

# Industry 4.0 –Chemical Industry

Industrial Summit JCC 4-6 April 2018

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April 2018

# Sources of this presentation

*Industry 4.0 and the chemicals industry Catalyzing transformation through operations improvement and business growth*

<https://www2.deloitte.com/.../industry.../chemicals-industry-...> last access March 31, 2018

*Digitization in the Chemical Industry*

*PRACE Scientific & Industrial Conference 2016*

[www.prace-ri.eu/IMG/pdf/20160510 PRACE CEFIC.pdf](http://www.prace-ri.eu/IMG/pdf/20160510_PRACE_CEFIC.pdf) last access March 31, 2018

# Industry 4.0 – Digitization in Chemical Industry

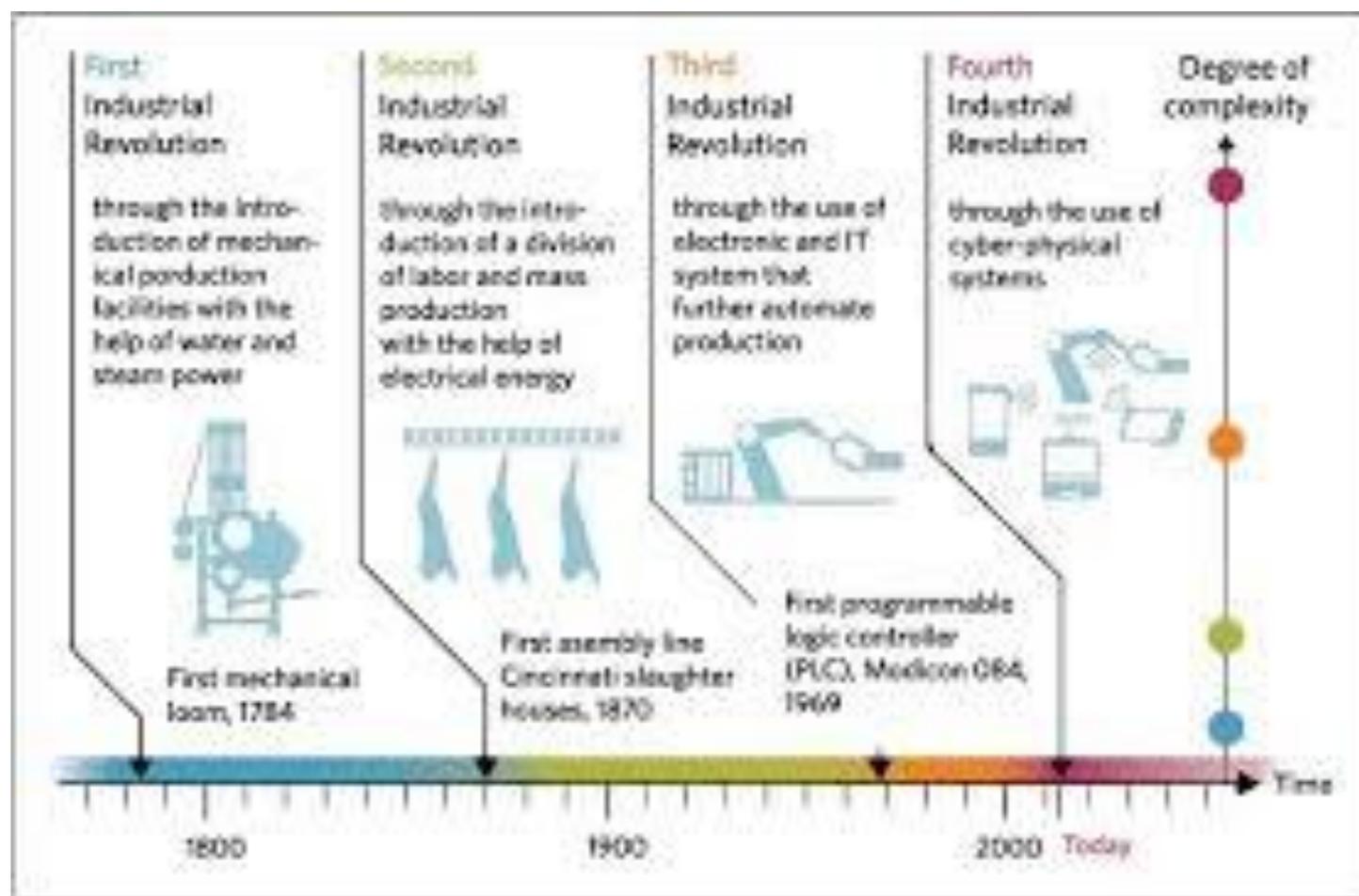
“Ninety-five percent of chemicals industry respondents said they foresaw digital technology innovation at their company over the next three years, and 50 percent expected breakthrough or radical advances”

