Towards a UK National Formulation Centre

Darren Ragheb, Knowledge Transfer Network

Consumer products through IB 5th June 2014



Overview

- Why is UK formulation important?
- The Special Interest Group Report
 - 'Realising the Potential for Formulation in the UK'
- The TSB Collaborative R&D Competition in Formulation
- The National Formulation Centre
- Status / Next steps



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The opportunity

- Formulation, the creation of multicomponent, 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 pa





A key strength for the UK



- > >22% of top 1000 UK R&D spenders are involved in formulation.
- Strong underpinning high—tech SME and academic supply chain
 - measurement, modelling and simulation, automation, surfactants, informatics, particle design, colloid science



































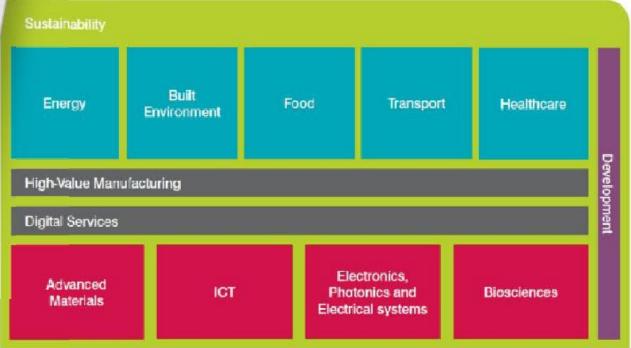
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Formulation in UK strategy



"Concept to commercialisation"

- TSB's overarching strategy
- Includes High-value manufacturing



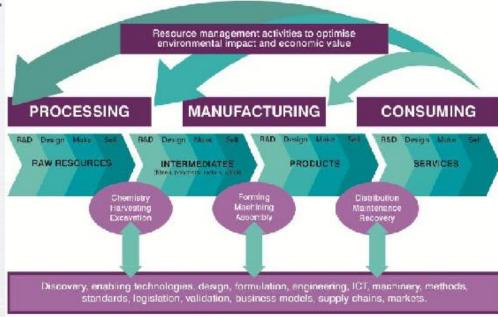


High Value Manufacturing

High value manufacturing is the application of leading-edge technical knowledge and expertise to the creation of products, production processes, and associated services which have strong potential to bring sustainable growth and high economic value to the UK. Activities may stretch from R&D at

one end to recycling at the other.





Such potential is characterised by a combination of high R&D intensity and high growth

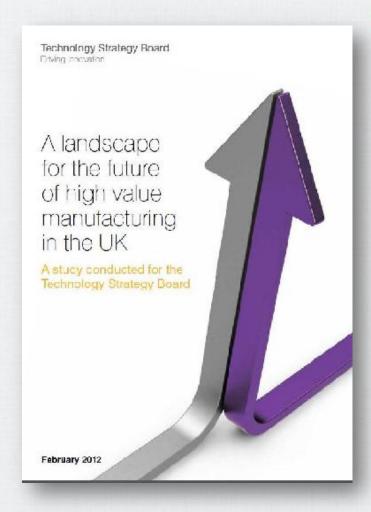


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Formulation in UK strategy

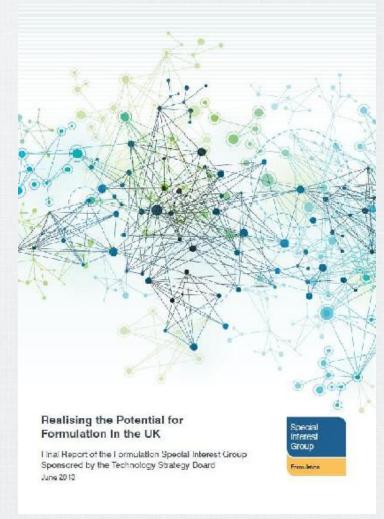
- May 2012:
 Formulation one of 22 key competencies within the TSB High Value Manufacturing strategy
- July 2012-Apr 2013:
 Formulation Special Interest Group created to answer a difficult question...
- "How can TSB best support innovation in UK formulating companies?"





The Formulation SIG Report

- Formulation and its Importance to the UK
- Mapping the Science and Technology Capabilities and Needs
- Building Projects and Collaborations
 - Collaborative R&D Competition
 - Creating an Open-Access
 Formulation Centre for the UK The business plan executive summary
- Skills Development and Training to Support Innovation







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TSB Collaborative R&D Competition

Technology Strategy Board
Diving Innovation



Formulated products meeting the product and process design challenge

COMPETITION FOR FEASIBILITY AND COLLABORATIVE R&D FUNDING APRIL 2013

- TSB and EPSRC investing in projects to accelerate the development of new ways of designing, improving and manufacturing complex high-value formulated products
 - Large collaborative R&D
 - Feasibility projects

