What will the future look like under Industry 4.0 and digital transformation in the healthcare space?

Morris Hosseini, Partner
Across industries, a technological and a sociological revolution are under way

Trend overview

**A TECHNOLOGICAL REVOLUTION**

- Mobile internet / democratization of Smartphone
- Potentially infinite storage capacities – Cloud
- M2M communication
- Decrease of technologies costs

**A SOCIOLOGICAL REVOLUTION**

- Faster and faster penetration of new technologies
- Increasing success of innovative business models based on free offerings
- Expectation of immediate and continuous availability of services

**EXPONENTIAL TRANSFORMATION**

- **INDUSTRY 4.0**
- **DIGITAL TRANSFORMATION**

Source: Roland Berger
Industry 4.0 can be understood as the full integration and digitalization of the industrial value creation

Definition of Industry 4.0 (not exhaustive)

> **Digital transformation** refers to the changes associated with the application of digital technologies in all aspects of human society

> Industry 4.0 is the **industrial application** of the concepts applied in the **digital transformation**, key elements are:
  - Complete connectivity with real-time ability
  - Decentralized, intelligent and self optimizing / organizing
  - Modular and reconfigurable

> Assessment of **Industry 4.0 impact** needs to take analogies from **digital transformation** and specifics of the manufacturing industry into account

> The digital transformation in the **consumer goods sector is much more advanced** than the industrial application – In the **healthcare space**, it has now arrived and is changing the landscape
Industry 4.0 combines a wide set of technologies at different stages of maturity

Example of technology mapping – Extract
The Factory 4.0 ecosystem – A set of technologies about to interconnect and disrupt plant operations

Factory 4.0 ecosystem

- **SUPPLIERS**
  - **CLUSTER OF SUPPLIERS**
  - **3D PRINTING / ADDITIVE MANUFACTURING**
    - > Scrap elimination
    - > Mass customization
    - > Rapid prototyping
  - **NANOTECHNOLOGY / ADVANCED MATERIALS**
    - > Smart value added products
    - > Technical differentiation
    - > Connectivity
  - **SENSORS**
    - > Zero default / deviation
    - > Reactivity
    - > Traceability
    - > Predictability
  - **ADVANCED MANUFACTURING SYSTEMS**
    - > Cyber Physical Systems (CPS)
    - > Numerical command
      - Full automation
      - Totally interconnected systems
      - Machine to machine communication
  - **ROBOT**
    - > Real time - Autonomy - Productivity
    - > Full transparency on data reporting
  - **AUTONOMOUS VEHICLE**
    - > Flow optimization
    - > Increased security
    - > Lower costs

- **LOGISTICS 4.0**
  - > Fully integrated supply chain
  - > Interconnected systems
  - > Perfect coordination

- **BIG DATA**
  - > Give sense to complexity
  - > Creativity
  - > Collaborative manufacturing

- **CYBER SECURITY**
  - > Stronger protection for internet based manufacturing
  - > Technology products with longer life cycle

- **CLOUD COMPUTING**
  - > Zero standard deviation

- **ADVANCED MANUFACTURING SYSTEMS**
  - > Reactivity
  - > Traceability
  - > Predictability

- **RESOURCES OF THE FUTURE**
  - **WIND**
  - **ALTERNATIVE / NON CONVENTIONAL**
    - Solar
    - Geothermal
  - **SOLAR**
  - **GEOTHERMIC**

- **MASS CUSTOMIZATION**
  - > Customer & marketing intimacy
  - > Flexibility
  - > Perfect match with customer’s needs with production mass efficiency
  - > On demand manufacturing

- **INTERNET OF THINGS**
  - > Object tagging
  - > Internet-object communication via low power radio
  - > Real time data capture
  - > Optimized stocks
  - > Reduced wastes

- **PLANT OF THE FUTURE**
  - **CLIENTS**
    - > Customer & marketing intimacy
    - > Flexibility
    - > Perfect match with customer’s needs with production mass efficiency
    - > On demand manufacturing

Source: Roland Berger
A smart Factory 4.0 is like a social network – People, machines and resources communicate and interact with each other autonomously.

