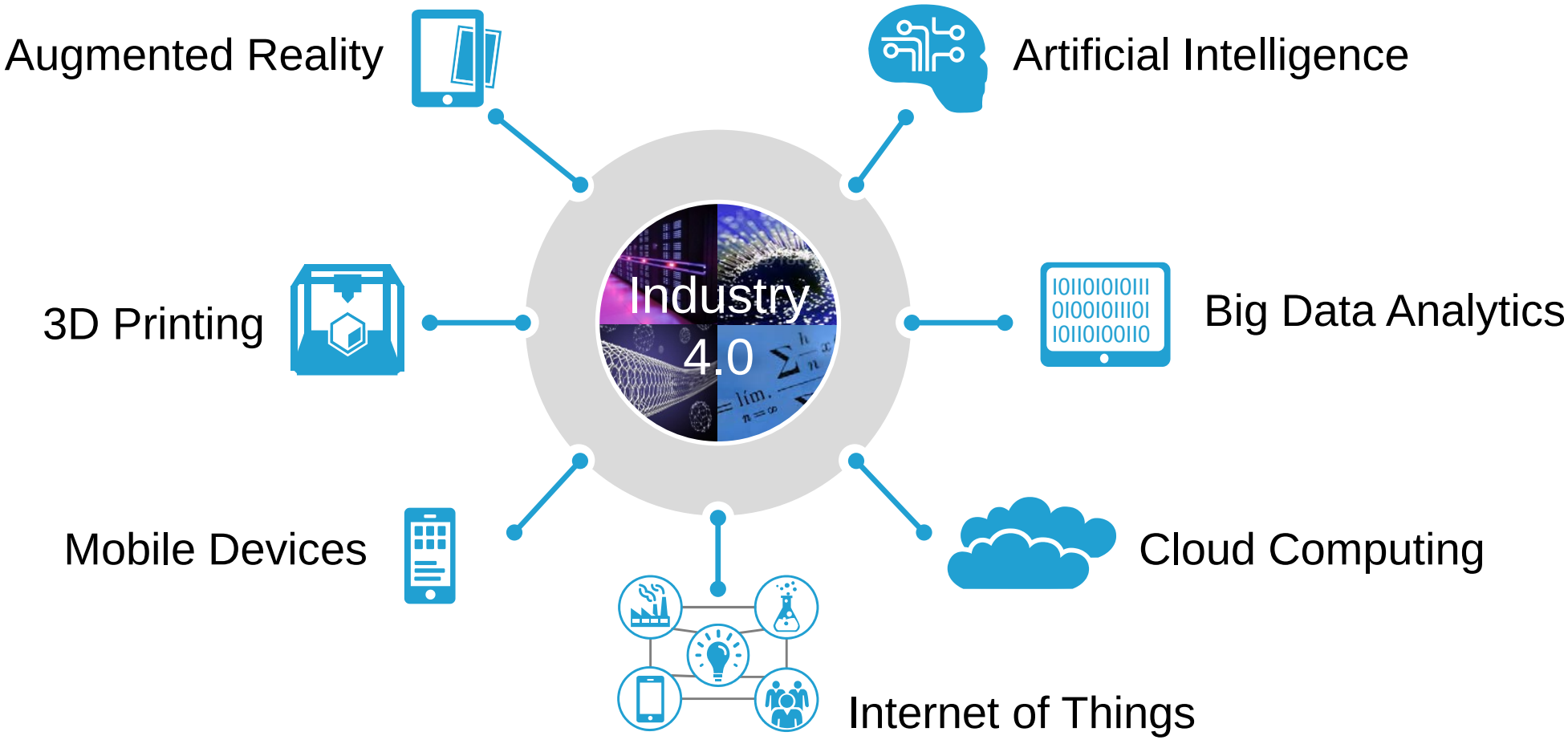
BASF 4.0

Leading the digital transformation in chemicals

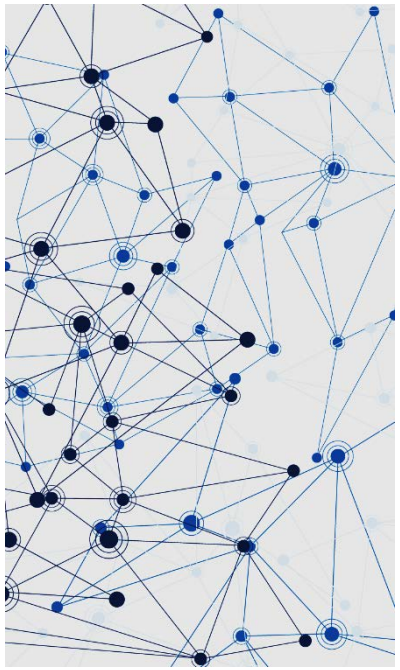
Innovation China 2017 Forum
Shanghai, Nov. 15 2017, Sebastian H. Schenk

