Special Interest Group

Formulation

Formulation Special Interest Group
The story so far
5th Feb 2013

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Formulation

Overview

- Formulation - The UK opportunity
- TSB Formulation Special interest Group
- TSB Collaborative R&D competition
- Collaborative project building
- The formulation centre
- Skills and training

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The opportunity

- Formulation, the creation of multi-component, often multi-phase products, is an enabling capability
- Underpins many sectors in our economy and high-value manufacturing industries globally.
- The formulated products market in the UK is worth around £180 billion pa with a potential for companies in emerging overseas markets of around £1,000 billion

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Formulation - a key strength for the UK

- UK has a critical mass of world leading formulation companies with manufacturing and R&D activities
  - -Over 22% of the top 1000 UK R&D spenders are involved in formulation.

- Underpinned by a strong SME and academic supply chain
  - -measurement equipment, modelling and simulation, high-throughput automation, surfactants, particle design, materials science, colloid science

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Formulation – UK strategy

Formulation part of the Technology Strategy Board national agenda

- Key competency within the High Value Manufacturing strategy (2012-2015)
- "Understanding, design and manufacture of all formulated products for relevant sectors across the supply chain"
- In total, formulation supports 15 out of the 22 competencies identified

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Formulation Special Interest Group overview

- TSB funded, CIKTN led, July 2012 – April 2013
- Key deliverables
  - Proposal, business plan and industry-led consortium for a **national formulation centre**.
  - A suite of potential **collaborative R&D projects/consortia** (target 8)
- Progress update
  - Consultation phase complete
  - Strong direct industry engagement
    - AkzoNobel, Unilever, P&G, AstraZeneca, Pfizer, GSK, Syngenta, Johnson Matthey, BP, Croda, Afton Chemicals, Reckitt Benckiser, Innospec, Bristol Myers-Squibb, Givaudan, Britest, Harman technology, Revolymer, Oxford Advanced Surfaces, Chemspeed, Novidec, Astech projects, FujiFilm IC, Schlumberger, Merck, Lonza.
  - Centre business plan in draft – due March
  - Projects portfolio/pipeline established; New funding route secured

TSB Collaborative R&D Competition

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TSB Collaborative R&D Competition - Formulation

- Technology Strategy Board will be providing up to £5M to co-fund industry-led innovation projects in the area of formulation
  - Up to £4m is available for **collaborative R&D projects.** These must be business-led, include an end user formulating company, last one to three years and will attract up to 50% public funding.
  - Up to £1m is available for **feasibility projects**. These must be business-led, may be collaborative or led by single companies, should last six to nine months and will attract up to 75% public funding.
  - EPSRC will contribute up to £1m; where need for fundamental research is demonstrated
  - Typical **total** project size: cR&D £1M; Feasibility £100K

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TSB Collaborative R&D Competition - Formulation

Project Themes

- **Radical Formulated Product Design:** Methods to accelerate the design and optimisation of new formulated products throughout the chain from R&D to production and the market.
- **Formulation for Delivery:** Technologies which enable or improve the precisely controlled and targeted use of ingredients or which provide radically new formulation architecture or product microstructure.
- **Radical Formulation Process Design:** Technologies which can be implemented in a production environment to provide better products, improved quality or a significant economic or environmental benefit.
- **Formulation for Stability:** New methods for prediction, measurement, characterisation, control and optimisation of the stability of complex products which can bring economic or environmental benefits.
- **Formulation for Sustainability:** Integrated product and process design which considers ingredient sources, the impact of production processes as well as the end-use of formulated products.

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TSB Collaborative R&D Competition - Formulation

- All sectors in scope; but project must have at its heart the design, manufacture or end-use of a complex formulated product

- Proposals are encouraged which:
  - Integrate and **embed new science-based knowledge**, improve the exploitation of existing knowledge, don't perpetuate the empirical trial and error culture, and which are multi-disciplinary in nature.
  - Realise the potential to **collaborate between industries** which do not compete with each other but which face common technical challenges.
  - Are **highly collaborative in nature**, for instance through building improved partnerships along **supply chains,** by fostering SME/SME or SME/large company **partnerships** or by making better use of academic and non-academic **expertise**.