### Factory 4.0 – key potential features

<table>
<thead>
<tr>
<th>Global Facilities</th>
<th>Social Machines</th>
<th>Augmented Operators</th>
<th>Smart Products</th>
<th>Virtual Productions</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; The center point of Industry 4.0 is a network of global production facilities.</td>
<td>&gt; Social machines are knowledge-based, sensor supported and spatially distributed units of autonomous production systems.</td>
<td>&gt; Augmented operators have a virtually extended view on production processes.</td>
<td>&gt; Smart products are clearly identifiable and always localizable.</td>
<td>&gt; A virtual production is characterized by digitalized production systems that interlink all dedicated people, machines and resources.</td>
</tr>
<tr>
<td>&gt; Pooling and bonding with partner companies from the same industry will increase profitability.</td>
<td>&gt; Social machines share newly gained information with their peers – additional configuration efforts are needless.</td>
<td>&gt; Smart devices as for example smart phones and tablets help employees to fulfill their tasks.</td>
<td>&gt; All information about the production process is stored on the product (e.g. by using RFID chips).</td>
<td>&gt; Analysis of existing data and simulation of future states allows an optimized production.</td>
</tr>
<tr>
<td>&gt; Interactions between industrial facilities and their environments create socio-economic systems with lots of benefits.</td>
<td></td>
<td>&gt; The future development will further intensify the socio-technical interactions.</td>
<td>&gt; Smart products are therefore able to steer their production process autonomously.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Arbeitskreis Industrie 4.0; Roland Berger
Data and communication will be the backbone of Industry 4.0 – Some players with already wide offering and new players entering

Positioning of different players for Industry 4.0 – Factory view

Source: Roland Berger
Industry 4.0 and digital transformation work via four levers that are supported by new enabler technologies and propositions

Example of technology mapping - Extract
Novel applications along the value chain in MedTech especially from digital data and increased connectivity

Selected use cases from digitalization in the MedTech industry

**Digital data**

- **Suppliers**
  - Sensors
  - Data analytics services

- **Manufacturers (Diagnostics)**
  - Data analytics

- **Manufacturers (Therapy)**
  - Data analytics

- **Hospitals & Doctors**
  - Predictive maintenance

- **Maintenance & Service**
  - Centralized access to health data

**Automation**

- > 3D-printing (e.g. artificial limbs and implants)
- > Additive manufacturing
- > Digitalization in operating theatres
- > Minimization (e.g. electric engines, smart pills)

**Interconnectivity**

- > Remote surgery
- > Remotely steered implants
- > Hybrid operations

- > Centralized access to health data
- > Remote maintenance
- > Service upgrades
- > Remote trainings

**Digital customer interface**

- > E-commerce portals

Source: Roland Berger
As an example, Additive Manufacturing brings new options to the manufacturing and materials world – Potential for disruptive change

Paths of disruption for Additive Manufacturing

<table>
<thead>
<tr>
<th>Individual products</th>
<th>New geometries &amp; materials</th>
<th>Decentralized production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct production from CAD data</td>
<td>Integration of new, enhanced functionalities (more efficient products) in high tech materials</td>
<td>Industrial production on demand</td>
</tr>
<tr>
<td>Freedom of design</td>
<td>Development of new materials/material properties</td>
<td>– production by quantity</td>
</tr>
<tr>
<td>Complexity for free</td>
<td>New repair strategies</td>
<td>– by location (decentralized)</td>
</tr>
<tr>
<td>Part consolidation</td>
<td></td>
<td>&gt; Home printing/production</td>
</tr>
<tr>
<td>Elimination of tooling</td>
<td></td>
<td>&gt; Outsourcing to partners</td>
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<tr>
<td>Prod. cost independent from batch size</td>
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<tr>
<td>New manufacturing processes</td>
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</tbody>
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Path of disruption

Examples

- Prototyping
- Mass customization
  - Medical products
  - Jewelry
  - Gimmicks
- Small series production

New business models (B2B, B2C)

Source: Pictures EOS, Roland Berger, NASA
Within MedTech, "technical" printing as well as Bio Printing has found first applications in the area of regenerative medicine.

Overview Additive Manufacturing technologies

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Master Forming</th>
<th>Forming</th>
<th>Cutting</th>
<th>Joining</th>
<th>Coating</th>
<th>Change of material properties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Materials</strong></td>
<td>Plastic</td>
<td>Ceramic, glass</td>
<td>Metal</td>
<td>Physical condition</td>
<td>Liquid</td>
<td>Solid, pastrious materials</td>
</tr>
<tr>
<td><strong>2 Technology</strong></td>
<td>Powder Bed Fusion</td>
<td>7 different technologies</td>
<td>VAT Photo-poly-merization</td>
<td>Change of material properties</td>
<td></td>
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<tr>
<td><strong>3 Application</strong></td>
<td>Personnel Printers</td>
<td>Prototypes, Mock ups</td>
<td>Series Production</td>
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**Bio Printing**

