Agenda

• SOLVAY

• Digital@Solvay

• Plant of the Future - Main Digital Initiatives

• 2 Examples of Proof of Concepts

• Industrial Digital Roadmap

• Key Take Aways
We are a World Leader
In the Chemical Industry

30,900 employees
53 countries
145 industrial sites
21 major R&I centers
0.77 occupational accidents at Group sites per million hours worked

€ 12.4 billion of net sales
€ 2,336 million of REBITDA
7.26 Kg CO₂ eq. per € REBITDA

1. Pro forma 2015, unaudited, including Cytec
2. MTAR: Medical Treatment Accident Rate (excluding Cytec)
We Adapt our Product Offering to Demanding Markets

Distribution of net sales
Pro forma 2015, unaudited, including Cytec

- CONSUMER GOODS & HEALTHCARE: 21%
- AUTOMOTIVE & AEROSPACE: 26%
- INDUSTRIAL APPLICATIONS: 18%
- ENERGY & ENVIRONMENT: 8%
- ELECTRICAL & ELECTRONICS: 6%
- AGRO, FEED & FOOD: 10%
- BUILDING & CONSTRUCTION: 11%

Internet of Manufacturing Munich, Germany
7-8 February 2017
Innovation Creates the Chemistry of the Future

Ernest Solvay invents the process for producing soda ash

1863

Solvay is the first industrial multinational operating simultaneously in the US and Europe

1878

Solvay installs in social welfare (paid vacations, social security, 8-hour day)

1880

Solvay invents the plastic bottle for mineral waters

1960

The congresses bring together the greatest physicists of their time

1911 & 1927

Solvay invents precipitated silica for green tires

1990

Solvay acquires Cytec

2017

Solvay flies around the world with Solar Impulse

2015

Solvay acquires Rhodia

2011

Solvay acquires Rhodia

2015

2nd Chemistry for the Future Solvay Prize

2015

Digital?
How Can “Digital” Help Us in Building a Model of Sustainable Chemistry to Meet the Challenges of Society?

- Evolving demography and consumer behavior
- Innovation acceleration
- Resources constraints and demand for sustainability
**Vision: Speed Up Solvay’s Transformation**

**Thanks to Digital**

**Objective**

Speed up Solvay’s transformation towards a more customer centric, agile, innovation driven multi-specialty company

**Digital Excellence**

Use digital technologies to boost operational excellence

- Increase productivity, efficiency, flexibility, profitability along the entire value chain

**New Business Models**

Leverage digital to innovate and disrupt our business models

- Be obsessed about customer needs
- Develop new services based on digital

**Digital Enablers & Culture**

Create the conditions to enable the digital transformation:

- Change Solvay’s culture & management model towards a more customer focused, collaborative, open to ecosystem, agile, analytics and innovation driven organization
- Develop digital talent & know-how
- Accelerate the adoption of adequate digital tools

Internet of Manufacturing Munich, Germany

7-8 February 2017
Digital Plant / Industry 4.0
Co-constructed in association with GBU Industrial Directors

Vision: The Plant of the future

- 2 Days workshop with all GBUs Industrial Directors
Vision: The Plant of the future

- Agile and flexible in the face of an ever changing customer market
- Modular, standardized, scalable, repeatable, relocatable
- Secure in its access to infrastructure and data
- Simple, transparent and open for learning
- Customer oriented, pro-actively connected to customer needs and creating value with innovative products and services
- Sustainable, ensuring employee health and safety, with zero environmental impact
- 100% under control: Predictive, predictable and reliable
Defining the Size of the Prize
From Proof of Concept to Broader Dissemination

Impacts, although difficult to size, are significant

- Solvay Group costs*
  - Fixed costs: 2 b€
  - Variable costs: 6 b€

- Reduction of operating costs: 1-2%
- Reduction in CAPEX
- Reduction in CO2 emissions
- Reduction in the number of Accidents/Incidents
- Increase people engagement

*R Costs in 2015 (incl. CYTEC)

Rationale for the Focus Factories

- Concentration of qualified resources (local, industrial, IT)
- Significant case for change
- Engagement of the site manager
- Role as a model factory