BASF
We create chemistry

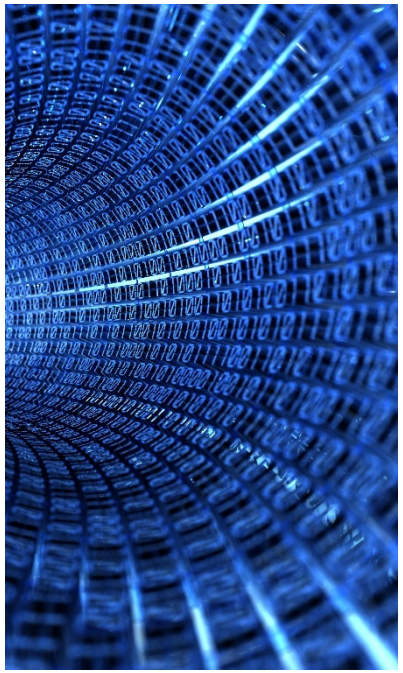
Seven core technologies will enable Industry 4.0 in chemicals



Digital market trends shaping BASF's environment

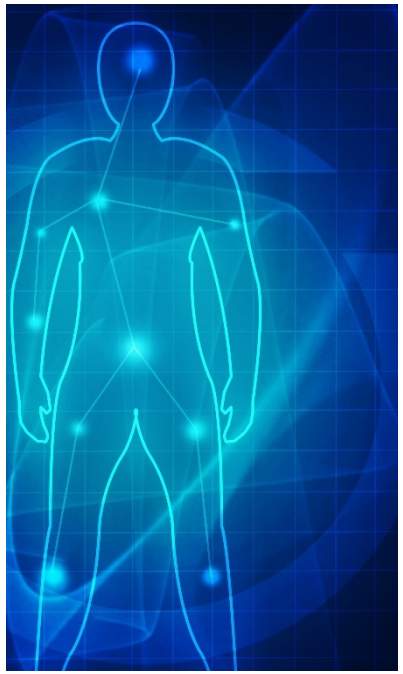


Massive Connectivity



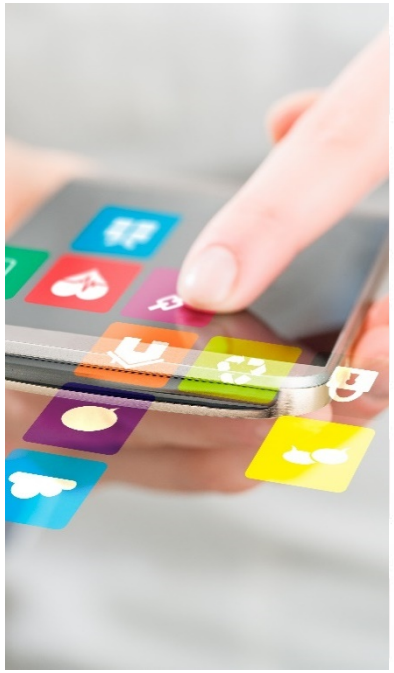
Data the "New Oil"

