AceForm4.0 Webinar
„The Strategic Research Agenda (SRA)“

Overview, Status and Learnings for Validation

Dr. Alexis Bazzanella, DECHEMA
Agenda:

Presentation of AceForm and main output/findings
Q&A
Project Overview

Objectives

- Establish a European Formulation Interest Group (EU-FIG)
- Identify common technical and industrial challenges for the European Formulated Products Industries
- Establish a common vision and roadmap
- Arrange knowledge exchange activities and facilitate new initiatives along the value chain

Key project outputs

- Influence the content of future EU calls
- EU-FIG community with >500 organizations
- > 10 new collaborative cross-sectorial initiatives

Horizon 2020 Coordination and Support Action (CSA) project Oct 2016 - Oct 2018
Objectives

Objective 1: Establish a European Formulation Interest Group

Objective 2: Identified Common Scientific and Industrial Challenges

Objective 3: Establish a Common Vision, Roadmap for 2025 and Associated Implementation Plan

Objective 4: Through Knowledge Exchange Activities Facilitate Creation of New Cross-Sector Value Chains Initiatives

Objective 5: Establish a Business Plan for Continuity
Europe will lead the global path in the innovation and commercialisation of new sustainable formulated products that deliver radical effects and high-performance to downstream industries, end-users and consumers whilst optimising resource and energy efficiency and minimising adverse impacts on biodiversity and the environment.
AceForm analysis focuses across 6 main sectors; selected based on:

i) Potential for economic and societal impact (sector size, EU footprint, potential for growth)

ii) Potential for cross sector collaborations and synergies (ingredient/materials base; current capabilities; collaboration culture).

• This approach does not preclude engagement and applicability of AceForm outputs to other sectors.
AceForm highlights and prioritises public intervention on complex opportunities; intractable by current value chains

**Action 1: Make recommendations for CR&D calls themes; highlighting potential for formulation (Fund)**

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<td>Product differentiation through personalisation</td>
<td>Personalised medicines</td>
<td>Preventative care models</td>
<td>Managing increasing variability in regional ingredient supply</td>
<td>Reformulation for low fat, low sugar; high nutrition</td>
<td>Process scale-out to regions with lower cost base</td>
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<td>Products for ageing population</td>
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<td>E-commerce driving reformulation to support novel Direct-to-Consumer models</td>
<td>Formulation for emerging therapies</td>
<td>Automated smart farm concept</td>
<td>Real time performance monitoring (service model)</td>
<td>IoT enables modelling of supply chain environment for enhanced product design</td>
<td>Reformulation for Additive Manf.</td>
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<td>Formulation for close-loop digital health model</td>
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Note: Examples given above are illustrative of fuller analysis available in full draft report.
Cross-sector trends / drivers

• New Product and Process Development
  • Faster Product lifecycles and product obsolescence
  • Radical effects and high performance
  • Faster time-to-market
  • Customisable and personalised products

• Manufacturing and Supply Chain Performance
  • Operating and maintenance costs of plants
  • Rejuvenating legacy assets to maintain and/or improve competiveness.
  • End-to-end productivity of supply chains
  • Responsiveness of supply chains
  • New revenue generating business models (e.g. shift to service)

• Sustainability and the Circular Economy
  • Resource efficiency and the reuse across the whole supply chains
  • Renewable and/or bio-degradable ingredients
  • Rising awareness of human impact on the environment (ocean, air and land)
  • Rise of internet-empowered consumer
Two **concrete examples** proposed by a member of the European Interest Group (EU-FIG) for possible future projects/initiatives:

1. **Agro-Manufacturing-Service Community:**
   - Background: Regional Agro-Manufacturing industry in Europe is suffering from the high seasonality of their business
   - Striving to offer their idled off-season capacity of equipment, machinery et., to other sectors: will try to extend manufacturing-services to e.g. painting, coating, fine chemical industry

2. **Technology transfer:**
   - Company has developed a machine for a new micro-coating process in the Pharma sector
   - Intention: use could be extended to other processes in other sectors

→ **Contact details and other ways to contact AceForm experts and EU-FIG members will be provided at the end of the presentation!**
Common Challenges and Opportunities

Value Chain & Cycle Collaboration – Systems-based Solutions for Complex Challenges

1. **Finding new Partners** – beyond ‘business as usual’ networks
2. **Modelling Value Chains and Cycles** – protecting IP and future role

Circular Economy – Unlocking Value through Systems-based Sustainable Solutions

3. **Understanding the Relevance** - for all formulated products
4. **Enabling Disruptive Companies and Business Models**
5. **Modelling the Impact** – Environmental, Societal, Commercial

Industry 4.0 – The toolkit for Future Formulation

6. **Understanding what it is and the Implications**
7. **An enabler for Radical Product and Process Design**
8. **Universal Industrial Challenges** - Integration, Data Sharing and Digital skills gap
9. **Formulation Specific Technical Challenges**
10. **Knowing where to start?** – Digital Formulation Capability Benchmarking and Roadmapping
A key recommendation from AceForm is to prioritise and enable collaborations that extend reach along and across value chains.

