Presentation at the
Regional Studies Association Global Conference 2014,
27th – 30th of April 2014, Fortaleza - Brazil

The Spatial Outcome of Modular Production: Organization of the Wind Industry in Brazil

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Current Market and Industry Dynamics

- Challenging market conditions in former core markets
- Changes in the competitive environment in international markets
- Coexistence of different types of value chains
- Pressure to reduce costs and increase efficiency in Wind turbine manufacturing
- Manufacturers adapt their supply chain and vertical integration leading to a modularization of value chains
- Specific market requirements in growing markets
Market Conditions – Changing Market Structures

Annually Added Capacity per Region

Figure 1: Annually Added Capacity per Region (based on data by GWEC and further national data)
Market Conditions – Changing Market Structures

Regions Share of World Market
- Annually Added Capacity

Figure 2: Regions Share of World Market by Annually Added Capacity (based on data by GWEC and further national data)
Market Conditions –
Changing Market Structures

Regions Share of World Market
- Cumulative Capacity

Figure 3: Regions Share of World Market by Cumulative Capacity (based on data by GWEC and further national data)
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- Specific market conditions in emerging/growing markets - the example of Brazil
Figure 4: Number of Wind Turbine Generator Manufacturers per Country (Menzel and Kammer 2011, 9)
## Market Share of Top 10 Producers

<table>
<thead>
<tr>
<th>Year</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td></td>
</tr>
<tr>
<td>Vestas (DK)</td>
<td>17.6%</td>
</tr>
<tr>
<td>Enercon (DE)</td>
<td>11.8%</td>
</tr>
<tr>
<td>Micon (DK)</td>
<td>10.4%</td>
</tr>
<tr>
<td>Bonus (DK)</td>
<td>9.1%</td>
</tr>
<tr>
<td>Nordtank (DK)</td>
<td>8.5%</td>
</tr>
<tr>
<td>Tacke (DE)</td>
<td>6.4%</td>
</tr>
<tr>
<td>Gamesa (ES)</td>
<td>6.1%</td>
</tr>
<tr>
<td>Nordex (DE)</td>
<td>2.9%</td>
</tr>
<tr>
<td>NEPC (IN)</td>
<td>2.8%</td>
</tr>
<tr>
<td>WindWorld (DK)</td>
<td>2.2%</td>
</tr>
<tr>
<td>Europ. Manuf.</td>
<td>75.00%</td>
</tr>
</tbody>
</table>

Market Share of Wind Turbine Producers (based on Data by BTM, MAKE and Bloomberg)

* Suzlon in 2006 without Repower; Suzlon Group in 2013 includes Repower/Senvion
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• Specific market conditions in emerging/growing markets - the example of Brazil
Value Chains of European Manufacturers

(Lema et al. 2011)
Value Chains of Chinese Manufacturers

(Lema et al. 2011)
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**Indicators for Value Chain Modularization**

- **Multiple Sourcing**
  - Usually several suppliers per component (optimally about two to "reduce uncertainty due to lower monitoring costs") (Zademach et al. 2006: 190)

- **Vertical disintegration**
  - Outsourcing of formerly integrated suppliers (Sturgeon 2002)

- **Product modularity**
  - Using interchangeable modules in different platforms without almost no adjustments
  - Prerequisites:
    - emergence of standards or de facto standards or
    - technological progress which enables to break up formerly complex information to be transformed into codes (STURGEON 2002: 467)
### Global Top Ten 2013 – Product Modularization, Vertical Integration and outsourcing

<table>
<thead>
<tr>
<th>Rank</th>
<th>Manufacturer</th>
<th>Origin</th>
<th>Market Share</th>
<th>Product Modularization</th>
<th>Vertical integration</th>
<th>outsourcing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vestas</td>
<td>DK</td>
<td>13,2%</td>
<td>2012</td>
<td>2012*</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Goldwind</td>
<td>CN</td>
<td>10,3%</td>
<td>?</td>
<td>2012**</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Enercon</td>
<td>DE</td>
<td>10,1%</td>
<td>?</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Siemens</td>
<td>DE</td>
<td>8,0%</td>
<td>2012</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Suzlon Group****</td>
<td>IN</td>
<td>6,3%</td>
<td>?</td>
<td>-</td>
<td>2011***</td>
</tr>
<tr>
<td>6</td>
<td>GE</td>
<td>US</td>
<td>4,9%</td>
<td>x</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Gamesa</td>
<td>ES</td>
<td>4,6%</td>
<td>x</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>United Power</td>
<td>CN</td>
<td>3,9%</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>MingYang</td>
<td>CN</td>
<td>3,7%</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Nordex</td>
<td>DE</td>
<td>3,4%</td>
<td>2010-2011</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- **mainly external supply**
- **in-house and external supply**
- **mainly in-house supply**