Increased Transparency



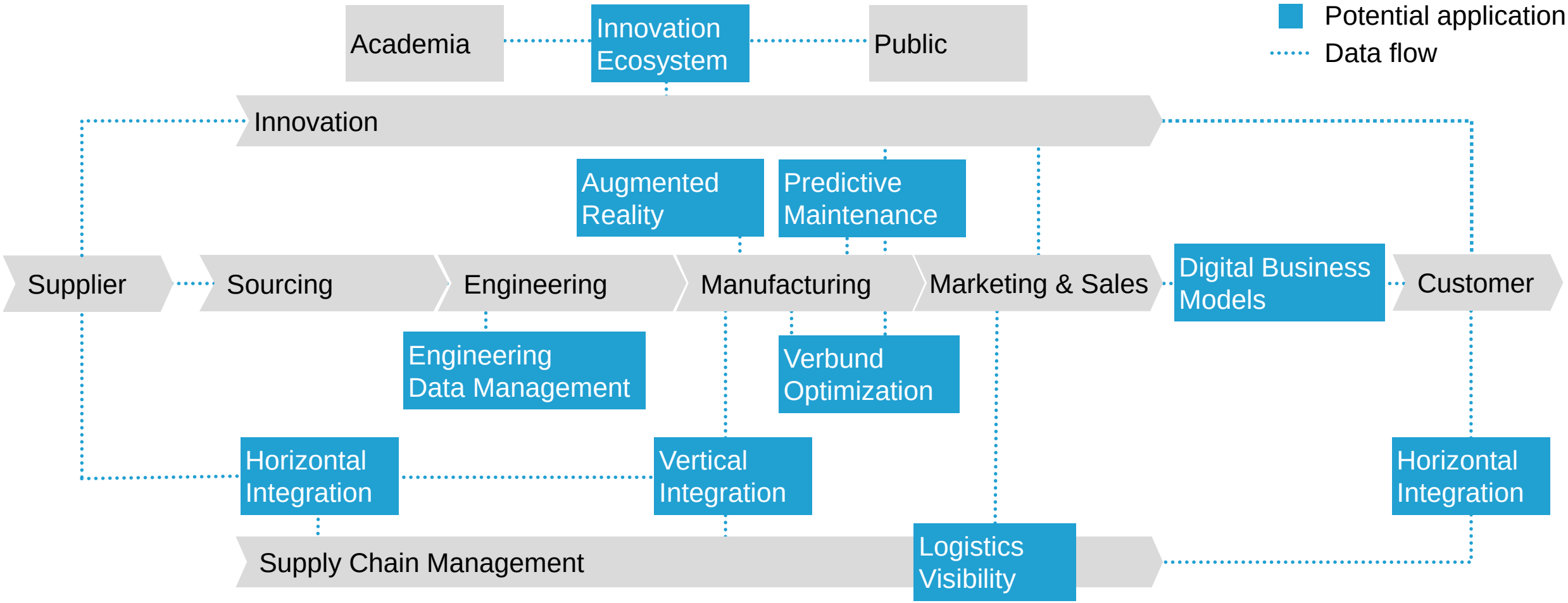
Quantification and Profiling

Mass Customization



Sharing

Attractive applications identified along the value chain



Smart Manufacturing: Augmented Reality

Increases efficiency, safety and documentation standard

Case example: **Butadiene LU**

Challenges

- Today roundtrips are supported by excel sheets or based on operator experience
- No access to central information in the plant
- Only connection to control room via walkie-talkie or speaker systems
- High complexity of the plant generates a high potential of mistakes by misunderstanding between on site and central operators or non-availability of required information

Solution

- To improve efficiency, transparency and safety, a mobile operator roundtrip solution using Augmented Reality was installed as a prototype
- The Augmented Reality system provides a check-list, access to manuals and real time plant data

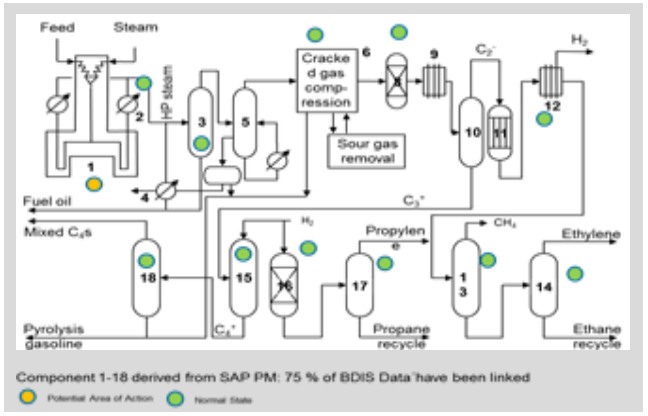
Smart Manufacturing: Predictive Maintenance

Optimize the coordination of maintenance and production processes

Grey Box

- **Bad Actors** with known **degradation scenarios**
- Combination of engineering & process knowledge and statistical methods
- Established methods, available on the market