The big 21st century challenges/opportunities demand better sharing of:

- Technical expertise, data and insights
  - Much of which extends beyond formulation
    - E.g. chemical production, devices, packaging, env. remediation, process eng.
- Specification/Customer understanding
  - Including extend reach beyond tradition routes consumers / consumer groups
- Constraints
  - E.g. cost base, supply base, regulations (sometimes conflicting across sectors)

Action 2: Improve Formulation outreach (Inform, Connect)

- Grow EU stakeholder value chain maps; reaching beyond ‘business as usual’ partner networks
- Develop resources to do better job of selling value of formulation.
A further recommendation is to prioritise and enable collaborations that extend to value cycle thinking. Action 3: Promote prioritisation of CR&D calls where extended value chain / cycle collaboration can be demonstrated (Fund). Action 4: Promote access to, and coordination of central resources for modelling value chains/cycles (Connect, Access).

Note: sustainability isn’t always the primary driver for value cycle collaboration e.g. other drivers - security of supply, quality.
Looking beyond the current “take, make and dispose” extractive industrial model, the circular economy is restorative and regenerative by design. Relying on system-wide innovation, it aims to redefine products and services to design waste out, while minimising negative impacts as well as energy consumption. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural and social capital.
Circular Economy (CE) and Formulation Understanding the relevance

• **CE is a significant opportunity for economic and societal impact across Formulating Industries**

• General awareness across Formulating Industries is good; but issues around understanding
  • Generally not enough big picture thinking – typically tackling sustainability from operational silos.
  • Consumables – unclear that CE can be applied, assumed not as product ‘in-use’ life-span is short
  • Difference between formulations that have potential to be:
    • intrinsically circular (e.g. motor lubricant); or a CE enabler (e.g. packaging ink that enables recycling)

**Action 5: Improve awareness of formulation related CE case studies (Inform)**
**Action 6: Promote and explore innovative ways to stimulate investment in disruptive CE businesses (Fund)**
Circular Economy (CE) and Formulation
Modelling the impact

- Formulating Industries, particularly SMEs, are limited in their ability to exploit CE opportunities as there is poor access to (or at least awareness of) relevant collaborative tools for modelling impact.
  - Environmental impact – Full Life-Cycle Analysis; Quantitative; Complex systems
  - Societal impact – see donut economics thinking (schematic below)
  - Modelling value chains/cycle – to secure role and IP in future disruptive value chain/cycle
  - Modelling Business models – e.g. shift to service model; how to re-configure business

**Action 7: De-risk shift to CE by improving access to relevant collaborative tools to model impact (Access)**
Industry 4.0 is the integration of various digitalisation technologies (existing and emerging) to enable advanced capabilities to **connect**, **model** and **automate** design, manufacturing and supply chains systems. => delivering products, processes and services faster, more efficiently and more flexibly.

**AceForm Definition**

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**Digitalisation Technologies**

- Virtual/Augmented Reality
- Digital Twin
- Cyber-Physical Systems
- Big Data/Smart Algorithms
- Internet of Things
- Advanced Robotics
- Cloud Technology
- 3D Printing/Additive Manufacturing
- Cyber-Security

Source: Siemens AG
Industry 4.0 and Formulation
Understanding what it is and the Implications

- AceForm consultation highlights a generally poor understanding of Industry 4.0 across Formulating Industries.
- Elements are being applied in silos; so missing the bigger picture opportunities.
- Action 8 – Improve awareness of resources and networks that promote the value of Industry 4.0 (Inform, Connect)

31. Are you familiar with the term "Industry 4.0" within your organization?

32. In which of the following areas, has your company implemented/is considering implementing the use of smart (interconnected) devices encompassed by Industry 4.0?
Industry 4.0 and Formulation
An enabler for Radical Product and Process Design

- Industry 4.0 can unlock a more collaborative, dynamic approach to product and process design
- i4.0 enables step-change learning from data (modelled, experimental, in-use)
- i4.0 enables flexibility to adapt design and production protocols to evolving technical and market learnings.
- Return on investment in radical toolkit is high
  - as products require re-formulation on regular cycles and are highly variable.

- Action 9 – Influence CR&D calls to prioritise deployment of i4.0 technologies for radical Product and Process Design (Fund)
- Action 10 - Influence wider Industry4.0/digitalisation calls; maximising relevance to formulating industries (Fund)

E.g. Resource Efficient Formulations for the Smart Farm
E.g. Digital Preventative Healthcare
E.g. Tailored Engine Oil; mobility as a Service
Industry 4.0 Challenges

Universal Industrial Challenges

- **Data-sharing** - A step-change is required for greater access and sharing of data currently segmented across a risk adverse supply chain.