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TSB Collaborative R&D Competition - Formulation

Projects will lead to a quantifiable economic benefit for the industrial partners and through them to the UK overall e.g:

- leading to the development of a new product(s)
- development of knowledge or IP leading to new services being offered to the market
- development of new and improved processes leading to lower costs or improved opportunities in the market
- should also show where possible how project leads to environmental or social benefits

Proposals also need to:

- demonstrate novelty and a clear scientific, technological and/or structural hurdle to be overcome
- demonstrate confidence in delivery plan.

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Timings

- Call document released — March 2013
- Competition opens — April 2013
- Stage I deadline — June 2013
- Typical project start date — Q4 2013/Q1 2014

- Project building should start now!
  - Key call information is available
  - Formulation SIG workshops outputs available
  - Formulation SIG ready to help
    - Call fit, eligibility, partnering, draft proposal review

Collaborative Projects

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Background

- 20+ Interviews and meetings with individuals and organisations
- 4 open workshops, ~100 delegates
  - Improving Product Stability
  - Closing the loop; Data-rich formulated product and process design
  - Sustainability: Design formulations for a more sustainable future
  - Process: Process design and manufacture of formulated products

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Projects developed by participants in the workshops

Workshop topic	Chosen projects
Stability	1. **Improved and integrated data handling, simulation, experimentation, prediction and modelling systems** to enable stability control over scales and timescales 2. **Measurement and control of microstructures** a. Improved understanding how to control a variety of parameters eg biological APIs, Nanomaterials, Phase separation of weak gel systems, Effects of temperature, humidity and oxygen on chemical stability and packaging, Thermodynamics and kinetics of phase separations in practical systems
Closing the loop; Data-rich formulated product and process design	1. **Prediction at Scale/ scale down** for fundamental understanding, measurement and design: Choosing real examples in 3 sectors; develop models from existing data and pooling it, predict and iterate 2. **'Build a tablet'** (Solid multicomponent formulations) -The ideal tool would: predict a range of starting formulations for experimental work, starting from a purely theoretical / paper structure, measure and model to predict scalability 3. **Data management project;** for both data and meta-data; capture, management and Integration, validation, analysis and modelling, visualisation, optimisation, standardisation produce a standardised process and infrastructure of reliable information to access when designing new products or processes, all compatible with standard informatics software.

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Projects developed by participants in the workshops

Workshop topic	Chosen projects
Sustainability: Design formulations for a more sustainable future	**1. Bio-derived ingredients for film forming** – BIFF! Formulation principles for film forming that apply for new bio-derived ingredients, to provide real sustainable routes for easier construction, deconstruction and removal of films **2. Integrating formulation with synthesis**. Finding ways to perform the total redesign of process steps when considered together, during development. **3. Raw materials resource for formulators**; For chemical and physical properties, expertise in use and case studies to enable increased use of more sustainable ingredients.
Process: Process design and manufacture of formulated products	1. Manufacturing and operability for quality and cost; develop **novel inline measurement techniques that would enable real-time monitoring** (and flexible processing) of complex, highly viscous liquid products. **2. Scale + batch to continuous**; - Innovative Manufacturing Processes for Agility in Scale - Scale Down of Continuous Processes - Energy Efficient (Continuous) Processing - Reliable (In Silico) Process Design Modelling **3. Specification of a capability hub and how to access it**;

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Project portfolio and Centre themes: 1. Sustainability Programme

Grand Challenge: Complete redesign of a product and the processes in its whole supply chain for the minimum environmental impact.

Sustainability Priority Themes:

- Su 1: Use of natural and sustainably sourced raw materials for effect
- Su 2: Customising and targeting for 100% product effectiveness in use
- Su 3: Solvents:
  - Replacement of VOC solvents
  - No/ low water formulations in manufacture and use
- Su 4: Separation processes for complex mixtures. Build in ability for components of formulation to be recovered and re-used.
- Su 5: Substitution of restricted ingredients

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Next steps

- SIG will circulate project-building report
  - To include outputs from all 4 workshops
  - Project themes/Grand challenges
  - Project pipeline and map of who's who (from workshops)
- SIG will refresh/update this info on _connect
- SIG will support individual projects and consortia pitching for the TSB call
- SIG will work with industry to develop the project portfolio for the centre

Questions?

