# Food Formulation: Ideas From The World Outside

**Jim Bullock**

**Director**

**iFormulate Ltd**

Image jscreationzs at freedigitalphotos.net

# A Little About Us

**A new company (2012) founded by two experienced industry professionals**

Combining diverse experiences, knowledge and wide range of contacts:

**…*polymers*, materials science, *chemistry*, imaging, *dyes*, pigments, *emulsion polymerisation*, biocides, *anti-counterfeiting*, environmental, *formulation*, consultancy, *marketing*, business development, *strategy*, regulatory, *training*, events, *R&D*, innovation…**

We work with clients ***large and small*** across different industries which use **formulation technology**

We help clients by providing and developing **new ideas**, helping commercialise **technologies**, project building, **consultancy**, workshops, contacts and **training**.

**…*pharma*, food, *cosmetics*, detergents and cleaners, *coatings*, inks, *agrochemicals*, disinfection etc…**

Benefit from **translation opportunities** from one industry to another → **Open Innovation Roadshows**

**Working in support of major UK national initiatives in** *formulation science and technology*.

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# Who Formulates?

- Pharmaceuticals
- Cosmetics
- Detergents and Cleaners
- Paints, Adhesives, Sealants
- Pesticides and Antimicrobials
- Lubricants
- Process Chemicals
- …Food and Nutrition


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# What Do They Formulate?

Tablets
Capsules
Granules
Powders
Gels
Emulsions
Suspensions
Creams
Lotions


Carlos Porto / FreeDigitalPhotos.net


Image: akeeris / FreeDigitalPhotos.net


Image: **graur razvan ionut** / FreeDigitalPhotos.net


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# Why Do They Formulate?

- Performance and Claims
- Availability in Application
- Quality Standard
- Product Stability
- Cost
- Manufacturability
- Regulatory Requirements



Image: Pixomar / FreeDigitalPhotos.net


stuart miles freedigitalphotos.net

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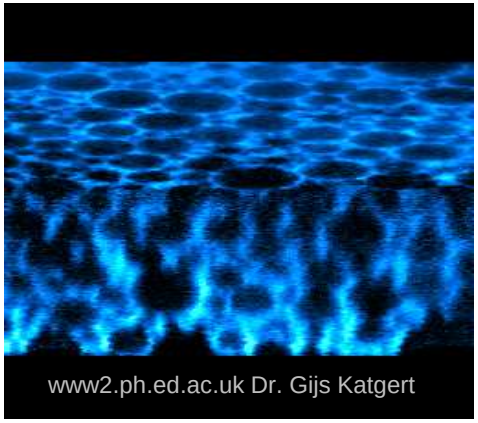
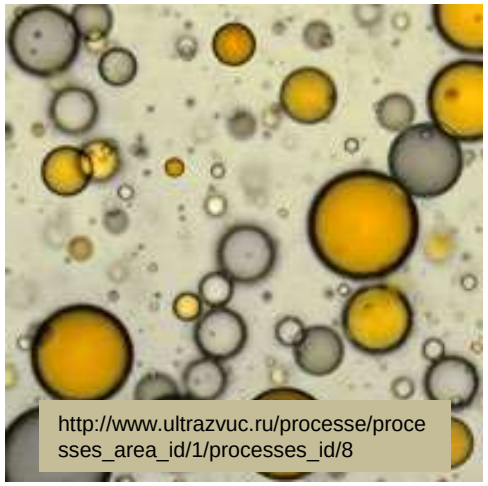
# What Have Formulated Products Got In Common?

- Multiple Ingredients
- Multiple Phases
- Complex Microstructure
- Microstructure Determines Properties as Much as Ingredients
- Particles, Droplets
- Surfaces and Interfaces
- Encapsulation, Release and Delivery



www2.ph.ed.ac.uk Dr. Gijs Katgert



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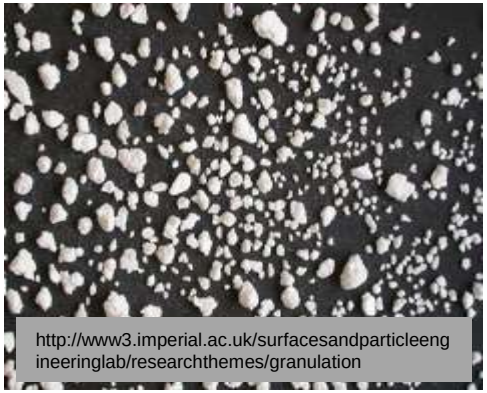
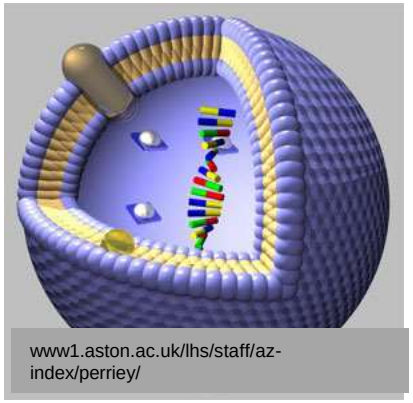


http://www3.imperial.ac.uk/surfacesandparticleengineeringlab/researchthemes/granulation



www1.aston.ac.uk/lhs/staff/az-index/perriey/

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# Formulation: Opportunities to Translate Ideas *Across* Industries

