Welcome to the
IFR Press Conference
24th September 2020
Frankfurt

#WorldRobotics2020
Agenda

Welcome

Presentation of the Speakers

World Robotics 2020 Industrial Robots

World Robotics 2020 Service Robots

Questions
Speakers on the panel

Milton Guerry
IFR President
President
Schunk, USA

Susanne Bieller
General Secretary
International Federation of Robotics, Germany

Christopher Müller
Director Statistical Dpt.
International Federation of Robotics, Germany

Werner Kraus
Vice Chair IFR Service Robot Group
Head of Dpt. Robot and Assistive Systems
Fraunhofer IPA, Germany
International Federation of Robotics

- Non-profit organization since 1987
- Connecting the world of robotics around the globe
- 65 members from over 20 countries
- Annual global robotics turnover $50 billion (robot systems including software & peripherals)
Two separate reports

- **industrial robots**
  - automatically controlled, programmable, multipurpose, 3+ axes, for use in industrial automation applications
  - based on 5 different kinematic types that are equipped with applications-specific end-effectors

- **service robots:**
  - performs tasks excluding industrial automation
  - usually application-specific design, often fewer than 3 axes
  - sometimes not fully autonomous but remote-controlled

- different customers, pricing, machinery, distribution channels, suppliers
The blurring lines between industrial and service robots

Depending on its application, the same unit can be a service robot or an industrial robot. **Usage concepts change** – new applications emerge.

**Reimagine business processes** to make optimal use of collaborative robots.

AI and machine learning technologies enable robots to **sense and respond** to their environment.

Robots are increasingly supporting humans both at **work** and in their **private lives**.
2019: Global economic downturn and trade tensions leave their marks

Robot stock
2019: 2.7 million units, +12%
• highest number ever recorded
• CAGR since 2014: +13%

New robots
2019: 373,000 units, -12%
• third highest number ever recorded
• CAGR since 2014: +11%
More robots deployed than ever

Operational stock of industrial robots - World
1,000 units

Year | Number
--- | ---
2009 | 1,021
2010 | 1,059
2011 | 1,153
2012 | 1,235
2013 | 1,332
2014 | 1,472
2015 | 1,632
2016 | 1,838
2017 | 2,125
2018 | 2,440
2019 | 2,722

Source: World Robotics 2020
More robots deployed than ever

Operational stock of industrial robots
('000 of units)

Source: World Robotics 2020
Operational stock by industry

Operational stock of industrial robots by customer industry - World

1,000 units

<table>
<thead>
<tr>
<th>Industry</th>
<th>2019</th>
<th>2018</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automotive</td>
<td>923</td>
<td>847</td>
<td>762</td>
</tr>
<tr>
<td>Electrical/electronics</td>
<td>509</td>
<td>597</td>
<td>672</td>
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<tr>
<td>Metal and machinery</td>
<td>248</td>
<td>216</td>
<td></td>
</tr>
<tr>
<td>Plastic and chemical products</td>
<td>182</td>
<td>176</td>
<td>171</td>
</tr>
<tr>
<td>Food</td>
<td>81</td>
<td>74</td>
<td>64</td>
</tr>
<tr>
<td>All others</td>
<td>121</td>
<td>149</td>
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<tr>
<td>Unspecified</td>
<td>410</td>
<td>349</td>
<td>282</td>
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</tbody>
</table>

Source: World Robotics 2020
Operational stock by application

Operational stock of industrial robots by application - World

1,000 units

<table>
<thead>
<tr>
<th>Application</th>
<th>2019</th>
<th>2018</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling</td>
<td>1,215</td>
<td>1,082</td>
<td>946</td>
</tr>
<tr>
<td>Welding</td>
<td>640</td>
<td>532</td>
<td>946</td>
</tr>
<tr>
<td>Assembling</td>
<td>287</td>
<td>225</td>
<td>591</td>
</tr>
<tr>
<td>Cleanroom</td>
<td>210</td>
<td>130</td>
<td>258</td>
</tr>
<tr>
<td>Dispensing</td>
<td>94</td>
<td>78</td>
<td>210</td>
</tr>
<tr>
<td>Processing</td>
<td>44</td>
<td>38</td>
<td>171</td>
</tr>
<tr>
<td>All others/unspecified</td>
<td>231</td>
<td>189</td>
<td>136</td>
</tr>
</tbody>
</table>

Source: World Robotics 2020
A decade of growth

Annual installations of industrial robots - World

1,000 units

Source: World Robotics 2020
High sales volumes in all major markets

Annual installations of industrial robots ('000 of units)