Black Box

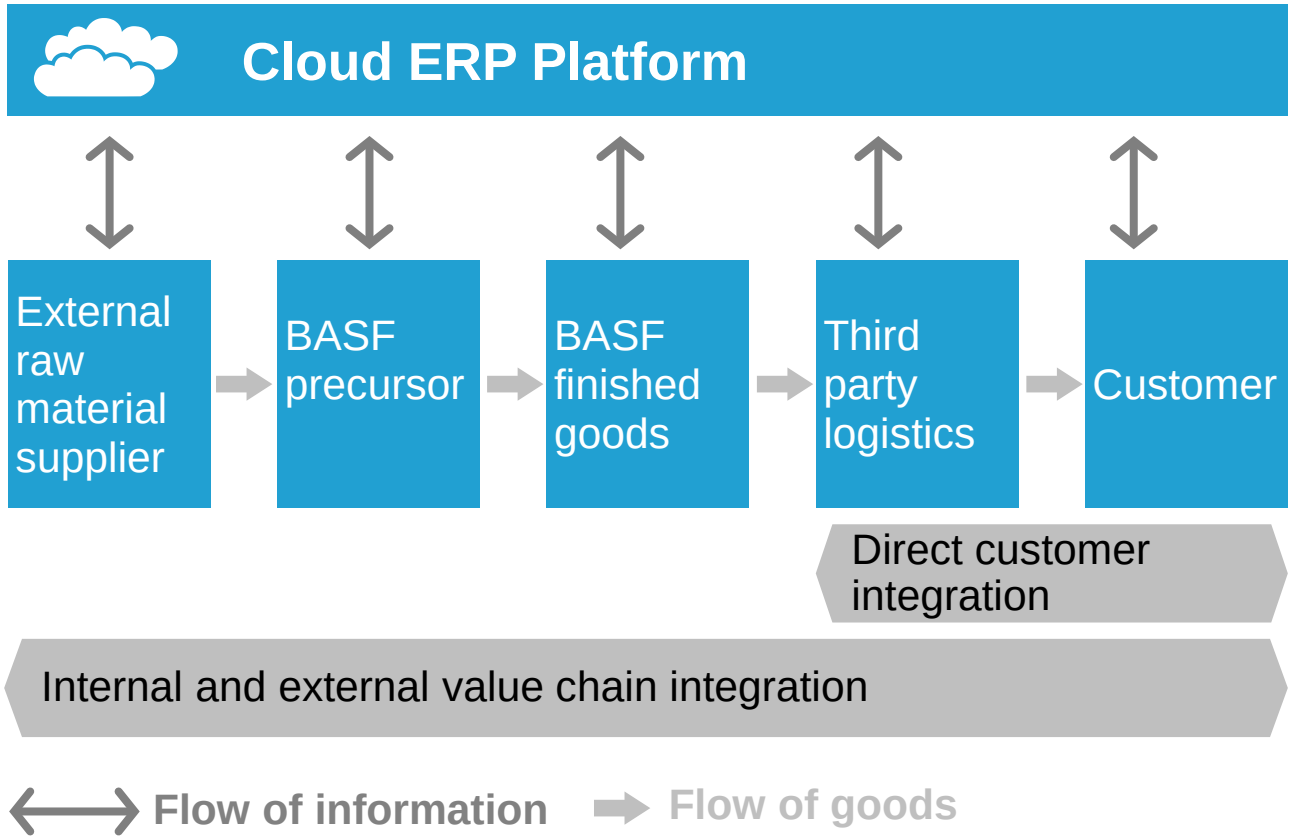


- Monitoring of **entire plant**
- Generalized data-driven approach to detect **unknown abnormal behavior**
- Ongoing BASF-specific development

Smart Supply Chain: Horizontal Integration

Connects supplier and customer to increase planning accuracy, speed and to reduce cost

Simplified example:



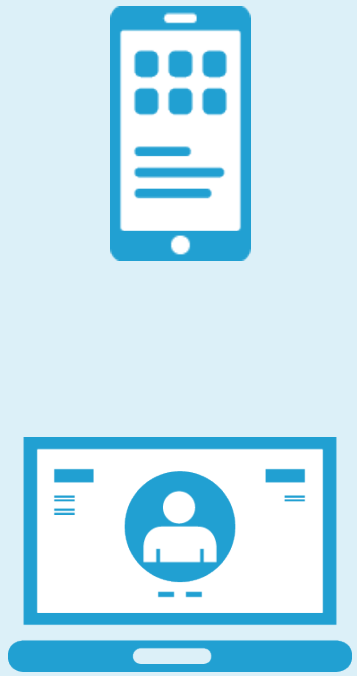
Benefits of Horizontal Integration

- Improved customer service, reliability and transparency
- Higher integration and stronger relationships with our key customers
- Value creation for our trading partners by improving efficiency and offering additional SC services
- Better planning (“one set of numbers”) and operational collaboration between trading partners
- Operational improvements for both parties, such as planning accuracy, inventory optimization, streamlined processes and less firefighting