Source: Strategy&/pwc 2015

# An Overview of Industry 4.0

From the perspective of the *manufacturing value chain*, we understand that organizations **create value** from information via the movement from physical to digital, and back to physical.

**Industry 4.0 combines 2 technologies which are the Internet of Things (IoT) with the Operation Technology based IT**, including: analytics, additive manufacturing, robotics, high-performance computing, artificial intelligence, cognitive technologies, advanced materials, and augmented reality, **to drive the physical act of manufacturing.**



**The essence of Industry 4.0** is the leap from digital back to physical and from connected/digital technologies to the creation of a physical object, in the other word it is a *process improvement*.

Industry 4.0 brings together a number of digital and physical advanced technologies to form a greater physical-to-digital to-physical connection—

and it can potentially transform the chemicals industry by promoting strategic growth and streamlining operations.

Broadly speaking, we identify two business imperatives for manufacturers:

- 1) operating the business
- 2) growing the business

Industry 4.0 helps chemicals companies plan their supply chains in two ways:

- 1) improving visibility into the supply chain
- 2) predicting demand patterns.

The productivity of chemicals plants **can be improved** by various smart manufacturing techniques: predictive asset management, process control, and production simulations, among others.

Digitization is only the first step, however. Industry 4.0 technologies such as realtime analytics and automated control actions bring together the digital and physical world—supporting prediction, alerts, and prescriptive responses.

Industry 4.0 incorporates and extends these combined technologies to complete :

- The physical-digital-physical cycle .
- The physical-to-digital
- The digital-to-physical leaps are unique to manufacturing process

# The Physical to Digital to Physical Leap of Industry 4.0

## 1. Establish a digital record

Capture information from the physical world to create a digital record of physical operation and supply network

