Integrative Production Technology
A Chance for High-Wage Countries

Cathrin Wesch-Potente

Managing Director of the Cluster of Excellence "Integrative Production Technology for High-Wage Countries"

Tampere, 11th of June 2013
RWTH Aachen University
A one-of-a-kind cluster of competencies

- Budget: 705 Mio. €
- Third party funds: 258 Mio. €
- Affiliated institutes: 35 Mio. €

- 465 professorships
- 262 institutes
  - including 20 major institutes and 4 Fraunhofer Institutes
- 13 affiliated institutes
- 9 Research Training Groups
- >32,000 students

Students by discipline

- Engineering: 54%
- Natural Sciences: 24%
- Humanities, Social Sciences, Economics: 14%
- Medicine: 8%

Source: Annual Report of RWTH Aachen
Cluster of Excellence
Integrative Production Technology

<table>
<thead>
<tr>
<th>Cluster of Excellence</th>
<th>Participating Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 82 Mio. € budget (2006 – 2017)</td>
<td>![Logos of various institutions]</td>
</tr>
<tr>
<td>• 32 Professors</td>
<td></td>
</tr>
<tr>
<td>• 842 Academic Staff / 563 Non-Academic Staff</td>
<td></td>
</tr>
<tr>
<td>• 132 doctoral theses completed within the area of the Cluster</td>
<td></td>
</tr>
<tr>
<td>• 7 researchers of the cluster became professors*</td>
<td></td>
</tr>
</tbody>
</table>

*by 2012
Industrial Advisory Board

BorgWarner Turbo & Emissions Systems
BorgWarner Turbo Systems, Kirchheimbolanden

ROFIN-SINAR Laser GmbH, Hamburg

EADS Deutschland GmbH, Ottobrunn

Gallus Fed. Rüesch AG, St. Galien

BÖHLER UDDEHOLM
Böhler Uddeholm AG, Wien (A)

MAGMA GmbH, Aachen

DECKEL MAHO GmbH, Pfronten

RKW SE, Frankenthal

MAN B&W Diesel AG, Augsburg

ThyssenKrupp Steel
ThyssenKrupp Steel Europe AG, Duisburg

CemeCon AG, Würtelien

Phoenix Contact GmbH & Co. KG, Blomberg

Lanxess Deutschland GmbH, Dormagen

Robert Bosch GmbH, Stuttgart

Gallus Druckmaschinen GmbH, Langgöns-Oberkleen

agiplan
Agiplan AG, Mülheim

Philips Lighting B. V., Eindhoven (NL)

BMW Group, Regensburg

German Machine Tool Builders’ Association (VDW), Frankfurt

TRUMPF
Trumpf GmbH & Co. KG, Ditzingen

SMS group
SMS Group AG, Düsseldorf

EPLAN Software & Service GmbH & Co. KG, Monheim

Festo AG & Co. KG, Eslingen-Barkheim

German Engineering Federation (VDMA), Frankfurt

Siemens AG, Erlangen

German Automobile Industry Association (VDA), Frankfurt

PSIFENTA Software Systems GmbH, Berlin

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Achievements of the cluster in the 1\textsuperscript{st} funding period 2006-2012
Integrating research activities in different domains

**Integrating different materials**
- Metals
- Plastics
- Hybrids
- ...

**Integrating different processes**
- Additive processes
- Cutting
- Grinding
- ...

**From micro- to macro-scale**

**For different industry sectors**

*First level of integration*

Coherent description and interpretation models, design methodologies and tools as well as key technologies for production in high-wage countries
Strategic Research Areas
Integrative Production Technology

Individualised Production

Integrated Technologies

Virtual Production Systems

Self-Optimizing Production Systems
Collaborative, interdisciplinary research

Integrative Production Technology for High-Wage Countries

Second level of integration

Achieve cooperative, scientific, structural sustainability
Top Performer consolidate their production sites in western Europe and expand in growing markets

*Investment and disinvestment in the last 10 years*

Where did you construct new or reduce production sites in the last 10 years world wide?