**Formulation technology used in many industries**

- Food, cosmetics, pharma, pesticides, coatings, inks, detergents etc.
- Complex products: Multiple ingredients and phases.
- Importance of controlling and measuring product microstructure
- Particles, emulsions, dispersions, gels, microcapsules

**But historically, a low tendency to look outside own industry**

- Formulation is learned empirically within companies and industries

**In formulation, ask yourself the questions**

- Who outside your industry might have a similar challenge?
- How have they tackled the challenge?

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# Formulation: What Is It Used For In Other Industries?

**Making active substance more *soluble / more bio-available***

- Many new pharma actives are low solubility / low availability

**Stabilising active substance from *chemical or physical degradation* during product storage or use**

- Especially for “biopharma” actives (peptides, proteins) - oral delivery not normally possible

***Improving delivery* of active substance**

- Agrochemical “adjuvants” to enhance coverage and penetration of leaf

***Controlling the release* of a substance**

- Slow release of agrochemical pesticides over time
- Delay release of pharma active until right part of GI tract

***Making actives compatible* with rest of formulation**

- Emulsification of oil soluble ingredients in cosmetics

***Taste masking* in pharmaceutical formulations**

***Photostabilisation* of pharma formulations**

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# Formulation Example: Lipsomes – Use in Drug Delivery

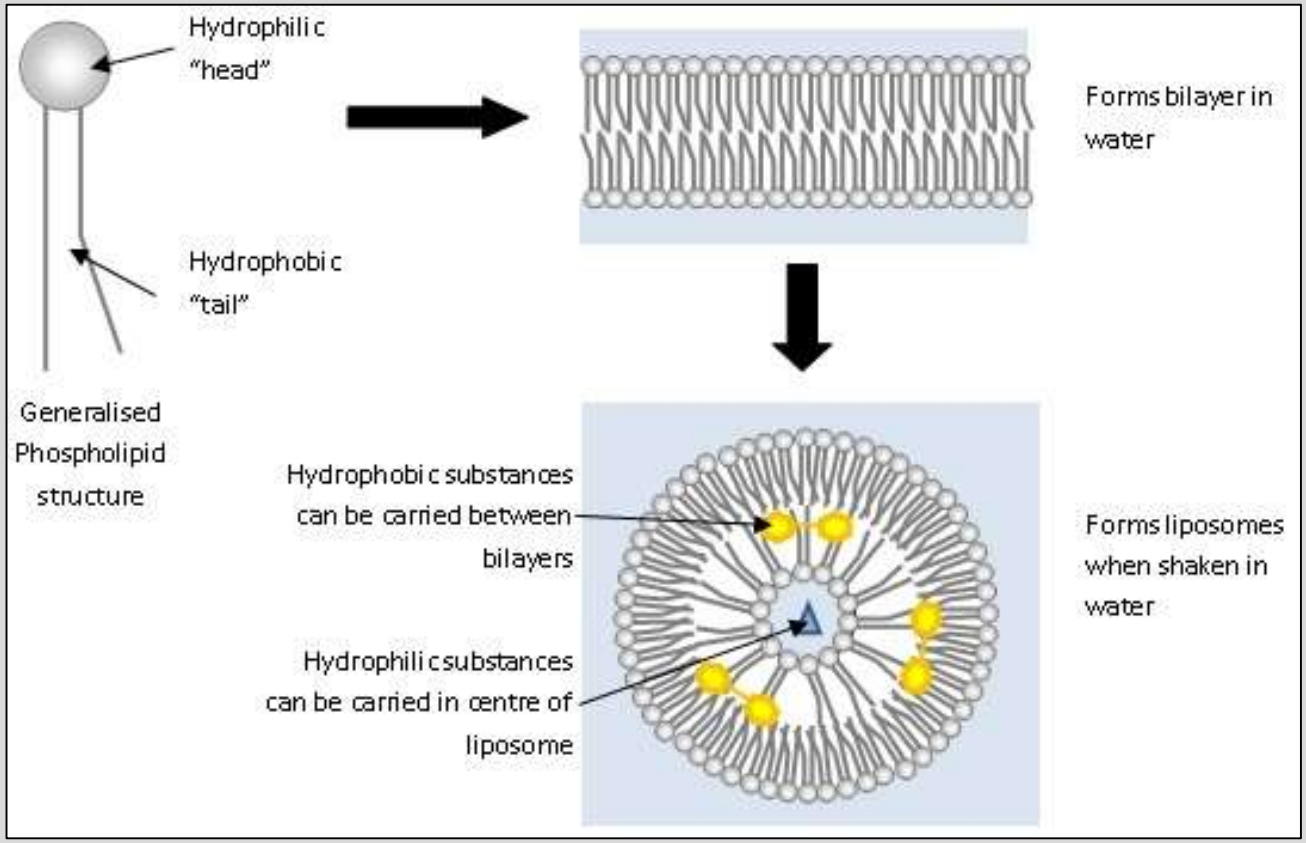
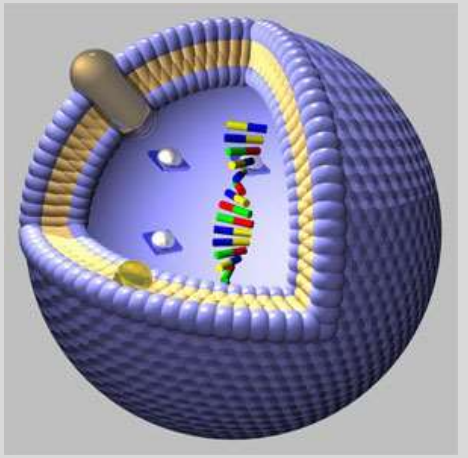



