Enabling daily R&D work with digital tools

Dr. Richard Trethewey
Head of Digitalization Bioscience & Knowledge
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By integrating digital technologies into BASF’s everyday R&D operations, we will boost effectiveness of research, increase efficiency, and open up new innovation opportunities.

Directly enabling all R&D staff with digital tools for everyday work is an essential component of the BASF approach to digitalization.
Enabling digital R&D work: What does this entail?

- Enabling R&D decision making
- Digital tools for all researchers
- Supporting digital transformation
- Connected knowledge
Example: Data sciences enables faster catalyst selection

Collecting and integrating relevant data

Process information + Analytical information + Performance data  

Interpretation

Knowledge graph + Interactive interfaces

Testing time reduced by 3 times through accelerated performance ranking
Enabling R&D decision making

Example: Visual machine learning for herbicide discovery

Impact

- 95% accuracy
- 90% time saving
- No operator bias
- Cost-effective
- User-friendly

Enhancement of decision making in routine laboratory workflow
**Example:**
Modeling to select crop protection candidates

**Target**
Identify compounds with an optimized on-target versus off-target profile

**Challenge**
High number of expensive and time-consuming experiments to test potential side-effects of active ingredients on environment required

**Contribution**
Statistical methods and computer models used to predict side-effects and prioritize candidates

Optimize balance between targeted effects and unwanted potential side-effects
Example: Developing polymers for complex formulations

**Target**
Bi-functional polymer to enable formulation of new active ingredient (a.i.) – Xemium® fungicide

**Challenge**
- 23 monomers
- 3 adjuvants
- 10 solvents
- $10^4$ polymer compositions
- $>10^8$ formulation compositions

**Contribution**
Multiscale modeling predicted polymer with improved formulation performance

Faster, more effective product development via modeling
Enabling R&D decision making

Example: Visualization to support enzyme selection

Advanced visualization enables interactive identification of opportunities
Introduction to apps at BASF

Key parameters

- Cloud-based
- Scalable throughout R&D
- Ecosystem of apps
- Accessible data
- Useable by all R&D employees

App platform

Digital tools for all researchers

Essential to drive adoption of digital technologies throughout R&D
Example: Machine learning app for enzyme engineering

Target
Accelerate enzyme engineering proposals

Challenge
Integrate data, apply machine learning and interactively visualize results

Contribution
Faster deployment of new scientific methods

Apps bring advanced capabilities directly to R&D project teams
Example:
App with utility from R&D to the market

Impact
- Deep learning technologies enable highly accurate detection of major wheat diseases from images
- Technology adapted from medical applications
- Provides fungicide recommendations
- Pictures collected for further training of the algorithm

Successful application of deep learning for wheat diseases
Supporting digital transformation

Adopting agile approaches in R&D

Example: Hackathon

- App development with end-users
- Intense focus on working software

Example: Employee dialogues

- Dialogue essential to drive transformation
- Supported with specific training programs

Success requires evolution in the working culture
The most important contribution management needs to make in the 21st century is … to increase the productivity of knowledge work and knowledge workers.

Peter Drucker, 1999
California Management Review 41 No. 2
Enabling all R&D employees with knowledge

Unparalleled internal knowledge

- Internal reports
- Extracted metadata
- Relationships

- Chemistry, Material Sciences, Bioscience
- > 400,000 internal reports from decades of research

Scientific and patent literature

- Full-text publications
- Commercial indexes

- Fast access
- State-of-the-art search

Connecting internal and external knowledge offers BASF R&D a competitive advantage
Example: Machine learning for knowledge

Question

How to increase abiotic stress tolerance of corn by use of microorganisms?

Machine learning and ontologies accelerate and improve literature assessment
BASF R&D is going digital!

- Digital technologies drive decision making in R&D
- Apps are key to enable digitalization broadly across R&D and beyond
- New digital working methods adopted
- Connecting knowledge is key for competitive success
BASF
We create chemistry