<table>
<thead>
<tr>
<th>Region</th>
<th>Top Performer</th>
<th>Follower</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>24%</td>
<td>-18%</td>
</tr>
<tr>
<td>Western Europe</td>
<td>24%</td>
<td>-53%</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>47%</td>
<td>44%</td>
</tr>
<tr>
<td>Middle East/Africa</td>
<td>18%</td>
<td>-6%</td>
</tr>
<tr>
<td>Russia/GUS</td>
<td>18%</td>
<td>18%</td>
</tr>
<tr>
<td>China</td>
<td>53%</td>
<td>36%</td>
</tr>
<tr>
<td>Rest Asia/Pacific</td>
<td>18%</td>
<td>-12%</td>
</tr>
</tbody>
</table>

What are the key factors to successfully produce in high-wage countries?

Source: Benchmarking Global Value Adding 2011

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# Integrative Production Technology – A Chance for High-Wage Countries

<table>
<thead>
<tr>
<th>1</th>
<th>Production systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Cooperation Productivity</td>
</tr>
<tr>
<td>3</td>
<td>Conclusio</td>
</tr>
</tbody>
</table>
The Toyota Production System is still the benchmark – but many companies are trying to copy the success of Toyota

When did you establish the Production System?

<table>
<thead>
<tr>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
</tr>
<tr>
<td>1992</td>
</tr>
<tr>
<td>1994</td>
</tr>
<tr>
<td>1996</td>
</tr>
<tr>
<td>1998</td>
</tr>
<tr>
<td>2000</td>
</tr>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2004</td>
</tr>
<tr>
<td>2006</td>
</tr>
<tr>
<td>2008</td>
</tr>
</tbody>
</table>

OEMs

But not every company was as successful

Source: following Keßler, 2008; study results KBM 2010

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Function of a Production System

How would you describe your Production System?

**Toolkit**

“Company-wide toolkit of methods”

**Operationalisation of goals**

“Operationalisation of the company’s goals on the shopfloor level”

**Continuous improvement**

“Basis for continuous improvement of the company”

Source: Study WZL, 2011, Pictures: Hobby-Zentrum-Schneider, Fotolia, Shutterstock
Top Performer with holistically implemented production systems benefit from significantly better results!

Which goals have you achieved since the introduction of your production system?

<table>
<thead>
<tr>
<th>Category</th>
<th>Top Performer</th>
<th>Follower</th>
<th>Source: Study WZL, 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in delivery on time [%]</td>
<td>61%</td>
<td>30%</td>
<td>Ø Top Performer</td>
</tr>
<tr>
<td>Reduction of leadtime [%]</td>
<td>50%</td>
<td>26%</td>
<td>Ø Follower</td>
</tr>
<tr>
<td>Reduction of missing parts [%]</td>
<td>65%</td>
<td>41%</td>
<td>Intervall Top Performer</td>
</tr>
<tr>
<td>Increase in quality [%]</td>
<td>77%</td>
<td>34%</td>
<td>Intervall Follower</td>
</tr>
<tr>
<td>Reduction of production costs [%]</td>
<td>23%</td>
<td>13%</td>
<td>Ø Top Performer</td>
</tr>
<tr>
<td>Increase in productivity [%]</td>
<td>46%</td>
<td>22%</td>
<td>Ø Follower</td>
</tr>
<tr>
<td>Reduction of inventory [%]</td>
<td>50%</td>
<td>28%</td>
<td>Intervall Top Performer</td>
</tr>
<tr>
<td>Increase in sales [%]</td>
<td>77%</td>
<td>59%</td>
<td>Intervall Follower</td>
</tr>
</tbody>
</table>

Legende: Ø Top Performer  ○ Follower  ← Intervall Top Performer  → Intervall Follower
Continuous improvement processes are important but quality and commitment are essential!