Smart Supply Chain: Logistic Visibility

A single-source-of-truth view on logistics information

- Tracking devices
- Carriers and forwarders
- SAP or hubsystems
- News & weather
- Social media



Transport Visibility

Door-to-door transparency of all shipments / deliveries

Early identification of potential delays

Collaboration on Supply Chain impacts

Benchmark and optimize routes

External News Feed

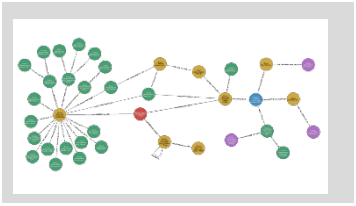
Identify potential Supply Chain impacts

Relate impacts to shipments in transport

Smart Innovation and Technology

First projects in R&D showed tremendous potential

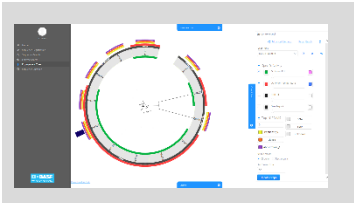
Predict catalyst lifetime performance



Intuitive structuring of all data relevant for catalyst research.

Performance ranking after 840 hrs in high throughput setup well correlated with 2700 hrs miniplant test.

Augment enzyme discovery by big data



More than 50 million enzyme sequences (internal and external), including patent status and properties can be explored interactively.

Intuitive interface developed with users.

Augment biological entity discovery by literature mining

Artificial Intelligence filtered **29 relevant out of 48,000** published documents.

3 months of manual search had only found **6**.

Continuous literature surveillance **with live relevance filtering** for specific questions.

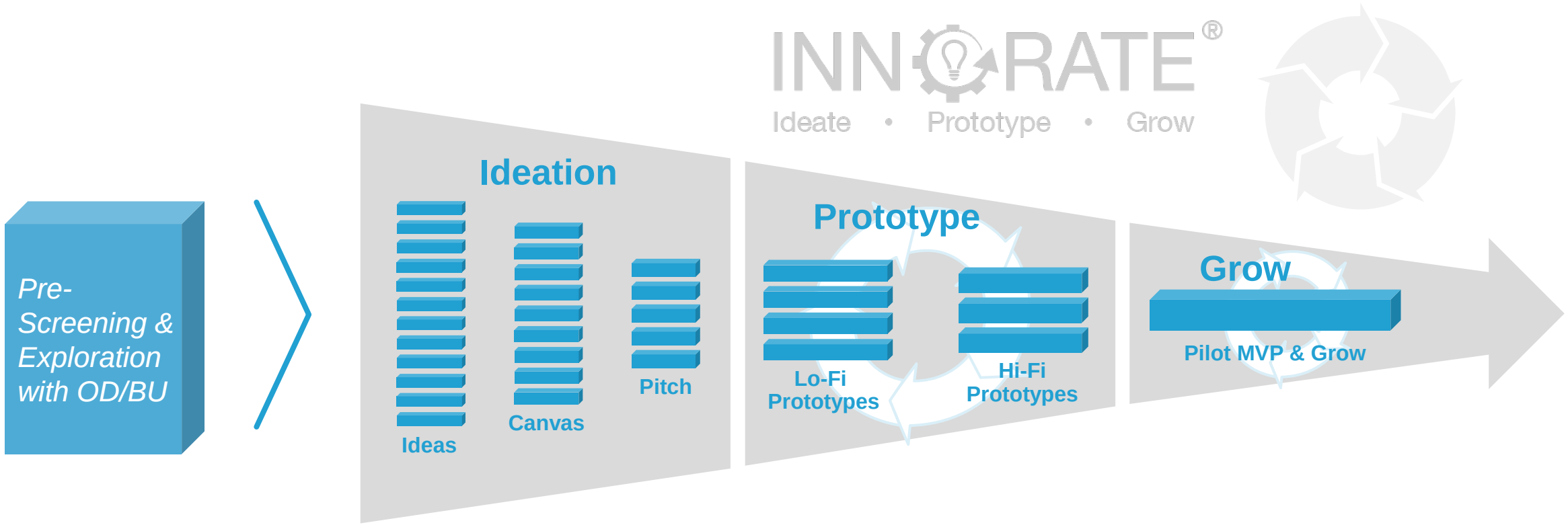
Accelerate formulation adjustment

First formulation batch adjusted using real customer application data. **Positive performance** in customer plant.

