TECHNOLOGY DEVELOPMENT & INNOVATION IN CROATIA – CHALLENGES AND OPPORTUNITIES

Ernest Vlacic
... we are living in VUCA times

Volatile
Uncertain
Complex
Ambiguous
Key enabling technologies and platforms

Industry 4.0

World Economic Forum

5G

EU komisija, kao dio strategije razvoja digitalnog društva
Volume/Scale Production Vs. Differentiation Evolution - a typology of global supply
I4.0 issues and myths – valid for Croatia and Austria too

- 1) IT security issues;
- 2) Reliability and stability of critical (M2M);
- 3) Maintaining integrity of production processes;
- 4) Avoiding IT snags, causing expensive production outages;
- 5) Protecting industrial know-how;
- 6) Lack of adequate skill-sets and Insufficient qualification of employees;
- 7) A threat of redundancy in the corporate IT department;
- 8) General reluctance to change by stakeholders;
- 9) Loss of many jobs to IT-controlled processes;
- 10) Low top management commitment;
- 11) Clarity on legal issues and data security;
- 12) Clarity on economic benefits/excessive investment;
- 13) Clarity on regulations, standard and forms of certifications;

......
... who will survive then?

*It Is Not the Strongest of the Species that Survives But the Most Adaptable*

Ne preživljavaju najjače vrste, ili najinteligentnijе, već one koje su najprilagodljivije promjenama.

C. Darwin
Where is Croatia in this turbulent world of 4th IR!
Resultats of EU national innovation (eco)systems assessment
- composite innovation indicators - 27:
  - environmental conditions
  - investment
  - innovation activities
  - impact

Source: European Innovation Scoreboard 2018
... more bad news

... november 2018

CREATING INNOVATION ECOSYSTEMS IN EASTERN EUROPE

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**Figure 1**
Share of population with tertiary education in CEE and selected countries in 2017

<table>
<thead>
<tr>
<th>Country</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romania</td>
<td>55.0%</td>
</tr>
<tr>
<td>Hungary</td>
<td>52.0%</td>
</tr>
<tr>
<td>Croatia</td>
<td>49.0%</td>
</tr>
<tr>
<td>Slovenia</td>
<td>48.0%</td>
</tr>
<tr>
<td>Poland</td>
<td>47.0%</td>
</tr>
<tr>
<td>Greece</td>
<td>46.0%</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>45.0%</td>
</tr>
<tr>
<td>Serbia</td>
<td>44.0%</td>
</tr>
<tr>
<td>Latvia</td>
<td>43.0%</td>
</tr>
<tr>
<td>Lithuania</td>
<td>42.0%</td>
</tr>
<tr>
<td>Slovakia</td>
<td>41.0%</td>
</tr>
<tr>
<td>Estonia</td>
<td>40.0%</td>
</tr>
<tr>
<td>Sweden</td>
<td>39.0%</td>
</tr>
<tr>
<td>Norway</td>
<td>38.0%</td>
</tr>
</tbody>
</table>

**Figure 2**
Quality of scientific research institutions, 2018

<table>
<thead>
<tr>
<th>Country</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>9.0</td>
</tr>
<tr>
<td>Germany</td>
<td>8.0</td>
</tr>
<tr>
<td>Netherlands</td>
<td>7.0</td>
</tr>
<tr>
<td>Switzerland</td>
<td>6.0</td>
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<tr>
<td>Austria</td>
<td>5.0</td>
</tr>
<tr>
<td>Italy</td>
<td>4.0</td>
</tr>
<tr>
<td>Spain</td>
<td>3.0</td>
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<tr>
<td>Portugal</td>
<td>2.0</td>
</tr>
<tr>
<td>Greece</td>
<td>1.0</td>
</tr>
<tr>
<td>Hungary</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Figure 3**
General R&D expenditure (GERD) (% of GDP)

