Sustainable Assembly Systems: Ergonomic Optimization of Volkswagen Commercial Vehicles Production

@ Assembly Engineering Conference 2016

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Contents

1. Challenges at Volkswagen Commercial Vehicles
2. General Procedure and Employee Participation
3. Implementation of Improvements
4. Ergonomic Design Process
5. Summary
Challenges at VW Commercial Vehicles
Length and Height in Comparison to Passenger Cars

- Crafter (max. 2,7 m)
- T6 (max. 2,4 m)
- Amarok
- Golf 1,4 m

- Crafter max. 6,9 m
- T6 max. 5,3 m
- Amarok
- Golf 4,2 m

Team Ergonomie, NP-HE/22
Challenges at VW Commercial Vehicles

(1) Product Dimensions

• **Product Dimensions:**
  - Greater length and height of vehicles
  - More difficult accessibility
  - Increased proportion of overhead work
  - Parts are bigger in size and weight
  - More assembly tasks in car interior

• **Product Lifecycle**

• **Plant Structures**
Challenges at VW Commercial Vehicles

Part Dimensions

Wooden ground floor (ca. 20 kg)

Paint auxiliary fittings
Challenges at VW Commercial Vehicles

(2) Product Life Cycle

• **Product Dimensions:**
  - Greater length and height of vehicles
  - More difficult accessibility
  - Increased proportion of overhead work
  - Parts are bigger in size and weight
  - More assembly tasks in car interior

• **Product Lifecycle**

• **Plant Structures**
Challenges at VW Commercial Vehicles
Product Lifecycle in Comparison to Passenger Cars
Challenges at VW Commercial Vehicles

(3) Plant Structure

• **Product Dimensions:**
  - Greater length and height of vehicles
  - More difficult accessibility
  - Increased proportion of overhead work
  - Parts are bigger in size and weight
  - More assembly tasks in car interior

• **Product Lifecycle**

• **Plant Structure**
Challenges at VW Commercial Vehicles
Structure of Hannover Plant: NZM (New Sustainable Assembly)
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General Procedure at Hannover Plant
Ergonomics as Part of the Plant Strategy

Volkswagen Production System

Volkswagen „Fit for Future“ Programme
General Procedure at Hannover Plant
Employee Participation in „Review Teams“

- Review Teams consists of representatives from different departments (Production, Planning, I.E., HR, Unions, etc.)
- Common generation and assessment of ideas for ergonomic improvements
- Systematic status tracking and continuous reporting to plant management
General Procedure at Hannover Plant

Reporting and Escalation Levels

Improving ergonomics workplace design in 21 review teams across the entire commercial vehicle production process

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
<th>Level</th>
<th>Turnus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cost center committee</td>
<td>Section Manager</td>
<td>Every 3 weeks</td>
</tr>
<tr>
<td>2</td>
<td>Ergonomics steering committee (all shops, all activities)</td>
<td>Plant Manager</td>
<td>Every 2 month</td>
</tr>
<tr>
<td>3</td>
<td>Live presentation of topics from Body, Paint and Assembly shop</td>
<td>Board Member</td>
<td>Every 6 weeks (1 example)</td>
</tr>
</tbody>
</table>
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Implementation of Improvements

Categories of Improvements

1. Work organization:
   1.1 Workplace design (working height, platforms, racks, trolleys, etc.)
   1.2 Process design (change of sequence, line balancing, optimization)

2. Technical improvements:
   2.1 Lightweight stool
   2.2 Raku seat
   2.3 Tools & Fixtures
   2.4 Manipulator & Balancer
   2.5 Automatic Tools / Screwdrivers
   2.6 Full Automation

3. Product design:
   3.1 Parts & Design changes
Implementation of Improvements
Definition of „Ergonomic improvement path“

(x dates and improvements are fictitious)


- x WP-design
- x Stools
- x Tools
- x Manipulator
- x Automation
- x Part design

- x WP-Design
- x Tools
- x Manipulator
- x Automation

- x WP-Design
- x Stools
- x Tools
- x Manipulator

- x WP-Design
- x Stools
- x Tools
- x Manipulator
- x Automation

- x WP-Design
- x Stools
- x Manipulator
- x Screwdriver

Product changes T7

Team Ergonomie, NP-HE/22
Status quo

T6

Work organisation & technical measures

Amarok

NZM 2016

NZM 2017

NZM 2018

T7

Status 01/2013

Status 02/2016

Status 01/2013

Status 02/2016

50%
Example: Press shop
(1) Roof frame

Before

• 3 parts at a time (total weight > 3 kg)
• Ergonomically bad picking height
• Deep bending while placing
• 2 workers (left/right)

After

• Decoupling of worker from press cycle time
• No manual load handling
• Packaging is now possible with one worker

- 23 Pts.
Example: Body shop
(2) Hood assembly und adjustment

**Before**
- Hood fixture has to be lifted manually (7.5 kg)
- Red workplace for 8 workers

**After**
- Fixture with gas spring. Lifting force < 30 N
- Strong reduction of asymmetric shoulder strain
Example: Paint shop
(3) Optimization glueing of interior rear view mirror

**Before**
- Rework for glueing the interior mirror
- Deep bending, standing posture or crouching
- Red workplace for 2 workers

**After**
- Sitting on lightweight stool
- Reduction of rework through optimization of the glueing station and workplace
Example: Assembly shop

(4) EC-screwdriver for seat belts

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
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</thead>
<tbody>
<tr>
<td><img src="image" alt="Before Image" /></td>
<td><img src="image" alt="After Image" /></td>
</tr>
<tr>
<td>• Screw seat belts with power screwdriver (pistol grip) and manually tightening with wrench</td>
<td>• Screws are tighten with the EC-screwdriver, no manual tightening and documentation</td>
</tr>
<tr>
<td>• Screws have to documented on data card</td>
<td>• Increased productivity, double handling avoided</td>
</tr>
</tbody>
</table>

- 25 Pts.
### Example: Assembly shop

**5) Door preassembly**

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
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<tbody>
<tr>
<td><img src="image" alt="Before image" /></td>
<td><img src="image" alt="After image" /></td>
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</table>

- Doors were fixed at the vehicle
- Ergonomic problems due to restricted accessibility in many assembly stations

- Doors are now separated in a pre-assembly line, and reassembled to the car later in the process
Example: Assembly shop
(7) Lightweight stool for interior tasks

**Before**
- Stool placed in the vehicle, multiple pick & place actions with asymmetric load handling (> 5 kg)
- Red workplace for 5 workers

**After**
- Lightweight stool 2.5 Kg
- Reduction of manual load handling > 50%
- High acceptance by workers

- 7 Pts.
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Ergonomic Design Process
General (Future) Procedure

Product Engineering
Ergonomic Product Design

Production Planning
Ergonomic Work Design

Series Production
Ergonomic Assessment and Continuous Improvement

Critical ergonomic work tasks from reference car

Optimizing ergonomically critical work from PRODUCT point of view

Optimizing ergonomically critical work from PROCESS point of view

Prospective Ergonomics

Corrective Ergonomics
Summary

• Ergonomic challenges in commercial vehicles production due to greater dimensions of body and parts and prolonged lifecycle

• Systematic approach is based on plant strategy and includes comprehensive risk assessment and status tracking

• Participation of employees (Review Teams) and reporting to plant management (Escalation Levels) is key for success

• In future more efforts should be concentrated on prospective ergonomic design at product and production process level
ERGONOMIE IM PRODUKTIONSSYSTEM

Nutzfahrzeuge

(Video 90 s)
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