The Future of Employment in a Digital World: Industrial and Education Policy implications

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Presentation outline

• **Production** in a digital world
  • Industry 4.0
  • Challenges for firms

• **Employment** in the digital world
  • Tasks, skills and occupations
  • Challenges for workers

• **Industrial and education policies**
  • Traditional features
  • Needed features
  • Challenges to developing countries

• Concluding remarks
The Digital World will reshape production & distribution

• Industry 4.0
  • Cyber-physical systems
    • **Cognitive computing**: self-awareness, self-organizing, decision-making capabilities
    • **Virtualization**: sensing, monitoring and maintenance capabilities
  • Cloud computing
    • **Internet of Things**: connectivity, identifiability, interoperability and security
    • **Big data algorithms**: real-time process, engineering and information representation capabilities
The Digital World will reshape production & distribution

- Industry 4.0 technologies
  - Internet of Things
    - Smart sensors and actuators
    - Connectivity, interoperability, authentication & security protocols
  - Cyber-physical systems
    - Cognitive and in-network computing: self-aware, self-organizing, decision-making capable components and systems
    - Virtualization: real-time process, engineering and information representation capabilities
  - Cloud computing
  - Big data analytics & algorithms
    - Convert data flows into information flows
    - Customer interaction and profiling
Challenges for firms


• End-to-end integration
  • Vertical and horizontal value chain integration
  • Focus on core competencies
  • Join partner ecosystems
  • Share operative information
  • New business models

• Smart, customized products and data-driven services
  • Developed new and tailored customer relationships
Challenges for firms

• Human beings as the drivers of value added
  • Manage HR strategically
  • Promote learning culture and learning fitness
  • Design goal-oriented training programs
  • Build collaborative environment
  • Foster flexible and attractive working conditions
The Digital World will reshape labor & education

• Some Jobs will be replaced

• Most Jobs will be reshaped
  • Task composition
  • Skills & ability requirements
  • Education levels and knowledge fields
  • Vocational training & in-job learning requirements
Jobs have always been disappearing

**Town criers**


**Switchboard operators**

Source: Wikimedia Commons
Jobs will continue to disappear

**Taxi Drivers**

**Newsstand vendors**

Source: Hans Vivek on Unsplash

Source: Wikimedia Commons
Jobs will continue to disappear

Policy analysts?

Source: United Nations
Which jobs are at risk?

Autor, Katz, Kearney (2006); Autor (2013)

• Jobs with a larger share of routine tasks
  • Can be broken down into a series of predictable steps and decision processes
  • Are more easily replaced by automated equipment and software solutions

• Routine tasks can be cognitive or manual
  • Cognitive: Operate and monitor production (e.g., quality control)
  • Manual: Operate machinery and control production pace

➢ Non-routine cognitive and manual tasks will continue to exist and develop
Skill needs (OECD, 2017)

Most needed skills
• Language usage
• Learning, listening, teaching
• Decision-making
• Time-management
• Systems evaluation
• Science & mathematics

Least needed skills
• Repairing
• Maintenance
• Operation & control
• Installation
• Quality control
• Management of resources

➢ Cognitive skills
➢ Routine skills
<table>
<thead>
<tr>
<th>Most needed fields</th>
<th>Least needed fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Computers &amp; electronics</td>
<td>• Mechanical</td>
</tr>
<tr>
<td>• Education &amp; training</td>
<td>• Construction</td>
</tr>
<tr>
<td>• Wealth</td>
<td>• Food production</td>
</tr>
<tr>
<td>• STEM fields</td>
<td>• Production &amp; processing</td>
</tr>
<tr>
<td>• Communications &amp; media</td>
<td>• Transportation</td>
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<tr>
<td>• Administration</td>
<td></td>
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Knowledge needs (OECD, 2017)
Ability needs (OECD, 2017)

<table>
<thead>
<tr>
<th>Most needed abilities</th>
<th>Least needed abilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Verbal</td>
<td>• Body flexibility &amp; coordination</td>
</tr>
<tr>
<td>• Analytical</td>
<td>• Physical strength</td>
</tr>
<tr>
<td>• Quativative</td>
<td>• Manual dexterity</td>
</tr>
<tr>
<td>• Memory</td>
<td>• Time reaction &amp; speed</td>
</tr>
<tr>
<td>➢ Cognitive abilities</td>
<td>➢ Physical &amp; manual abilities</td>
</tr>
</tbody>
</table>

OECD, Organisation for Economic Co-operation and Development
Challenges for workers

Jacobs, Kagermann & Spath (2017)

- Lifelong learning skills
  - Ageless training mentality
  - Career planning skills
  - Autonomy and self-reliance

- Collaboration skills
  - Cross-functional
  - Beyond company boundaries
• Will traditional policies keep up with these transformations?
  • Recent Brazilian experience and trends
    • What not to do!

• Challenges for developing countries and regions
  • What to do?
Industrial policies in Brazil (2004-2013)

• Subsidized financial support
  • Benefits to established, powerful economic groups

• Focus on manufacturing
  • Commodity-based and/or foreign-owned companies

• Local incentives
  • Amazon special economic zone
    • Maquiladora-style electronics manufacturing
  • Fiscal wars
    • States compete to offer attractive local tax exemptions
    • Financial exhaustion
Industrial policies in Brazil (2004-2013)

• National content requirements & high import taxes
  • Costly components
  • No global value chain integration
  • No path to competitiveness
  • Low production scales

• South-South cooperation
  • Didn’t advance beyond exporting mineral and agricultural commodities

• No articulation with education and training policies
  • Economic growth of the earlier 2010’s plagued by the shortage of skilled labor
Education and training policies in Brazil

- Low effectiveness of education spending
  - Regional imbalances and heterogeneity
  - Low accountability
  - Low investments in teacher training
  - Insufficient focus on student achievement

- Imbalance between primary and secondary, versus tertiary education
  - Low investment in primary & secondary public education harms low-income students
  - High investments on tertiary public education favors high-income students
Education and training policies in Brazil

- Secondary & vocational education
  - Focus on 20th century skills
  - Deficient language, mathematics & science attainment

- Tertiary education and research
  - High-cost investment in scientific research
  - Few incentives to partner with private firms
Resulting skill trends in Brazil

Source: Maciente (2016)
Skills present at larger regions

Note: larger municipalities to the left of the horizontal axis
Source: Maciente (2013)
Skills present at middle-sized regions

Note: larger municipalities to the left of the horizontal axis
Source: Maciente (2013)
Skills present at smaller regions

Note: larger municipalities to the left of the horizontal axis
Source: Maciente (2013)
Education policies in developing countries

• Integration of economic and education policy goals
• Generalize basic reading, math and Science skills
• Special attention to educational attainment in
  • Rural and mineral producing regions
  • Large-city low-income population
• Create training opportunities and modular certification paths for adults workers
• Better integration between science investments and private-sector technological needs
Production policies in developing countries

• Focus on productivity, competitiveness and better job opportunities (regardless of sector)

• Search strategic opportunities in global value chains (regardless of region)

• Focused financial support
  • Data infrastructure
  • Logistics
  • Emerging players instead of established ones

• Attention to business regulations

• International dialogue on regulation, certification, standards, cyber security and property rights