Source: World Robotics 2020
The two major customers struggled in 2019

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**Annual installations of industrial robots by customer industry - World**

1,000 units

<table>
<thead>
<tr>
<th>Industry</th>
<th>2019</th>
<th>2018</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automotive</td>
<td>105</td>
<td>126</td>
<td>123</td>
</tr>
<tr>
<td>Electrical/electronics</td>
<td>88</td>
<td>105</td>
<td>122</td>
</tr>
<tr>
<td>Metal and machinery</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Plastic and chemical products</td>
<td>19</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>Food</td>
<td>11</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>All others</td>
<td>30</td>
<td>34</td>
<td>23</td>
</tr>
<tr>
<td>Unspecified</td>
<td>56</td>
<td>76</td>
<td>81</td>
</tr>
</tbody>
</table>

Source: World Robotics 2020
Handling remains the major application

Annual installations of industrial robots by application - World

1,000 units

Handling 173 178
Welding 75 89
Assembling 36 82
Cleanroom 25 49
Dispensing 12 34
Processing 6 5
All others/unspecified 39 58

Source: World Robotics 2020
China remains the main end user of industrial robots

Annual installations of industrial robots
15 largest markets 2019

<table>
<thead>
<tr>
<th>Country</th>
<th>'000 of units</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>140.5</td>
</tr>
<tr>
<td>Japan</td>
<td>49.9</td>
</tr>
<tr>
<td>United States</td>
<td>33.3</td>
</tr>
<tr>
<td>Rep. of Korea</td>
<td>27.9</td>
</tr>
<tr>
<td>Germany</td>
<td>20.5</td>
</tr>
<tr>
<td>Italy</td>
<td>11.1</td>
</tr>
<tr>
<td>France</td>
<td>6.7</td>
</tr>
<tr>
<td>Chinese Taipei</td>
<td>6.4</td>
</tr>
<tr>
<td>Mexico</td>
<td>4.6</td>
</tr>
<tr>
<td>India</td>
<td>4.3</td>
</tr>
<tr>
<td>Spain</td>
<td>3.8</td>
</tr>
<tr>
<td>Canada</td>
<td>3.6</td>
</tr>
<tr>
<td>Thailand</td>
<td>2.9</td>
</tr>
<tr>
<td>Poland</td>
<td>2.6</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Source: World Robotics 2020
Singapore and Rep. of Korea with highest robot density

Robot density in the manufacturing industry 2019

Robots installed per 10,000 employees:
- Singapore: 918
- Rep. of Korea: 855
- Japan: 364
- Germany: 346
- Sweden: 277
- Denmark: 243
- Hong Kong: 242
- Chinese Taipei: 234
- United States: 228
- Italy: 212
- Belgium and Luxembourg: 211
- Netherlands: 194
- Spain: 191
- Austria: 189
- China: 187
- France: 177
- Slovakia: 169
- Canada: 165
- Switzerland: 161
- Slovenia: 157

Average Europe: 114
Average America: 103
Average Asia: 118
Average World: 113

Source: International Federation of Robotics
Collaborative robots: sales volume growing

Collaborative and traditional industrial robots

<table>
<thead>
<tr>
<th>Year</th>
<th>Traditional Industrial Robots</th>
<th>Collaborative Robots</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>355</td>
<td>18</td>
</tr>
<tr>
<td>2018*</td>
<td>406</td>
<td>16</td>
</tr>
<tr>
<td>2017</td>
<td>389</td>
<td>11</td>
</tr>
</tbody>
</table>

* '000 units

Source: International Federation of Robotics

*revised
Covid-19: a digitalization booster

Today

✓ Electronics industry seems to be a winner of social distancing
✓ Increased demand in new applications like healthcare and for the production of personnel protective equipment
✓ Good opportunity for modernization and digitalization of production
  - Deferred investments, plummeted consumer demand and other demand-side issues
  - Travel restrictions, disrupted supply chains and other supply-side issues
  - Adaption to the ‘new normal’
  - Non-Covid issues remain: automotive transition, political headwinds
Recovery expected for 2021

Tomorrow

- Catch-up effects
- Robots make production resilient
- Many governments support investment in modern production technology
- Geographical diversification of supply chains, including reshoring/repatriation

- Recovery likely to happen at different times in different markets
- 2021 will see recovery
- May take until 2022 or 2023 to reach pre-crisis level
Personal/Domestic Service Robots

Value of Sales:
2019: USD 5.7bn, +20%
2020: USD 6.5bn, +15%
2023: USD 12.1bn, +23% (CAGR)