<table>
<thead>
<tr>
<th>Country</th>
<th>GERD</th>
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</thead>
<tbody>
<tr>
<td>Norway</td>
<td>3.5</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.0</td>
</tr>
<tr>
<td>Austria</td>
<td>2.5</td>
</tr>
<tr>
<td>Germany</td>
<td>2.0</td>
</tr>
<tr>
<td>France</td>
<td>1.5</td>
</tr>
<tr>
<td>Italy</td>
<td>1.0</td>
</tr>
<tr>
<td>Spain</td>
<td>0.5</td>
</tr>
<tr>
<td>Greece</td>
<td>0.0</td>
</tr>
</tbody>
</table>

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Source: [OECD](https://www.oecd.org/; for education and research databases).
Various classifications on I4.0 implementation national preparedness:

- WEF
- Roland Berger
- Danish assessment methodology
- ....
Where is Croatia in EU ?? Roland Berger

RB Industry 4.0 Readiness Index

1) 1 = low, 5 = high
2) Adjusted for outliers Cyprus, Latvia, Luxemburg, Romania, Greece
Where is Croatia worldwide, end 2018 ??

### Drivers of Production

<table>
<thead>
<tr>
<th>Driver</th>
<th>Weighting</th>
<th>Rank</th>
<th>Score /10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology &amp; Innovation</td>
<td>20%</td>
<td>52nd</td>
<td>4.2</td>
</tr>
<tr>
<td>Human Capital</td>
<td>20%</td>
<td>58th</td>
<td>4.9</td>
</tr>
<tr>
<td>Global Trade &amp; Investment</td>
<td>20%</td>
<td>46th</td>
<td>5.5</td>
</tr>
<tr>
<td>Institutional Framework</td>
<td>20%</td>
<td>47th</td>
<td>5.3</td>
</tr>
<tr>
<td>Sustainable Resources</td>
<td>5%</td>
<td>11th</td>
<td>8.2</td>
</tr>
<tr>
<td>Demand Environment</td>
<td>15%</td>
<td>84th</td>
<td>3.5</td>
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</tbody>
</table>

### Structure of Production

<table>
<thead>
<tr>
<th>Structure</th>
<th>Weighting</th>
<th>Rank</th>
<th>Score /10</th>
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<tbody>
<tr>
<td>Complexity</td>
<td>60%</td>
<td>28th</td>
<td>7.0</td>
</tr>
<tr>
<td>Scale</td>
<td>40%</td>
<td>72nd</td>
<td>3.3</td>
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</table>
Where is Croatia?? WEF
## Innovation CSF Assessment – Croatian Companies vs. Public Sector

### CSF

<table>
<thead>
<tr>
<th>CSF</th>
<th>FIRM'S RESULTS ARIT. MEAN</th>
<th>FIRMS RANKING</th>
<th>FIRMS 'the most important'</th>
<th>FIRMS 'the less important'</th>
<th>IF RESULTS ARIT. MEAN</th>
<th>IF RANKING</th>
<th>IF 'the most important'</th>
<th>IF 'the less important'</th>
<th>MEDIAN</th>
<th>ARIT. MEAN DIFFERENCE</th>
<th>RANKING DIFFERENCE</th>
<th>$d^2$, RANKING DIFFERENCE $^2$</th>
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<tbody>
<tr>
<td>Availability of financing</td>
<td>2,15</td>
<td>1</td>
<td>47</td>
<td>7</td>
<td>2,69</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2,36</td>
<td>0,78</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Marketing support</td>
<td>3,15</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>4,38</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>4,17</td>
<td>1,21</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Institutional incentives</td>
<td>3,01</td>
<td>2</td>
<td>17</td>
<td>12</td>
<td>4,08</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3,62</td>
<td>0,85</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Education on innovation</td>
<td>3,29</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>2,00</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>2,12</td>
<td>-1,22</td>
<td>-3</td>
<td>9</td>
</tr>
<tr>
<td>Collaboration with academia</td>
<td>4,00</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>3,15</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3,36</td>
<td>-0,93</td>
<td>-2</td>
<td>4</td>
</tr>
<tr>
<td>Intellectual property</td>
<td>4,31</td>
<td>6</td>
<td>10</td>
<td>7</td>
<td>4,69</td>
<td>6</td>
<td>1</td>
<td>5</td>
<td>5,01</td>
<td>0,40</td>
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</tbody>
</table>
Can Croatia benefit from the I4.0+ wave??