**Materials**
- Cell suspension
- Cell-encapsulating hydrogels
- Microfluidic fill-in for cells
- Bio-filaments

**Technology/Application**
- Inkjet printing
- Acoustic bioprinting
- Laser-induced bioprinting
- Laser-guided bioprinting
- Extrusion-based deposition

Source: Roland Berger
Industry 4.0 will have fundamental impacts on traditional ways of doing

Impacts of Industry 4.0

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<thead>
<tr>
<th></th>
<th>Flexibility / Mass customization</th>
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<th>Direct client relationship</th>
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<th>De-laborization</th>
<th></th>
<th>Asset rotation</th>
<th></th>
<th>Decentralization / Regionalization</th>
<th></th>
<th>Fast-product launch</th>
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<th>Shift of skillset</th>
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<tr>
<td>1</td>
<td>&gt; Ability to reduce changeover time – seamless production change</td>
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<td>&gt; Closer relationship between producer and customers</td>
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<td>&gt; Reduced share of labor cost – Reduced dependency to LCC</td>
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<td>&gt; Increase machine open time &amp; utilization, reduce breakdown time thanks to conditional maintenance</td>
<td></td>
<td>&gt; Reduce impact of size / scale effect – Ability to decentralize processes</td>
<td></td>
<td>&gt; New product industrialization is performed seamlessly and without disruption</td>
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<td>&gt; Less working forces in daily operations thanks to automated robotics</td>
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<td></td>
<td>&gt; Dynamic product schedules allowing to adapt real-time to customer needs</td>
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<td>&gt; Disintermediation and change of business rules</td>
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<td>&gt; Reduce stocks along the value chain</td>
<td></td>
<td></td>
<td>&gt; Possibility to relocate production process close to customer needs</td>
<td></td>
<td>&gt; People are guided through virtual tools to adopt new products</td>
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<td>&gt; Maintain of needs for medium-qualified workers due to simplified Human-Machine Interface</td>
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Moreover, digital transformation impacts the healthcare space far beyond the product only by tapping into the information dimension.

**Evolution of healthcare product business offering**

- **Differentiation solely through product innovations** (≈ 1920s-1980s)
- **Differentiation by providing services to key players** (physicians, payors, providers) (≈ 1980s-2010s)
- **Differentiation via operational efficiency, proven product value and customer channels** (including new services) (≈ 2010s-20??)

Source: Roche, Roland Berger
Data-driven business models have the potential to re-shape the customer landscape for MedTech and healthcare players

Healthcare market 2020 with data-driven business models – Simplified view

Source: Roland Berger
Leading MedTech players have already understood the value of data and started to leverage extra value for their business.

The key to success is knowing how to get access to the required data (generating or collecting) and how to generate value out of it (connecting the dots or interpreting the results).

Source: Roland Berger
Analyzing this space, Roland Berger has developed a data-based business model landscape in healthcare

Data-based business model landscape in healthcare

Source: Roland Berger
Leveraging digital transformation requires many different areas of expertise, hard to find under one roof...

Digital transformation requirements

1. Connect to the Digital world
   - Influencers
   - Entrepreneurs
   - Think tanks
   - Institutions

2. Detect innovation
   - Schools
   - Start-ups
   - Incubators
   - VCs
   - Investment funds
   - Crowdfunding platforms
   - Development capital

3. Conceive new businesses
   - Web developers
   - Designers
   - IT players
   - Data scientist
   - Accelerators
   - Viral marketing
   - Agencies

4. Proof and test digital innovations
   - Prototypers
   - Living / Development laboratories

5. Finance new businesses
   - VCs
   - Investment funds
   - Crowdfunding platforms
   - Development capital

6. Staff digital projects
   - Recruiters
   - Trainers

7. Launch new businesses
   - Schools
   - Start-ups
   - Incubators
   - VCs
   - Investment funds
   - Crowdfunding platforms
   - Development capital
…this is why Roland Berger launched Terra Numerata through partnerships and alliances

Terra Numerata

> Covering the entire value chain and meeting clients' needs
  - Consulting
  - Investment
  - Technical platforms with partnerships
  - Specific expertise (cloud, data scientists, developer, etc.)

> Playing the role of an architect within Terra Numerata offer by ensuring the quality of services for each part of the value chain thanks to partnerships with digital leaders steered by Roland Berger digital experts
Let's think: act!

Roland Berger
Strategy Consultants