Unit Sales:
2019: 23.2 million units, +34%
2020: 26.7 million units, +15%
2023: 55.3 million units, +27% (CAGR)
Vacuuming and floor cleaning: a task for robots

Service robots for personal/domestic use.
Unit sales 2018 and 2019, potential development 2020-2023

millions of units

Robots for domestic tasks

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>13.2</td>
<td>18.6</td>
<td>21.6</td>
<td>31.2</td>
<td>39.0</td>
<td>48.6</td>
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</table>

Entertainment robots

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>4.6</td>
<td>4.6</td>
<td>5.1</td>
<td>5.6</td>
<td>6.1</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Source: World Robotics 2020
Steady growth of turnover expected

Service robots for personal/domestic use.
Value of sales 2018 and 2019, potential development 2020-2023
billions of USD

Robots for domestic tasks
- 2018: 3.5
- 2019: 4.3
- 2020: 6.7
- 2021: 8.2
- 2022: 10.0

Entertainment robots
- 2018: 1.1
- 2019: 1.3
- 2020: 1.4
- 2021: 1.5
- 2022: 1.7
- 2023: 1.9

Source: World Robotics 2020
Professional Service Robots

Value of Sales:
2019: USD 11.2bn, +32%
2020: USD 13.9bn, +24%
2023: USD 27.7bn, +26% (CAGR)

Unit Sales:
2019: 173,000 units, +32%
2020: 240,000 units, +38%
2023: 537,000 units, +31% (CAGR)
Robots in logistics are still the growth drivers

Service robots for professional use. Top 3 applications
Unit sales 2018 and 2019, potential development 2020-2023
'000 of units

Source: World Robotics 2020
Professional cleaning on the way to a top 3 application

Service robots for professional use. Top 4-7 applications
Unit sales 2018 and 2019, potential development 2020-2023

'000 of units

<table>
<thead>
<tr>
<th>Application</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection and maintenance robots</td>
<td>11</td>
<td>15</td>
<td>18</td>
<td>23</td>
<td>30</td>
<td>37</td>
</tr>
<tr>
<td>Professional cleaning</td>
<td>10</td>
<td>13</td>
<td>19</td>
<td>28</td>
<td>38</td>
<td>54</td>
</tr>
<tr>
<td>Field robots</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>15</td>
<td>19</td>
<td>22</td>
</tr>
<tr>
<td>Powered human exoskeletons</td>
<td>7</td>
<td>9</td>
<td>11</td>
<td>14</td>
<td>17</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: World Robotics 2020
Medical robots: growth expected as patents expire
Every 5th service robot supplier is a start-up

- 889 service robot suppliers
- 183 start-ups (est. 2015 or later)

- 728 professional service robot suppliers
- 155 start-ups

- 237 personal/domestic service robot suppliers
- 39 start-ups
Global distribution of service robot suppliers

Number of service robot suppliers by region and age - all applications

Europe: 330 total suppliers, 94 incumbents, 204 start-ups
America: 2 total suppliers, 51 incumbents, 204 start-ups
Asia: 5 total suppliers, 36 incumbents, 144 start-ups
Australia/Africa: 3 total suppliers, 7 start-ups

Source: World Robotics 2020
Technology & application trends in service robotics

Important markets to watch out:

• Unbroken scale-up of logistic systems (AGV, AMR)
• Mergers & acquisitions activities, e.g. in medical robotics
• Heavy construction machinery become robotized allowing multi-machine operation by one single person
• Information interaction (telepresence, advisory); >30 new disinfection robot models in 2020
• Covid-19 raised attention on healthcare robots

Major Technology Accelerators

• Cloud technologies and 5G: e.g., remote procedures using surgical robots and 5G in China
• Business models like Robot-as-a-Service lower the entrance level, especially in new markets
• Standardization & “platformization”: e.g. for peripherals (app store), sales platform, plug & play
Long-run perspectives for robotics remain excellent

- There are still many “4d” (dull, dirty, dangerous and/or delicate) tasks that could be done by robots, improving worker health, safety and job satisfaction.
- Ageing societies will feel additional need to relieve employees from physical tasks.
- Technological development will further increase the ROI in robots.
- Matrix production layouts use robots for automatic workpiece transportation.
- Modern robots support a smaller carbon footprint.
- Human-robot collaborative applications will complement traditional robotics.
- “Plug and play” system integration makes deployment easier (e.g. through OPC-UA).
- Ease of programming (e.g. through demonstration) makes redeployment easier.