IT HAS TO!!!
National industrial strategy 2030 of Germany

- fundamental (radical) innovations
- speed of innovation

.....combining digitalization and I4.0 is key support for the fundamental innovation of our age, particularly artificial intelligence!
Croatian labour costs vs. others

Hourly labour costs in € for the whole economy
(excluding agriculture and public administration), 2018
(enterprises with 10 or more employees)

* see country notes
Croatian strategic positioning in the implementation of the I4.0

Reindustrialization

Nonindustrial segments: energy, tourism, agriculture, e-mobility including blue growth, environmental protection...

Javni sektor, kultura ...

... selection of I4.0+ as leading technology platform

Visionary national determination, eg. AI in specific field
Transglobal example of implementation I4.0 Cro-USA-Taiwan-Japan

SMART FACTORY | INDUSTRIJA 4.0

- Approximately 310 Employees Total
  - Applied Ceramics USA 100
  - Applied Ceramics Croatia 130
  - Kul IN 10
  - Sunceco 30
  - Pisak 40

- Digitalized each of our operations
  - Material Manufacturing
  - Education
  - Services
  - Assemblies

ACI Vertical Integration

- Modules: Accounting | Order Allocation | Material Mgmt | Purchasing | Sales | Production | Assemblies | Quality Control | Shipping | Alert System | Admin Mgmt

iOT + AI + Cloud + 3D Printing Mfg & Design Shop
Adding reporting ability for real time status in manufacturing + System intelligence to split jobs, auto order and auto correct/adjust + Cloud access and global synchronization + 3D printer manufacturing with attached 3D design shop.

GLOBAL REAL-TIME ACCESS

USA – TAIWAN – JAPAN - CROATIA
Analysys sector/industry vs. technology, the model

**Sector**
- Industrial / Manufacturing
- Pharmaceutical
- Retail
- Tourism
- Energy and sustainable environment
- FinTech, banking and insurance
- Other

**I4.0+ technologies**
- Augmented and Virtual Reality
- (Industrial) Internet of Things
- Big Dana Analytics
- Additive manufacturing, 3D printing
- Cyber security
- Autonomous Robots
- Horizontal and Vertical System Digital Integration
- Artificial Intelligence
- The Cloud, full or hybrid
- Advanced Modelling and Simulation

The model compares sector I4.0+ technologies, focusing on industrial sectors and related technologies.
Ongoing activities – national level

- new innovation strategy in preparation
  - using combined, globally proven and OWN innovation (technology) orientation and positioning
- ongoing NIV – IVI – TIV processes
  - EDP
  - Preparation for current and new EU financial envelope
- NRS2030 (national development strategy 2030)
- reindustrijalisation commitment – with strong orientation on higher value adding
- new Science and higher technology law in preparation
  - better Linking science and economy
  - motivating researchers
- growing and proliferating start-up scene
- ....
Final thoughts – *takeaways*

- I4.0 + represents an excellent platform for the re-industrialization of the Republic of Croatia
- Identify analytically the segments where I4.0 synergistically strengthens the competitiveness of the national economy
- Visionary-strategic at the policy level dare to direct and encourage technological SOA-s and emerging technologies - to become AI HUB in particular field
- In the re-industrialization process, when choosing a partner-investor, take into account the higher added value
- The human component is essential in terms of availability, competence and motivation in the re-industrialisation process
Quo vadis Croatia??
... shell we change it
Thank you!

Questions?