Innovation Themes

- Radical Formulated Product Design
- Formulation for Delivery
- Radical Formulation Process Design
- Formulation for Stability
- Formulation for Sustainability



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TSB Collaborative R&D Competition

Technology Strategy Board Driving Innovation



Formulated products meeting the product and process design challenge

COMPETITION FOR FEASIBILITY AND COLLABORATIVE R&D FUNDING APRIL 2013

- V. successful, total TSB investment raised from £6m to £9.2m
- With matched private investment, total
 \$20m in formulation projects
- Diverse project coverage: e.g.shampoo, catalysts, chocolate, cutting fluids, medicines, paints, Agrichem, cosmetics, packaging adhesives, wine making, medical devices, env. remediation, biosensors, (bio)pharma, process chemical intermediates
- Excellent way to prime a larger, more strategic investment / activity



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Centre Implementation Team - Industry

	Industry High–level Group	Industry Working Group
AkzoNobel	Andrew Burgess Chief Scientist	John Carroll Director RD&I
Unilever	Jon Hague VP Open Innovation Matt Reid Senior Open Innovation Director	Ian Howell High Throughput Science leader
P&G	Charles Bragg R&D Director	Euan Magennis Strategic Innovation and Technology
AstraZeneca	Paul Stott VP Medicines Development	Marcel de Matas Principal Scientist Richard Storey Physical Scientist

Other companies engaged: GSK, Pfizer, Johnson Matthey, Syngenta, Infineum



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Enabling UK leadership in a global capability race

Past	2014	2017	2020	2025	2030	
Empirical	Semi-empi	rical Prec	ictive(sub-sys	tems) Predic	ctive(system)	Formulation maturity
Data-poor	Data-ric	n Infori	mation-rich	Knowledg	e-rich	Knowledge intensity
'Experts'	Fragme syste		Connected /data sta		Closed-loop design	Knowledge capture
Rules of the	umb Infor	mation-base	ed 'clues' k	(nowledge-bas	sed 'clues'	Problem- solving (shortcuts)



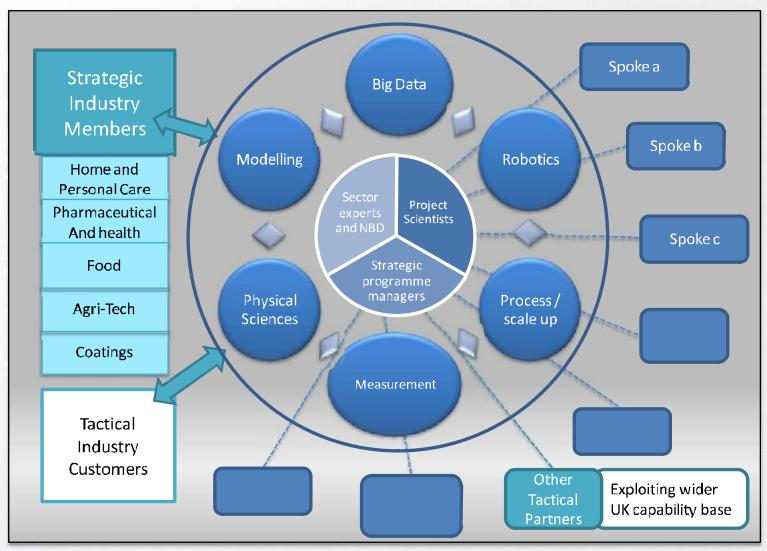
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Enabling UK leadership in a global capability race

Past 2	2014	2017	2020	2025	2030			
coverage	Gaps filled incl. Inferential, non-disruptive, inline Linkages of measured properties & fund. understanding Suite of predictive methods							
'Brute-force' s	creening	'Intelligent' map	oping incl. SARs	Model valida	tion & QC	нт		
Limited exploit	ation En	abling adv. statis	stical design / d	ata mining	??????	Informatics		
Simplified models		ed and time/len			Whole system modelling; in-silico product design	Modelling		
Poor scaling rules; limited		lled in process c		Right first time scale- up; flexible, adaptive,	Process			
process agility	Fund. understanding -> concurrent prod:process design closed-loop							
ragmented QSAF molecules)	Rs	Fragmented QS (sub-systems)	SARs	Whole-system "fundamental	QSARs mxm understanding"	Fund. understandin		



Accelerating Innovation - Hub and spoke model





Bringing the Vision to Life: What Will The Formulation Centre Do?

Vision: A world-leading collaborative industrial innovation centre which will revolutionise the development and manufacture of complex high-value formulated products by embedding fundamental understanding into new predictive methods for product and process design.