Formulation Centre

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Formulation Centre - vision

- An open-access innovation space for advanced formulated product design and manufacture comprising a central hub connecting to spokes of world class cross-sector expertise, technology and skills

- Enabling companies to accelerate to market high value products and processes underpinned by a step-change in predictive design capability built on mechanistic understanding of complex formulated systems

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Building on UK World-class expertise

- An open-access innovation space for advanced formulated product design and manufacture comprising a central hub connecting to spokes of **world class cross-sector expertise, technology and skills** in:
  - Formulation - sector/application specialists
  - Physical sciences - colloids, particles
  - Advanced measurement
  - Experimental design, modelling and data management/exploitation
  - High throughput platform and workflow design
  - Formulation process technology
  - Technology project building and management
- Most of this capability already exists, but need for better access and convergence

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What does it look like

- A physical centre (hub)
  - Central management; collaboration space; front door; technology demonstration
  - World-class expertise and capabilities in some key areas of science and technology
  - A platform for future growth
  - Coordinating access to and collaboration...
- With an alliance of delivery partners (spokes)
  - Providing leading experts and capacity in several key platforms
  - Drawn from companies, universities, RTOs
  - Enabling access to an extended network
- With integrated Communities of Practice
  - Facilitating cross-sector sharing of best practice
  - Driving strategic cross industry programmes
  - Defining future needs and project activity (e.g. Tech transfer, R&D, shared capital)
  - Enabling 'intelligent' growth of extended network

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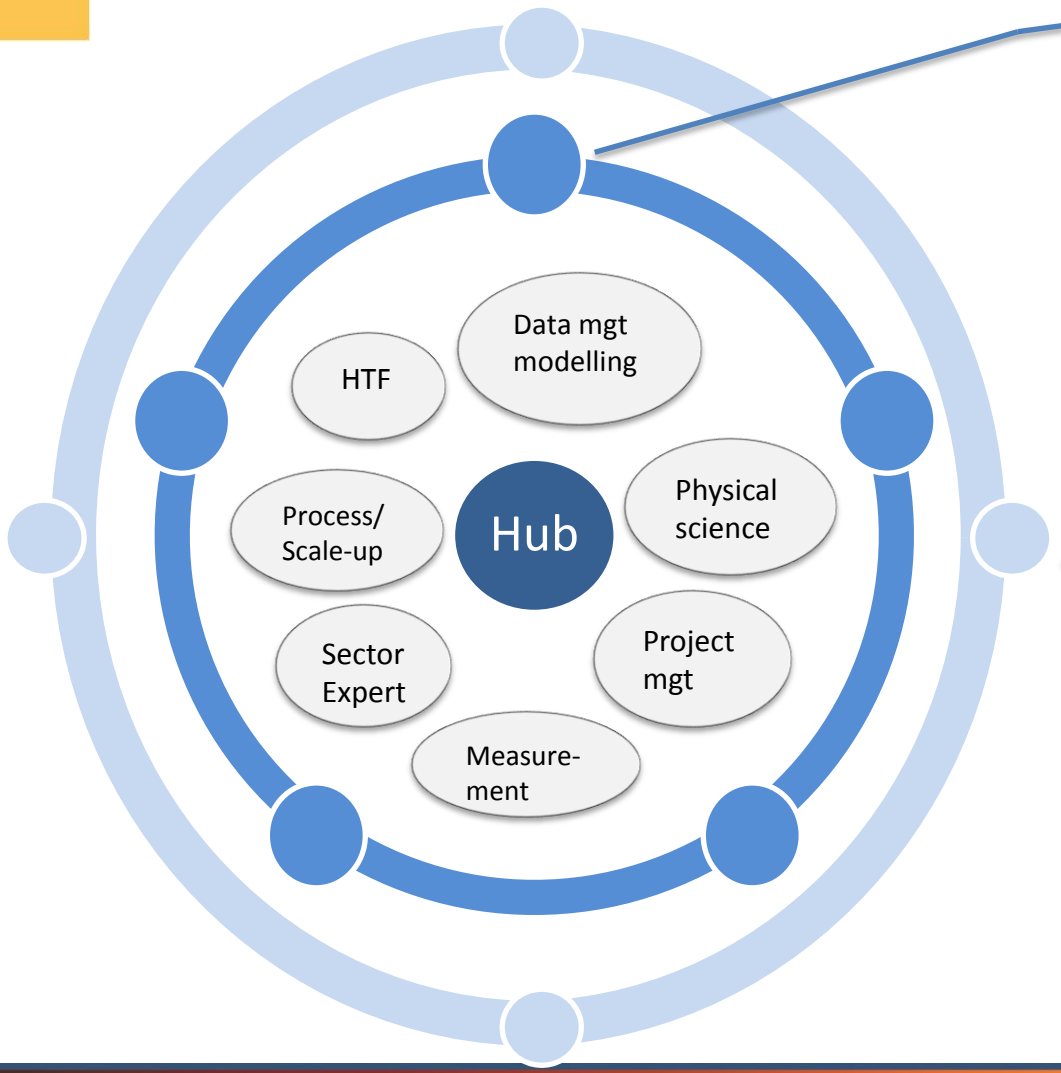
Hub and spoke model