### Number of CIP per year

<table>
<thead>
<tr>
<th>Year</th>
<th>Top Performer</th>
<th>Follower</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>76</td>
<td>192</td>
</tr>
<tr>
<td>2009</td>
<td>67</td>
<td>140</td>
</tr>
<tr>
<td>2008</td>
<td>72</td>
<td>179</td>
</tr>
<tr>
<td>2007</td>
<td>70</td>
<td>133</td>
</tr>
</tbody>
</table>

- **Top Performer**
- **Follower**

### Average time effort for improvements

#### Top Management [% of working time]
- 0% → 19%
- 15% → 80%

#### Middle Management [% of working time]
- 0% → 20%
- 19% → 70%

#### Foreman/ group leader [% of working time]
- 0% → 21%
- 18% → 70%

#### Employees [% of working time]
- 0% → 8%
- 8% → 30%

**Legend:**
- Ø Top Performer
- Ø Follower
- Intervall Top Performer
- Intervall over all
The Production System has to be established by top management and lived by middle management.

What was the meaning of the following items during the introduction process?

<table>
<thead>
<tr>
<th>Top-Down introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Performer</td>
</tr>
<tr>
<td>Does not apply</td>
</tr>
<tr>
<td>20%</td>
</tr>
<tr>
<td>Follower</td>
</tr>
<tr>
<td>12%</td>
</tr>
</tbody>
</table>

Exemplified by the top management

<table>
<thead>
<tr>
<th>Top Performer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not apply</td>
</tr>
<tr>
<td>7%</td>
</tr>
<tr>
<td>Follower</td>
</tr>
<tr>
<td>4%</td>
</tr>
</tbody>
</table>

Production Systems are especially an executive manager duty!

photocredit: Marceating
Vision and goals of the company have to be concretized in roadmaps to define pilot projects and lighthouses.

Please characterize your implementation process.

Roadmap:

“We follow a defined implementation roadmap”

<table>
<thead>
<tr>
<th>Top Performer</th>
<th>Follower</th>
</tr>
</thead>
<tbody>
<tr>
<td>7%</td>
<td>20%</td>
</tr>
<tr>
<td>27%</td>
<td>24%</td>
</tr>
<tr>
<td>66%</td>
<td>41%</td>
</tr>
</tbody>
</table>

| Source: Studie WZL, 2011 |

Lighthouses:

“We implement the production system via pilot projects and lighthouses”

<table>
<thead>
<tr>
<th>Top Performer</th>
<th>Follower</th>
</tr>
</thead>
<tbody>
<tr>
<td>13%</td>
<td>5%</td>
</tr>
<tr>
<td>13%</td>
<td>5%</td>
</tr>
<tr>
<td>74%</td>
<td>31%</td>
</tr>
<tr>
<td>59%</td>
<td></td>
</tr>
</tbody>
</table>

| Source: Studie WZL, 2011 |

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Looking for the same language: „If you want to speak ONE language, you have to educate.“

How much do you invest into education an qualification?

- **Training for/ by…**
  - Top Management
  - Middle Management
  - Employees
  - Foreman/ Group leader

### Hours per year in the top management
- 0 h
- 28 h
- 41 h
- 120 h

### Hours per year for foreman/group leader
- 0 h
- 38 h
- 37 h
- 100 h

### Hours per year in the middle management
- 0 h
- 31 h
- 40 h
- 100 h

### Hours per year for employees
- 0 h
- 21 h
- 27 h
- 50 h

**Legende:**
- Ø Top Performer
- Ø Follower
- Intervall Top Performer
- Intervall over all

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Top Performer expect almost the same potentials as followers!

What improvement potential do you expect on long term?