- x - yes, year of introduction not known
- (x) - planned or in progress
- ? - unknown
- * - Sold tower factory in Varde (DK)
- ** - Sold tower manufacturer Tellhow Wind Power
- *** - Sold Gearbox manufacturer Hansen to ZF
- **** - Suzlon Group (including Senvion) - Data without Senvion

Market Share based on data by MAKE Consulting
### Global Top Ten 2013 – Vertical Integration by Component

<table>
<thead>
<tr>
<th>Rank</th>
<th>Manufacturer</th>
<th>Blades</th>
<th>Gearboxes</th>
<th>Generator</th>
<th>Tower</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>In-house</td>
<td>extern</td>
<td>In-house</td>
<td>extern</td>
</tr>
<tr>
<td>1</td>
<td>Vestas (DK)</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>2</td>
<td>Goldwind (CN)</td>
<td>-</td>
<td>x</td>
<td>direct drive</td>
<td>x</td>
</tr>
<tr>
<td>3</td>
<td>Enercon (DE)</td>
<td>x</td>
<td>?</td>
<td>direct drive</td>
<td>x</td>
</tr>
<tr>
<td>4</td>
<td>Siemens (DE)</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>5</td>
<td>Suzlon Energy (IN)</td>
<td>x</td>
<td>-</td>
<td>?</td>
<td>x</td>
</tr>
<tr>
<td>6</td>
<td>GE Wind (US)</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>8</td>
<td>United Power (CN)</td>
<td>x</td>
<td>?</td>
<td>x</td>
<td>?</td>
</tr>
<tr>
<td>9</td>
<td>MingYang (CN)</td>
<td>x</td>
<td>?</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>10</td>
<td>Nordex</td>
<td>x</td>
<td>-</td>
<td>x</td>
<td>-</td>
</tr>
</tbody>
</table>

* Including Susidiary Cantarrey  ** Without Subsidiary Cantarrey  *** Including Windar (Gamesa with 32% Stake in Windar)  ? unknown, if additional in-house/ external supply
Modularization and knowledge

- Development and transfer of tacit knowledge benefit from – especially – spatial proximity (Malmberg and Maskell 1997)
- Codified knowledge enables a transfer on a broader (e.g. national or inter-national) scale (Malmberg and Maskell 1997)
- Codified knowledge thus gives rise to new organizational forms of cooperation between
  – manufacturers and suppliers
  – different location sites of these actors
- It thus enables changes in the spatiality of production, especially in emerging markets
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Wind Industry in Brazil – Overview

• Market Conditions/ Environment
  – Political incentives
  – Favorable wind conditions
    ➔ result in a growth market of the wind energy industry
  – Demand
  – Local content requirements\(^1\)
  – Lack of a second-tier supplier base\(^2\)
    ➔ led to the emergence of an ever more broadened manufacturing base of wind turbines and its components.

\(^1\) To be applicable for loans from the Banco Nacional de Desenvolvimento Economico e Social (BNDES), companies must source 60% of components locally. From January 2013 on they will have to be producing or assembling at least three of the four main wind turbine components - towers, blades, nacelles and hubs - in Brazil.

\(^2\) Alfonso Faubel (Alstom, senior vice president) in http://www.windpowermonthly.com/article/1184025/BNDES-approves-Alstom-local-sourcing on 28 of May 2013 (30.01.2014)
Wind Industry in Brazil – Market per State

Potência Total por Estado (Operação + Construção + Contratado) em MW

Gráfico 4- Potência Total por Estado (Fonte: ABEEólica)

Wind Industry in Brazil – Market Share Year-End 2011 and 2012

Source: MAKE Consulting 2013: Global Wind Turbine OEM 2012 Market Share 2013_03
Research Questions and Design

• Investigate the relations between
  – manufacturers and suppliers in Brazil
  – manufacturers and their HQ
  – (global) suppliers and their HQ

• Investigate the Modularity of value chains per component and company in Brazil

• Investigate the drivers for the location decisions of
  – manufacturers
  – suppliers
Thank you for your attention!