Formulation expertise from key industry sectors e.g.

- Home and personal care
- Agrochemicals
- Coatings
- Pharmaceuticals
- Oil additives and lubricants
- Catalysts
- Food

Strategic science and technology spokes

- High throughput technologies
- Process technology/Scale-up
- Data management/modelling
- *Physical sciences – colloids, particles*

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People

Role	Principle Activities	No. of people
Centre Director	• Delivery against strategy • Relationship management	1
• Connectors/Bus. Dev. • Sector specialists • Tech. project manager	• Project development • Sector specific knowledge • Technical project management	6
World class experts/specialists	• Project definition • Consulting • Manage Communities of Practice	6
Project scientists /post-docs/technicians	• Project delivery	12
Admin	• PM support • Events etc	2

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Projects/activity portfolio – tbc

Infrastructure

- Data management/standards infrastructure
- Computer-aided formulation

Collaborative R&D

- Batch to flexible continuous tablet processing for personalised medicines
- Stability prediction tools in aqueous gel systems
- High throughput biocide/preservative screening (sme-led)

Communities of practice

- Batch to continuous processing
- High throughput technologies
- Predictive measurements

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Formulation Centre – The Spokes

Aim to have a small number of Strategic Spokes…

- Built into business plan. Written into major Centre projects
- Provided with some flexible resource to service ad-hoc member projects
- Need to fill capability gaps not covered by industry partners
- Must currently have breadth (critical mass) and depth of expertise; strategic commitment to formulation; track record in industry engagement

…as well as an extended network

- Centre will signpost customers to the best placed to do the work
- Network members can bid for inclusion in funded projects
- Have specific expertise – but less breadth
- Could include - Universities, RTOs, contract R&D labs, consultants

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Potential Spokes

The following potential spokes were identified:

University of Birmingham
University of Bath
University of Bradford
University of Bristol
University of Cambridge
The Centre for Process Innovation
De Montfort University
University of Durham
University of Edinburgh
University of Greenwich
University of Hull
Imperial College London
Lancaster University
Kings College London
University of Leeds
University of Liverpool
Loughborough University
University of Manchester
National Measurement Office / Institute
University of Nottingham
University of Sheffield
Science and Technology Facilities Council
Strathclyde University
University of Surrey
UCL (London School of Pharmacy)

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Tiered membership model

Profile	Position	Needed for start-up (yr 1 -2)
Tier I industry partner (spokes)	•Highly project active – strategic programmes; communities of practice; own company • Lead centre definition/governance	•Target 5 @ 250K • Multi-sector • ideally 2 competitors • Significant contribution (in-kind and direct) • direct payment for bigger projects
Tier II industry partner	• Project active • Community of practice active • See the agenda but don't drive it	• Target 15 @ 10-50K • Includes 5 SMEs • buys membership and project credits
Tier III industry partner	• Pay as you go • Basic membership	• Target 50 @ 1K • Likely to provide letter of support
Other spokes & demo partners	• *Has relevant capability (e.g. expertise, technology, location) that should be integrated into the centre*	• *5 Unis/RTOs* • *4 SMEs* • *May make in-kind contribution*