<table>
<thead>
<tr>
<th>Quality</th>
<th>Missing parts</th>
<th>Lead time</th>
<th>Inventory</th>
<th>Productivity</th>
<th>Production Cost</th>
<th>Delivery on time</th>
</tr>
</thead>
<tbody>
<tr>
<td>27%</td>
<td>27%</td>
<td>29%</td>
<td>27%</td>
<td>27%</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>36%</td>
<td>40%</td>
<td>26%</td>
<td>22%</td>
<td>19%</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>22%</td>
<td>27%</td>
<td>26%</td>
<td>22%</td>
<td>27%</td>
<td>15%</td>
<td>12%</td>
</tr>
<tr>
<td>19%</td>
<td>20%</td>
<td>19%</td>
<td>20%</td>
<td>19%</td>
<td>15%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Legend:  
- Ø Top Performer  
- Ø Follower  
- Intervall Top Performer  
- Intervall Follower

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Production Systems have to be rolled out in indirect areas

Which penetration level exhibits your Production system in the following areas?

Key:
- Ø Top Performer
- Ø Follower

<table>
<thead>
<tr>
<th>Area</th>
<th>Production</th>
<th>Logistics</th>
<th>Purchase</th>
<th>Administration</th>
<th>Service</th>
<th>R&amp;D</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>96%</td>
<td>86%</td>
<td>79%</td>
<td>70%</td>
<td>60%</td>
<td>57%</td>
<td>55%</td>
</tr>
<tr>
<td>Logistics</td>
<td>78%</td>
<td>60%</td>
<td>45%</td>
<td>43%</td>
<td>43%</td>
<td>38%</td>
<td>25%</td>
</tr>
<tr>
<td>Purchase</td>
<td>60%</td>
<td>45%</td>
<td>27%</td>
<td>43%</td>
<td>38%</td>
<td>38%</td>
<td>25%</td>
</tr>
<tr>
<td>Administration</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
</tr>
<tr>
<td>Service</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
</tr>
<tr>
<td>Sales</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
</tr>
</tbody>
</table>
Integrative Production Technology – A Chance for High-Wage Countries

1 Production systems

2 Cooperation Productivity

3 Conclusio
Cooperation Productivity

- leading know-how in leading technologies in companies and universities
- Several alternative providers and cooperation partners for any technical challenge
- Highly qualified people

Leading innovations in the world wide market: Clusters of small and medium-sized companies, that cooperate openly and complementary!
The RWTH Aachen Campus: 
Strategic development of the university

- With its new areas, RWTH Aachen University covers an area of approx. 2.5 km²
- RWTH Aachen Campus
  - Area: 800,000m²
  - Capital commitments: 2 bn. €
  - New direct and indirect jobs: approx. 10,000
- Goal: The largest technology-oriented campus area in Europe
  - 19 technology clusters
  - Cooperation between institutes and industry

The RWTH Aachen Campus will generate a continuous campus which is integrated into public life and strengthens the urbanistic perceptibility of the RWTH Aachen significantly.
Structural Sustainability
Campus Cluster Integrative Production Technology

Cluster Integrative Production Technology

Aachen House of Integrative Production
(start of construction 2013, first building 12,000 m²)

Henn Architects aus München und Capricorn Development GmbH & Co. KG aus Düsseldorf
Technology Platforms
Sustainable structures in Campus Cluster

Production Engineering for E-Mobility Components

Synchronised Tool & Die Production

Campus Cluster Logistics
(High Resolution Production Management)

Integrative Light Weight Engineering
Integrative Production Technology – A Chance for High-Wage Countries

1 Production systems

2 Cooperation Productivity

3 Conclusio
Key Factors for small and medium sized companies

"Knowledge exchange increases efficiency. Exchanging and connecting knowledge becomes a success factor."

- Prof. Dr. Reinhold Achatz, ThyssenKrupp AG

Utilize Cooperation Productivity within Clusters

Production Systems as motor for productivity increase
Thank you!

Cathrin Wesch-Potente

Managing Director of the Cluster of Excellence
"Integrative Production Technology for High-Wage Countries"

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1 Production systems

2 Cooperation Productivity

3 Conclusio
Backup