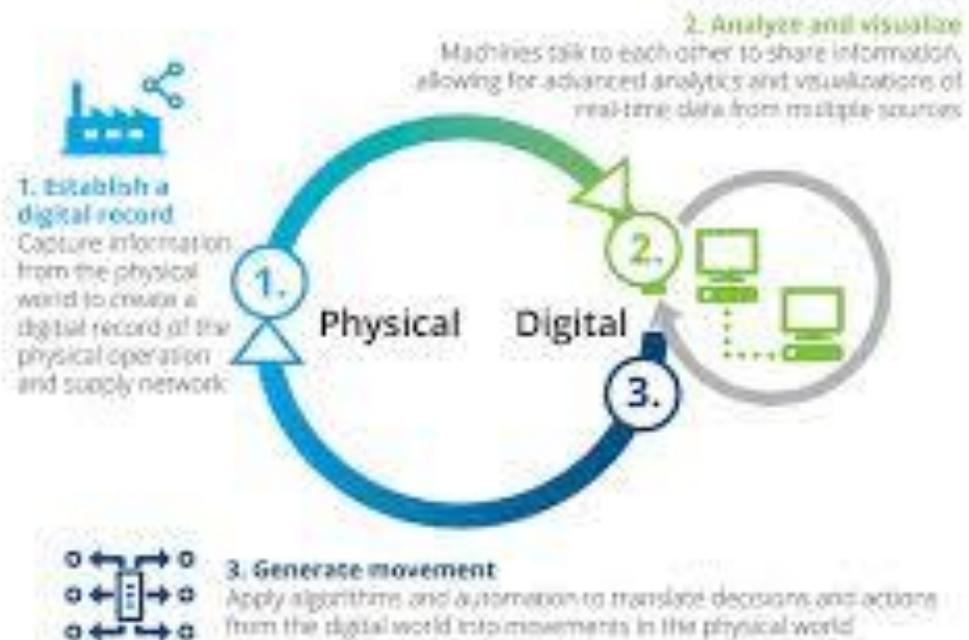
## 2. Analyze and Visualize

Machines talk to each other to share information (analytics and visualization of real time data from multiple sources)

## 3. Generate Movement

Apply algorithms and automation to translate decisions and actions from the digital world into movement in the physical world

Figure 2. The physical-to-digital-to-physical loop of Industry 4.0



Information and Communication Technology (ICT ) enables to manage various processes from raw materials to customers in the chemical industry Distribution :

- Filling/packaging/labeling
- Order processing
- Outbound logistic
- Warehouse management
- Claims/returns management Delivery
- Transport management
- Customer relationship • Differentiated service

and

Raw Material Sourcing • Supplier management • Inbound logistic • Warehouse management

And also

Manufacturing Operations • Production planning • Quality management • Blending/customizing • Optimization • Maintenance

**Table 1. Industry 4.0 transformational plays for the chemicals industry**

Product Impact	Key objectives	Transformational plays
 <b>BUSINESS OPERATIONS</b>	Improve productivity	<ul style="list-style-type: none"> <li>• Smart manufacturing</li> <li>• Supply chain planning</li> </ul>
	Reduce risk	
 <b>BUSINESS GROWTH</b>	Add incremental revenue	<ul style="list-style-type: none"> <li>• Research and development</li> <li>• Smart products and services</li> </ul>
	Generate new revenue	

Source: Deloitte analysts.

Graphic: Deloitte University Press | DUPress.com

Table 2. Key objectives and transformational plays related to business operations

Key objectives	Transformational plays and descriptions	
 <p>Improve productivity Reduce risk</p>	<p><b>Smart manufacturing</b></p>	Predictive asset management: Maximize asset utilization and minimize unplanned downtime
		Process management and control: Minimize production variability and improve quality
		Energy management: Reduce energy costs and explore alternative energy sources
		Safety management: Monitor assets, processes, people, and products on a continuous and real-time basis
		Production simulation: Improve operator training, manufacturing planning, and timely plant commissioning
	<p><b>Supply chain planning</b></p>	Safety management: Monitor assets, processes, people, and products on a continuous and real-time basis
		Demand forecasting: Adjust production schedules in line with changing customer needs

Source: Deloitte analysis.

Graphic: Deloitte University Press | DUPress.com

**Table 3. Industry 4.0 key objectives and transformational plays related to business growth**

Key objectives	Transformational plays and description	
 <p>Add incremental revenue</p> <p>Bring in new revenue</p>	<p>Research and development</p>	Additive manufacturing for testing or developing new products
		Advanced analytics for selecting materials
		3D printing for developing advanced materials
	<p>Smart products and services</p>	Developing smart products for chemicals applications
		Offering data services to augment existing revenues
		Building new revenue models by forward-integrating into customers' operations

Source: Deloitte analysis.

Graphic: Deloitte University Press | DUpres.com

# Supply Chain Management Software

PCS, ERP, SAP-APO, MES, CAD, CAE

ERP, MES, LES, Labeling, RFID, GPS

ERP, LES, Barcodes, RFID, Labeling

IT Solutions CAD: Computer Aided Design CAE: Computer Aided  
Engineering ERP: Enterprise Resource Planning GPS: Global  
Positioning System LES: Logistics Execution System MES:  
Manufacturing Execution System PCS: Process Control Systems  
RFID; Radio Frequency Identification SAP-APO: Advanced Planner  
& Optimizer

# Cases Industry 4.0 for Chemical Industry

## 1. Simulation of Hazardous Chemicals

As a worldwide leader LONZA supplying the pharmaceutical and biotechnology industries with biopharmaceuticals.