Viral approach

15 GBU
145 industrial sites (10 -> 800 people)
## 5 priority initiatives supported by digital

<table>
<thead>
<tr>
<th>Priority digital initiatives</th>
<th>Objectives</th>
<th>Impact rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asset performance enhancement through ‘Data Analytics’</strong></td>
<td>Enhance process performance (yield, energy, throughput, quality) through advanced non-linear process modeling and parameter optimization</td>
<td>Optimize material and energy yield to improve 2% of baseline (raw material /energy/utilities)</td>
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<tr>
<td><strong>Asset-network value maximization</strong></td>
<td>Maximize asset-network profitability applying dynamic optimization algorithms on end-to-end product flows across networks or complex sites</td>
<td>Increase REBITDA margin by 2% of sales generated by complex asset networks</td>
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<td><strong>Data-enabled asset reliability</strong></td>
<td>Leverage equipment data analytics to optimize maintenance and asset reliability strategy and prevent / predict equipment failure</td>
<td>Reduce by 3% Group maintenance costs Reduce 30% of reliability downtime</td>
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<td><strong>Digital workforce</strong></td>
<td>Implement human – machine interface technology to streamline key processes (e.g., work-permits, inspections –link to ERP/MES)</td>
<td>Reduce 20% of addressable fixed costs (production fixed cost related to digitizable processes)</td>
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<tr>
<td><strong>Robotics &amp; Cobotics</strong></td>
<td>Optimize plant fixed costs through robotization of key processes of production or linked to production</td>
<td>Reduce by 5% production fixed costs</td>
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**Legend:**
- 📋 First proof of concept activity started
- First estimate at Group level
Asset Performance Enhancement Through ‘Data ANALYTICS’

- Chemical industry has a long tradition of process data acquisition for control purpose with PLC – DCS and MES systems to ensure high reliability and security.
- Real time & Historical Data are available in our MES but only a small fraction is used for production optimization (quantity, quality).
- Plant data rarely integrated (Supply Chain, Production, Lab, HR, ...).
- “Digital” progresses/transformations needed at all level (sensors, data collection, data analysis, operator interface).

PLC (Programmable Logic Controller): computer ruggedized and adapted for the real time control of manufacturing processes

DCS (Distributed Control System): computerized control system for a process or plant, in which autonomous controllers are distributed throughout the system, but there is central operator supervisory control

MES (Manufacturing Execution Systems) are computerized systems used in to track and document and optimize the transformation of raw materials to finished goods.
Digital Transformation: A 4-Step Process

**Data integration**
- Locate and retrieve data from multiple data-sources
- Integrate collected data into a consistent “big data-lake”

**Modelling and optimization**
- Model unit processes and flows leveraging data lake
- Derive insights on optimal parameter set points, and evaluate impact

**Design and plan**
- Design future state operating model e.g., embedding of tool, processes and governance (incl. performance management)
- Plan integration and training (TIP)

**Integrated and train**
- Implement new generation model into daily operations
- Train and coach users; monitor results
Digital Workforce
Data-Enabled Asset Reliability

- Round Guard
- Inspection
- Basic Inspection (regulatory)
- Equipment health monitoring
- Predictive Maintenance

- Common needs:
  - Equipment identification (BarCode, QRCode, RFID, ...)
  - On line availability of documentation, drawings, Work order, ...
  - Access to ERP, MES (Manufacturing Execution System)
  - Wireless Network covering workshop (metallic reflections)
  - ATEX device (tablet, reader)
  - Apps on mobile device
Example of APP for Inspection Round Guard

- Detects a problem in the installation
- Identifies the equipment (Bar Code, QR code, RFID, etc.)

- Checks current installation notifications
- Creates SAP notification if necessary
- Adds picture or video
- Modifies the image to highlight the defect
- Fills-in the form to complete the maintenance notification

Added Value

- Check, in the field, if the defect has been declared already (no need to go back to control room)
- Create a notification with all requested details (equipment SAP identification, defect description, pictures, ...)
- Increase Safety, avoiding errors in the equipment identification

Time
Quality
Safety
Data-Enabled Asset Reliability

Application on mobile device (ATEX Tablet) programmed internally using Appsheet

See Gartner report on RMAD (Rapid Mobile App Development)
Group Industrial digital roadmap

Proposal to accelerate “proof of concept” over the coming months

- Align on value of digital and advanced analytics in industrial
- Develop common vision around digital within the broader Solvay industrial family
- Start first-level “POCs” in several GBU

Q1-Q3 2016

Q4 2016

- Accelerate “proof of concept” studies at selected “pioneer” GBU.
- Develop common vision around digital within the broader Solvay industrial family.
- Demonstrate and validate feasibility and impact potential of digital initiatives.

Vision development

Proof of concept (small scale)

Pilots & Rollout (full scale)

Q1 2017 - ...

- End-to-end transformation waves for proven initiatives (from diagnostic to full implementation).
- Structural capability and infrastructure development within Solvay industrial team.
- “At scale” deployment across priority areas in each GBU.

Proof of concept (small scale)
Key Take Aways

- Digital is a strong lever (catalyst) to boost Operational Excellence
- Identifying what is at stake is crucial to embark teams on the rights projects
- Bottom-up approach, launching POCs with multidisciplinary teams (process, technology, engineering, instrumentation, data analytics, cybersecurity, networking, etc) AND external key expertise
- Industrial Roadmap: “At scale” deployment from Focused Factories across priority areas in each GBU
- Main issues:
  - Wireless networks in obstructed “metallic” environment
  - Data collection integration / cybersecurity
  - Sustainable integrated platforms / Standards solutions
  - Training / organizational issues
Thank you for your attention, Any Questions ?
Asking More from Chemistry
Thanks to Digital

February 2017

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