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Estimated budget

Expenditure - annual (years 1 & 2)

People

	Number	Fully overheaded costs (£ '000/year)	Total
Manager	1	200	200
Connectors	6	150	900
World class experts	6	200	1200
Project scientists	12	100	1200
Admin	2	30	60
		Total	3560 K

Facilities/capital

Assume yr 1-2 mostly in-kind; increasing to £4m/year

Hub refurb/rent/IT infrastructure - £1m

Income - annual (years 1 & 2)

Membership

	Number	Rate (£ '000/year)	Total
Tier 1	5	250	1250
Tier 2	15	30	450
Tier 3	50	1	50

Total	1750 K
TSB/public funding (assume 50:50)	1750 K
Grand total	3500 K

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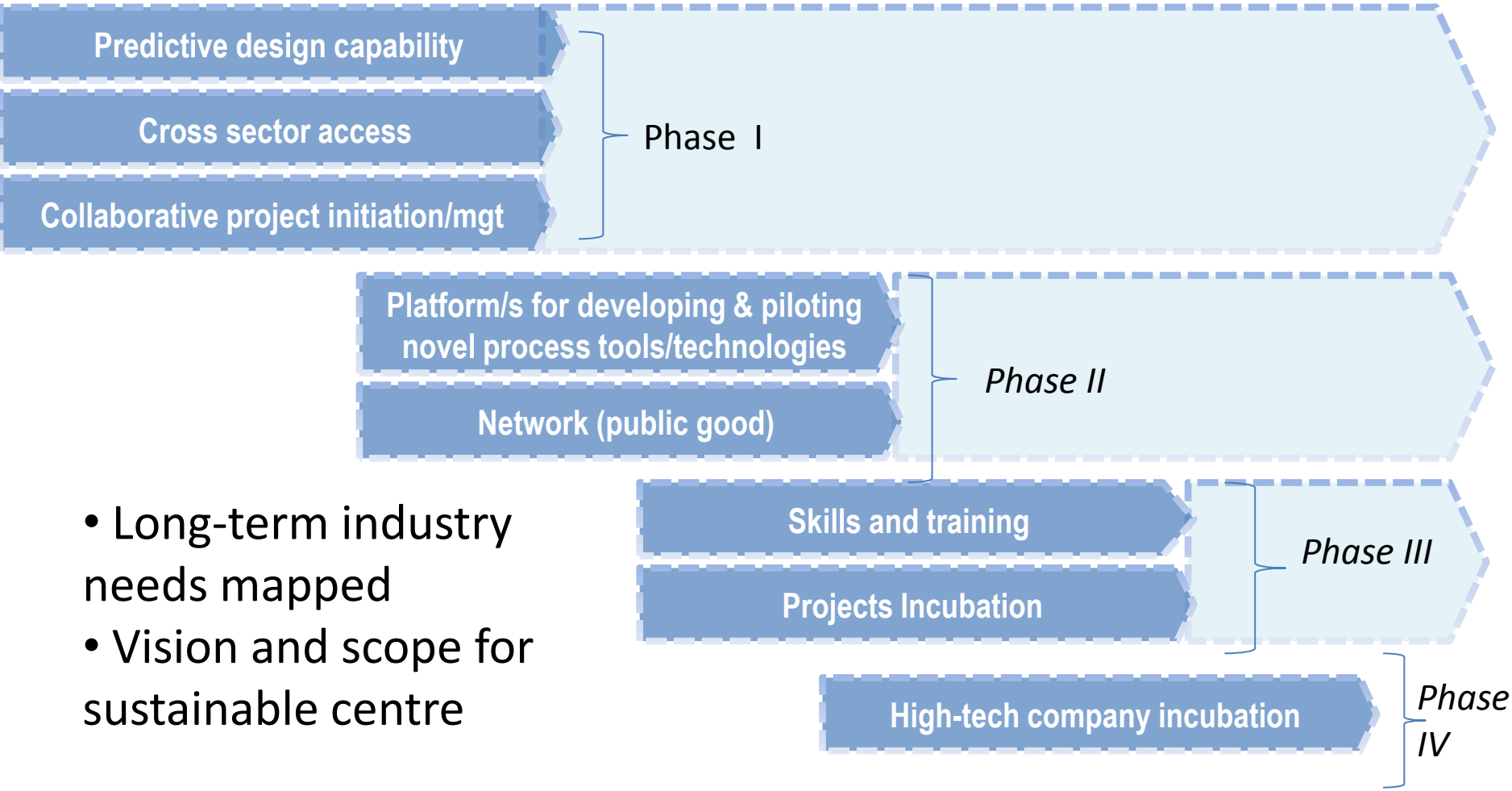
Start focussed; think big