Fortissimo 2 –2015-2018 builds on the success of Fortissimo and aims to extend and demonstrate the business potential of an ecosystem for HPC-Cloud services, specifically for applications involving simulation of coupled physical processes or high-performance data analytics.

Partners: University of Paderborn, University of Stuttgart (HLRS).

HPC-Cloud-based simulation of hazardous chemicals

Benefits demonstrated: By using HPC-Cloud-based molecular simulation Lonza is able to save more than €80k (>80%) of the usual costs gathering physical properties for designing of a distillation column (Lonza designs more than 5 distillation processes per year).

Source: Fortissimo Case Studies

## 2. Seismic Data Processing

Repsol produces oil and gas, and operates refineries, petrochemical plants, and service stations in Europe

Repsol is breaking ground with seismic processing technology and growing its exploration and production operations, with major discoveries in Brazil and a ramp up in operations in the US and elsewhere

Using seismic processing technology, the company interprets images 10 miles below the earth and through nearly two miles of sea water. These techniques help pinpoint targets where wells are drilled and help the company refine the picture of operating oil fields. The techniques used in seismic processing require huge amounts of processing power, including extensive data cleansing in order to filter out the noise measured along with the signal received by detectors

Source: Repsol Public Information

### 3. Supply Chain Management

Royal DSM is a global science-based company active in health, nutrition and materials.

By connecting its unique competences in life sciences and materials sciences DSM is driving economic prosperity, environmental progress and social advances to create sustainable value for all stakeholders simultaneously

Source: DSM

# Technically Industry 4.0 can help :

1. 'Modeling, Simulation and Forecast': Integrate modeling of single processes into production routes by new and accurate models in combination with statistical approaches, modeling of materials , reactions, reactors , thermodynamics and dynamic phenomena
2. 'Cognitive Plants': Intelligent self-learning systems, integrated automation solutions related to complete process routes by taking into account all aspects of automation (e.g. monitoring, diagnosis, assistance systems, process control, process supervision, tracking, logistics, etc.). Cyber-physical systems and systems of systems
3. 'Condition based 'Advanced Maintenance': Allowing remote control of equipment, prediction and prevention of failures

4. 'Resource and Energy': Enable monitoring of environmental targets, energy consumptions, industrial symbiosis
5. 'Digital Business Models': Digital support to replace physical customer support, digital customer solution design
6. 'Cloud Technologies': Using cloud based networks to communicate, on sensor, plant, site, remote -site levels, up and down the value chain
7. 'Plant Life Cycle Planning': Digital enabled plant design over the whole life cycle

# Conclusion

INDUSTRY 4.0 will impact the way chemicals companies operate and grow their businesses, as they shift from the “pay-by-the-ton” revenue model to provide value-added products as well as excellent services to their customers.

How fast and well companies perform will depend on the decisions taken today and the commitment for the coming years. A clear understanding of their crucial strategic can enable chemicals companies to plan their Industry 4.0 and how to integrate their digital and physical assets across different stages of the value chain.

The cases discussed illustrate how chemicals companies can use Industry 4.0 technologies to improve operations via asset optimization, process and energy management, and safety processes. Also to plan the ways to grow their business through advanced material discoveries, smart chemical products, and new customer-driven service.

Industry 4.0 offers the evaluation company's current strategic position; deployment advanced technologies in selecting applications to develop a proof of concept; and reconfiguration operating models.

First step toward Industry 4.0, it is critical the companies prepare their technology and data landscape to support the evolving changes in their products, services, and new business models to create a competitive advantage in the long run.

Beyond technology, however, the agility of people and organizations in adapting to change determines how effectively they adopt Industry 4.0.