)</td>
</tr>
<tr>
<td>Small batch: &lt; 500 Units/Year</td>
<td>Small batch: &lt; 500 Units/Year</td>
</tr>
</tbody>
</table>

3D-Printing „Vision 2025“
Efficient production and factory automation
Automation in vehicle production

Digitization strategy
„Weißbuch“ standard factory

Conventional
Production

Today

Factories of the future

Digital
connected
production

State of the art

Factories of the future

PW KB L M

PW: Press shop
KB: Body shop
L: Paint shop
M: Assembly

Efficient volume production technologies in factories of the future
Conclusions

- Intensive transformation of products
- Significant Technology push
- Increase of Complexity

- Improving economic and ecologic efficiency
- Digitalization of entire Process Chain

- New Dimension of Innovation implementation
- New Dimension of Collaboration networks
Digitization of manufacturing technologies for production of the future

Thanks for your attention!

Dr. Martin Goede, Volkswagen AG
Medienworkshop Digitalisierung in der Produktion, 07. Dezember 2017, Wolfsburg
**Motivation – goals – benefit**

The aim is to unlock potential from the advancement of information technologies to increase productivity in vehicle production:

- Support maintenance processes through digital tools
- Increase manufacturing efficiency through digitally supported processes
- Reduce data handling effort through intelligent interfaces

**Approach**

The digital way maps opportunities for improvement in various manufacturing and manufacturing-related processes. Linking worker guidance to the Arbeitsplan system prevents maintaining duplicate sets of identical data. The wireless pick-by-light shelf reduces investment costs through the intelligent use of new technologies borrowed from the consumer sector. The Digital Transparent Production Line project demonstrates how line failures can be prevented (predictive maintenance) and how augmented reality can help to eliminate failures quickly. Workers or maintenance technicians can be provided with relevant information much more effectively through the use of tablets or data glasses (HoloLens).

**Timeline**

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<td>2018</td>
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</table>
Vehicle identification and servicing materials positioning

Motivation – goals – benefit

The aim is to establish new identification and positioning technologies for vehicle identification, servicing materials positioning and construction status documentation (BZD)

- Position-dependent tool activation/deactivation
- Monitoring and documentation of process sequences and results

Approach

Linking vehicle identification and position with exact servicing materials positioning in real time enables the definition of more precise work areas relative to the moving vehicle. Different technologies and hybrid solutions are tested, with a currently achievable tolerance radius of 0.3–0.4 metres.

<table>
<thead>
<tr>
<th>Identification</th>
<th>Location</th>
<th>Location</th>
<th>Precise Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>manual</td>
<td>Auto ID</td>
<td>± 1 ... 2m</td>
<td>± 0.5m</td>
</tr>
<tr>
<td>Passiv RFID UHF</td>
<td></td>
<td>Aktive RFID UHF</td>
<td>UWB</td>
</tr>
<tr>
<td>Barcode</td>
<td></td>
<td>Fzg- Ortung</td>
<td>BM-Ortung in Produktzonen</td>
</tr>
<tr>
<td>Objekt ist da / ist nicht da und bewegt sich in Richtung xy</td>
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</table>

Timeline

- Set up pilot production line in hall 25
- Production line test
- Pilot evaluation / optimisation
- Set up pilot production in hall 54
- SOP production line

2016 - 2017 - 2018
**Fully automatic vehicle commissioning**

**Motivation – goals – benefit**

The Volkswagen product offensive brings with it the upcoming challenges of both an increase in the volume of data and the number of electronic devices in each individual vehicle, which increase the amount of time required for vehicle commissioning.

- Sustainable
- Utilisation of unused areas
- Reduced production steps
- Increased direct run rate
- Phased introduction

**Approach**

The aim is to be able to put the control units in operation at any time with location-independent and fully automatic commissioning. By doing so, it will be possible to react quickly and with flexibility to future challenges.

**Timeline**

<table>
<thead>
<tr>
<th>Introduction KTI demo set-up</th>
<th>Pilot project</th>
<th>Lines pilot</th>
<th>Cross-line roll-out</th>
<th>Cross-plant roll-out</th>
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<tbody>
<tr>
<td>2017</td>
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<td>2018</td>
<td>2019</td>
<td>2020</td>
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</table>
Human-robot collaboration
urea filling

Motivation – goals – benefit

The aim is to implement a project for human-robot collaboration (HRC) in filling technology.