Grand Challenges: Radical products, speed, flexibility, true predictivity Radical Formulated Product Design

Designing The Right Product Right, First Time

Radical Formulation <u>Process</u> Design Making The Right Product Right, First Time

Formulation for Delivery and Performance

Predictive Product Design to Maximise Product Benefits

Formulation for Stable Products and Processes

Predictive Design for Product Stability and Robust Processes

Modelling, Simulation

Formulation for Sustainable Products and Processes

Design for Zero Environmental Impact

Strategic Themes

Example
Programmes
and Projects

Example Capabilities

 Product Design: From Data to Knowledge

 Design of Complex Microstructures

- Designing New Effects and Functionality
- Designing New Product Forms

and Data for Stability

Microstructure Control

Data and for Stability

Knowledge Fundamental Component

Liquid Stability Solid Stability

Hub

 Predictive Scale-Up and Scale Down

& System Understanding

- Robust Quality
 Manufacturing
- · Agile Manufacturing
- Demonstrating 21st
 Century Manufacturing

- Enabling Sustainable Raw Materials
- Sustainable Manufacturing Processes
- Maximum Efficacy from Minimum Product
- Minimum Water Footprint, Minimum VOC
- Maximising Recovery and Re-Use



The USP

- Unique cross-sector collaboration hub to enable best practice to be exchanged across industries – benefits from academic and industry expertise.
- Centre takes companies on a strategic journey to achieve goals
 which would be too long-term and complex to do on their own.
 Timelines up to 10 years, compared to companies <5year horizons.
- Model enables leverage (public and private) allowing ~7x the project to be done for the same money, or to get otherwise unfundable projects through a stage gate process.



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The Hub v1.0



Initial focus:

- Brains > New Kit
- Fill 'Data and Knowledge management' capability gap
- Central mgt team
- Location tbc



Technology Strategy Board Driving Innovation

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E-Science for the National Formulation Centre

Efficient Data Capture: A consistent toolset for experimental data capture, connecting UK formulation centre partners. Utilisation of Electronic Laboratory Notebooks is the first step in the establishment of a national formulation e-Science Infrastructure.

Codifying our knowledge: Establishment of a Structured Information Library which draws data from a suite of data capture tools and connects disparate data into a unified whole to enable data analytics and visualisation.

Predictive Solutioning: A consistent modelling toolset to enable rapid, new insights from data and create new product solutions.



Project 1.1 - Liquids Performance and Stability

Business benefits Radical performance/sustainability profile from 'new' ingredients

Speed to market / robustness with current ingredient base

Vision and follow-on activity (centre & inhouse)

Project

Outputs

'Universal' predictive model - liquid performance



- New systems
- · Failure modes
- Performance parameters

'Universal' predictive model - rheological stability/performance

Product classspecific models (x3)

Mechanistic understanding & predictive models (realworld systems Integrated exp. toolkit (design/process) - liquids

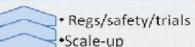


- Other perf.
 parameters
- •Pilot scale
- Automate/HT

Predictive, rapid ageing tests - demonstration

Characterisation best practice

Experimental tools/ methods Radical product innovations in market



• Cross sector

Bio-derived/simplified rheology control systems - tech demo

Yr 5-

10

Yr 3

Yr 0-2

Proof of principle

Ingredient / products innovations



The Centre in Numbers

- Tiered industry membership model
 - > Tier I @ 250K per year; Tier II @ 20-50K per year; cash or in-kind
- People
 - > 27 FTEs; approx. 8 secondees from industry and academia
- Budget
 - ➤ £50m overall investment (2015 2020); ~50:50 Public:Private
 - > Targeting initial public contribution ~£19m
 - > Projected spend profile: 20% capital, 80% revenue
- UK Business Benefit
 - > Direct return of ~£300m GVA; 'projects specific'; 2015 2025
 - > Anchor & grow £180bn UK industry; 'exploiting global leadership'; 2020+



Recent Developments / Next Steps

- Secured 'ownership' from senior leaders in TSB/Catapult, BIS
 - Shared vision for the centre to be delivered by CPI as part of the HVM Catapult
- Centre also a flagship programme in the Chemical Growth Strategy
 - Co-chairs Neil Carson (CEO, Johnson Matthey)
 Michael Fallon (Business Minister)
 - Centre is also a priority for the parallel 'UK Pharma Manufacturing' initiative
- TSB/BIS Bid for £19m set-up funding in 2014 Autumn Statement (Oct)
 - Follows unsuccessful spring budget bid



The journey so far

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May 2012 July 2012 March 2013 2015 Special Strategy, community, recommendations Manufacturing strategy · Centre business plan Interest TSB High Value · Projects pipeline Group Scope for TSB CR&D competition Innovation projects £6m Collaborative New products/processes **R&D** competition Step-change innovation · Cross-sector, supply chain Capability building £50m and Biz plan Open for Formulation access published business • Cross-Centre sector, industry-led · De-risking innovation Technology Strategy Board