- **Integration** - many digital systems, many functional business needs, many legacy capital assets

- **Digital skills** – retraining for tools of the future

Formulation Specific Technical Challenges

- **Digital Twins** - are not easily created for Formulations; performance/failure mechanisms are not well understood (rooted in subtle nano/micro phenomena; often product specific) and so i4.0 may create more data and levers, but without any underpinning insights as to how/when to use them.

  - **Formulations are inherently unstable.** ‘Good’ is only a point in time. As such, stability / performance / quality assessments over can be unreliable over short periods of time.

  - **Standards** for describing formulations or structuring data don’t exist. This limits the ability to apply novel data approaches and codify knowledge.

- **Target properties** - are generally difficult to reduce to a discrete measure/physical attribute; as such it will continue to be difficult to make a meaningful quality measurement.

- **Action 11 – Raise awareness and build on projects already seeking to resolve these issues (Inform, Connect)**
Knowing where to start?
Digital Formulation Capability Benchmarking & Roadmapping

- AceForm proposes that capability journeys should be mapped over 5, 10 and 15 years.

### Against Four themes

1. **Quantification** – all aspects of the formulation life-cycle should be reduced to numbers or numerical models.
2. **Connection** – data should be generated through all stages of the formulation life-cycle and captured centrally. Associated integrated control capabilities should also be in place.
3. **Embed multiscale modelling** – truly predictive design capability will only be realised by bridging material/structure-property relationship models across time/length-scales and across the formulation life-cycle.
4. **Embed intelligence** – systems should be developed to codify ‘expert’ human intelligence so as to automate routine decision making and artificial intelligence to enable better resolution (advanced empiricism) of intractable design problems.

### Across six stage of Formulation life-cycle

1. **Ingredients**
2. **Mixture** (often viewed at the formulation)
3. **Process** – including recovery/recycle
4. **Delivery** - Storage/transportation/device e.g. pack, lorry, shelf, injection, spray
5. **Application** e.g. wetting, delivery, heat transfer
6. **Subject** e.g. skin, leaf, engine

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**Action 12** – Develop and deploy toolkit to roadmap and benchmark digital formulation capability (Connect, Access).
**Action 13** – Influence CR&D calls to value impact of co-development of advanced underpinning formulation capability (Fund)
**Action 14** – Analyse capability roadmaps to identify infrastructure gaps to be supported through public investment (Fund, Access)
## Recommendations

### Summary of Actions

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Common Vision for 2030

Success Indicators

- Formulation is valued as a key contributor to EU economic growth, job creation, sustainability and well-being.
- Formulating Industries has a step-change in extending reach and partnering across value chains and value cycles.
- Formulating industries embraces, adapts and identifies new ways to create value through the Circular Economy.
- Formulating industries lead in exploiting Industry 4.0 to enable Radical Formulated Product and Process Design.
- All formulating companies have a roadmap and active action plan to advance underpinning digital formulation capabilities.
- Public and private uplift in R&D and innovation investment; driven by evidence of value creation.
- SMEs with high growth potential have enhanced access to advanced capabilities via open-access facilities.
- Cross sector and value chain collaborations function with minimal friction and are common place for leading innovative companies.

Europe will lead the global path in the innovation and commercialisation of new sustainable formulated products that deliver radical effects and high-performance to downstream industries, end-users and consumers whilst optimising resource and energy efficiency and minimising adverse impacts on biodiversity and the environment.
How can I inform myself and actively contribute?

URL: http://formulation-network.eu/strategic-research-agenda
The EU Formulation Interest Group
Validating and actioning AceForm outputs

Register and connect here: formulation-network.eu/members

Your benefits

• Matchmaking tool → find new partners across sectors and along the value chain (goes live soon)
• Download area (deliverables, events, project results)
• Regular newsletters and announcements
• Influence on future call topics within a strong community
• Free of charge

Deliverables

• Deliverable D2.3 - Technological and Industrial Challenges Identified
• Deliverable D3.1 - Common Vision and Roadmap for Formulated Products
• Deliverable D3.2 - Recommendations for the Implementation and Realisation of the Ro
• Deliverable D4.1 - Formulation Community Value-chain Maps
• Deliverable D5.2 - Communication and Dissemination Activities Report 1

Event Downloads

• Workshop at CPI, Sedgefield, UK
• Workshop at Flamma, Gent, Belgium
• Workshop at RISE, Stockholm, Sweden
• Workshop at DEHEMA, Frankfurt, Germany
• WCCE Workshop

Public Consultation Results

• Public Consultation One Results - Insights gathered during the first AceForm4.0 public
AceForm4.0 experts:

Project coordinator: Darren Ragheb (CPI), Darren.Ragheb@uk-cpi.com

Communications Director: Alexis Bazzanella (DECHEMA), alexis.bazzanella@dechema.de

Collaboration Support and Matchmaking: Léopold Mottet (Flamac), Leopold.MOTTET@flamac.be
Nils Bohmer (DECHEMA), nils.bohmer@dechema.de

Questions to the consortium: info@formulation-network.eu
Q&A