Partnership definitions ongoing now.

Digital Business Models

Created along the INNORATE® process



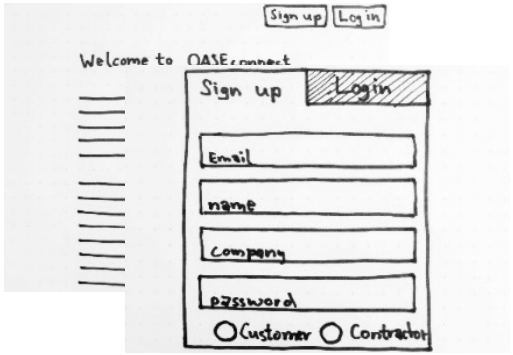
Produce innovative digital Business Models in Workshops

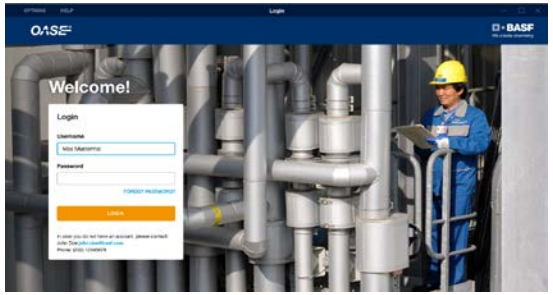
Use prototypes to get feedback from customers & improve business model

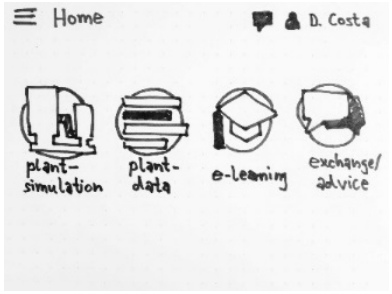
Pilot Minimum Viable Product in test market and roll-out subsequently

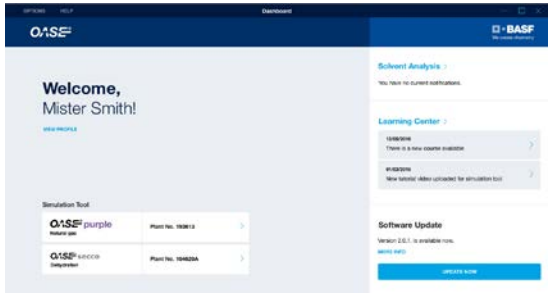
Project example: OASE.connect

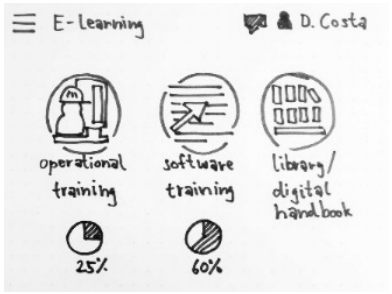
From idea to realization

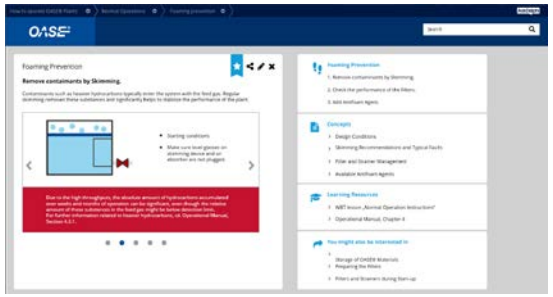












- OASE.connect will support customers in BASF gas treatment business
- Compliments visits of technical experts
- Platform was adapted due to feedback from customers in prototyping phase

Smart IT

Enables sustainable application of digital technologies

- Big Data Analytics
- Data as “New Oil”
- Cloud Computing
- Internet of Things (IoT)

Smart IT

Smart Innovation & Technologies

Integrate Research & Development Data into a single platform, improve access to the data via specific user interfaces, design models to analyze big data for predictive energy demand.