- Long-term industry needs mapped
- Vision and scope for sustainable centre

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Delivery mechanism

- Targetting delivery via the TSB High Value Manufacturing Catapult Centre
  - 'Formulation' fundamental to the TSB HVM Manufacturing Strategy
  - Catapults exist to enable access and development of otherwise inaccessible innovation capability
  - Delivers cross-sector, cross company and supply chain leverage
  - Strong independent centre needed
  - Too complex and high risk for any single entity to deliver
  - Vehicle for long term UK investment in formulation
  - Established Catapult mechanism and systems would enable timely start

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Next steps

- 1st March - Industry leadership group workshop
  - Refining, not re-inventing, the centre
    - Projects, communities of practice, capabilities, IP/collaboration models, delivery plan
- Feb/March - One to one company negotiations
- End March – Final business plan; consortium set
- April – March 2014 - Bridging activity
  - Consortium negotiations, establish communities of practice, 'virtual projects', infrastructure development
- April 2014 – Open
  - Included in catapult (and company) 2014/15 budget cycles

Skills and training

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Skills and Training Work Package

Objective:

To develop and deliver activities **identifying** and **addressing** the skills and training gaps across the **full spectrum** of formulating activity

Challenges recognised:

Skills gaps in formulation science amongst technical and R&D personnel.

Lack of skills is therefore a potential **barrier to effective innovation** in companies.

Knowledge transfer difficult within companies and across industries.

Universities give **patchy coverage** - some good examples but many don't cover industry-relevant formulation science and technology.

Little formalised **training structure** inside companies and external training is **ad hoc** and providers can be difficult to find.

Work Package in SIG:

iFormulate, Cogent SSC – support from IChemE, RSC and CIKTN

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Skills and Training

Activities During SIG Period:

1. **Development of "Gold Standards" for three typical Formulation roles**

- Cogent's Gold Standard www.cogent-ssc.com/Gold_Standard/ is a national **framework for continuous professional development** setting out the skills required for world class performance in key job roles in the process industries.
- **Competency framework** to assist employees, line managers and HR with development plans.
- On behalf of Cogent, iFormulate consulted with industry to draw up Gold Standards for the roles of: Formulation Scientist R&D, Senior Formulation Technician and Process Technician Formulation.

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Skills and Training

Activities During SIG Period:

2. **Proposal for Formulation Curriculum and Delivery Framework**

- Cogent preparing a major "**Industrial Partnership**" (IP) bid to UKCES (Government Skills Funder)
- IP will be employer led and cover several science-based industries and enabling technologies, formulation will be a distinct part of this.
- Joining up curriculum framework, training providers and employers – and setting standards.
- Company engagement is starting – a formulation session is planned for early March
- In support of this activity iFormulate has drafted a curriculum for company consultation (covers vocational up to senior professional levels).

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Skills and Training

Next Steps:

1. **Formulation "Gold Standards" to be formally published by Cogent**
- Opportunity for employers and Cogent to work on embedding these in companies

2. **Industrial Partnership – Formulation element**
- Company engagement meeting early March – plus 1:1 engagement
- Cogent to submit EOI by end March

3. **Explore other Opportunities arising from Formulation SIG**
- Could the proposed Formulation Centre act as a base for some training activities?
- Could the proposed Formulation Centre be linked to a new Centre for Doctoral Training (EPSRC)?

Questions?