- Unlock flexibility, ergonomics and productivity potential
- Partial automation of handling the filling adaptor

Approach

The AdBlue filling adapter is guided by a lightweight robot right up to the tank flap cup. The operator then adjusts the injection adapter and starts the refuelling process.

Through the robot’s sensitivity, the tolerance is adjusted during refuelling without the use of additional sensors.

After the refuelling process is finished, the robot removes the adapter and returns to its basic position.

Timeline

<table>
<thead>
<tr>
<th>Set up pilot production line in hall 25</th>
<th>Feasibility study of KUKA</th>
<th>Lessons learned</th>
<th>Principle suitability achieved</th>
<th>Start integration in production line</th>
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<tbody>
<tr>
<td>2017</td>
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Filling console with lightweight robot

Adaptation of the AdBlue filling adapter for use with a lightweight robot
Mounting coupling rod in the VM subframe

Motivation – goals – benefit

The aim is to implement additional projects for human-robot collaboration (HRC) in assembly.

- Unlock flexibility, ergonomics and productivity potential
- Use of light-way robots for mounting requiring documentation

Approach

The coupling rod is automatically mounted using a lightweight robot. Through the robot's sensitivity, the tolerance is adjusted without the use of additional sensors.

Timeline

<table>
<thead>
<tr>
<th>Set up pilot production line in hall 25</th>
<th>Production line test</th>
<th>Determination of biomechanical limits</th>
<th>Set-up production line in hall 54</th>
<th>SOP production line</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>2017</td>
<td>2017</td>
<td>2018</td>
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</table>
**Motivation – goals – benefit**

The aim is to implement additional projects for human-robot collaboration (HRC) in assembly.

- Unlock flexibility, ergonomics and productivity potential
- First use of lightweight robots for mounting requiring documentation

**Approach**

Using a lightweight robot, the alternator is automatically mounted including the final tightening.

Through the robot’s sensitivity, the tolerance is adjusted without the use of additional sensors.

As part of the pilot application in the Competence Centre for technology and innovation (KTI), in addition to the alternator, the air conditioner compressor and the tensioning roller are also mounted by robots to prove technical feasibility.

**Timeline**

- Set up pilot production line in hall 25
- Production line test
- Determination of biomechanical limits
- Set-up production line in hall 54
- SOP production line

2017
Motivation – goals – benefit

The aim is to implement the pilot project for human-robot collaboration (HRC) in body construction.

- Raising awareness of HRC among workers
- Unlock flexibility, ergonomics and productivity potential
- Development of new technologies
- Consistent adhesion seam quality
- “No rework”

Approach

The adhesive is to be applied automatically using an HRC robot. By doing so, there is less stress on the employee and there is no direct exposure to the adhesive. The challenges include the development of a safe glue nozzle and the interaction of the adhesive hose with the robot.

Timeline

<table>
<thead>
<tr>
<th>Event</th>
<th>Year</th>
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<tbody>
<tr>
<td>Set up pilot production line in hall 25</td>
<td>2017</td>
</tr>
<tr>
<td>Feasibility study / Test phase</td>
<td></td>
</tr>
<tr>
<td>Lessons learned Biomechanical strength measurement</td>
<td></td>
</tr>
<tr>
<td>Principle suitability achieved</td>
<td></td>
</tr>
<tr>
<td>Start integration in production line</td>
<td>2018+</td>
</tr>
</tbody>
</table>
Vehicle body construction robot cell

Motivation – goals – benefit
The variety of components and technologies available in body construction requires robust processes in manufacturing plants. The factory’s economic efficiency is ensured by an extensive testing phase under real conditions.
Possible topic clusters include:
- Test field for technologies/components
- Test runs of VASS/robot standards
- Firmware version compatibility

Approach
In addition to the analysis of problems in the field, establishing a flexibly expandable body construction test cell enables in particular deliberately instigating fault patterns. The result is a reduction in commissioning times and downtimes of running production plants.

Timeline

<table>
<thead>
<tr>
<th>Conception/Robot cell technology selection</th>
<th>Set up and commissioning in hall 25</th>
<th>Qualification of 3D camera systems on Fanuc robot</th>
<th>Condition-based maintenance Energy data capture</th>
<th>Completion of full commissioning of the robot cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>2016</td>
<td>2017</td>
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