Smart Manufacturing

Define prototype models to analyze the data on real time, enable mobile devices to integrate the physical plant with the virtual data and information.

Smart Supply Chain

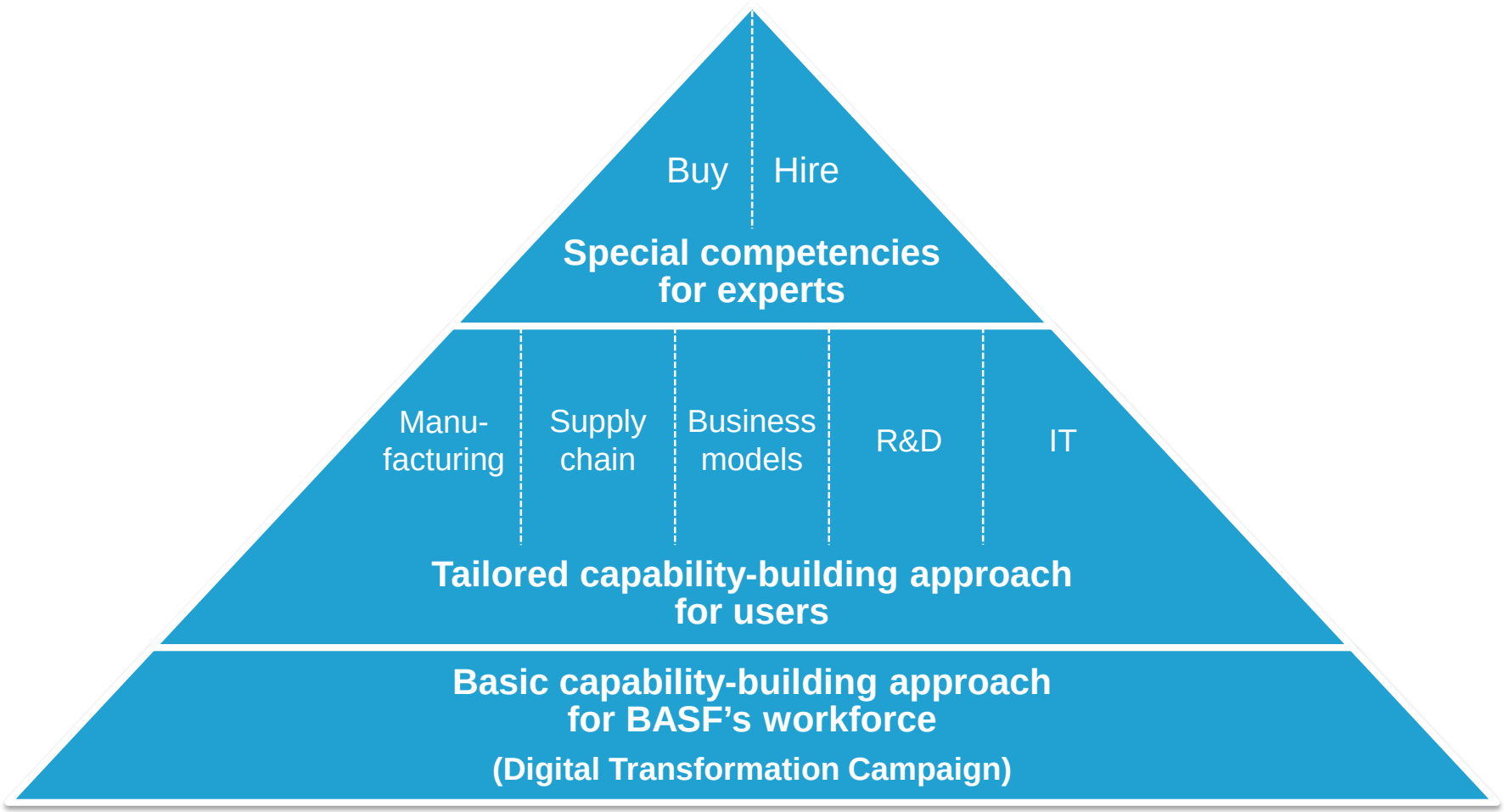
Enable the integration of different cloud solutions within the value chain, consolidate the supply chain data in the data integration layer for easy access through different devices.

Digital Business Models

Implement digital technology to empower customer demand, define reliable data analytic models to increase customer satisfaction.

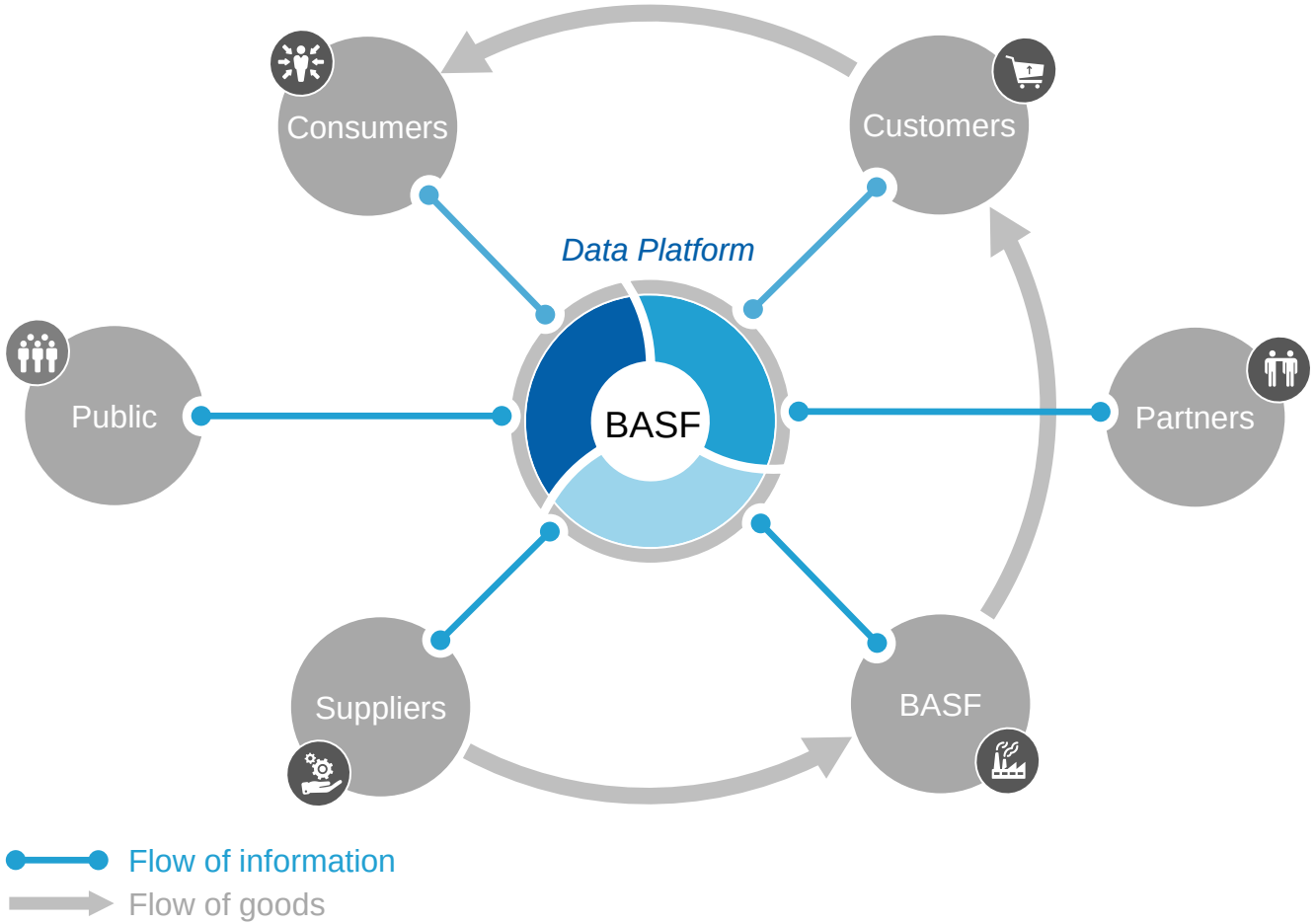
Smart HR

Framework for building digital competencies reflects a multi-layered approach



Digital transformation at BASF

BASF's digital vision



BASF adds value to customers through digitally enabled products and services.

BASF enhances effectiveness and efficiency through horizontally and vertically connecting value chain data and applying advanced data analytics to enhance decision making.

The BASF team understands and leverages the value of data and new digital technologies.

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