Image: http://www.di.uq.edu.au/proj5background (University of Queensland )



Yvonne Perrie, Aston Univ:
Phospholipid based liposomes for oral vaccine delivery
www1.aston.ac.uk/lhs/staff/az-index/perriey/

Aston University
Life & Health Sciences

vbi

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# Formulation Example: Lipsomes – Use in Drug Delivery

**Lipsomes can enable delivery through barriers due to incorporation of phospholipids**

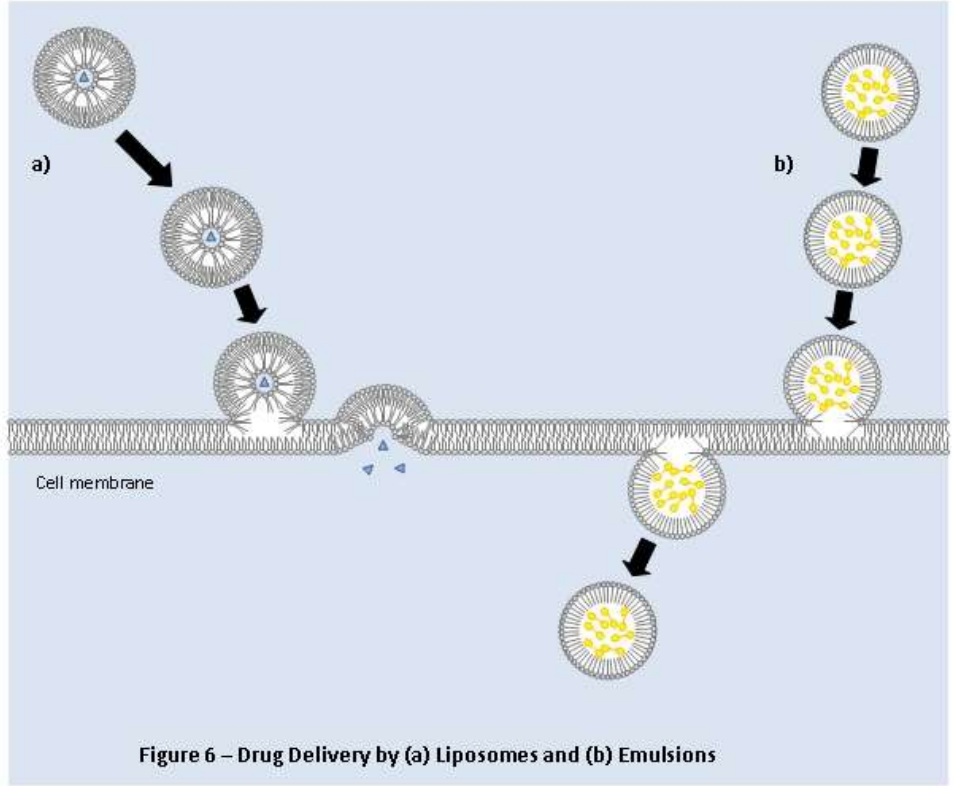


Figure 6 – Drug Delivery by (a) Liposomes and (b) Emulsions

Image: http://www.di.uq.edu.au/proj5background (University of Queensland )

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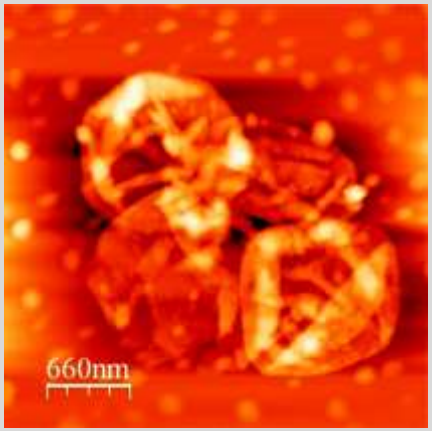
# Formulation Example: Core Shell and Controlled Release



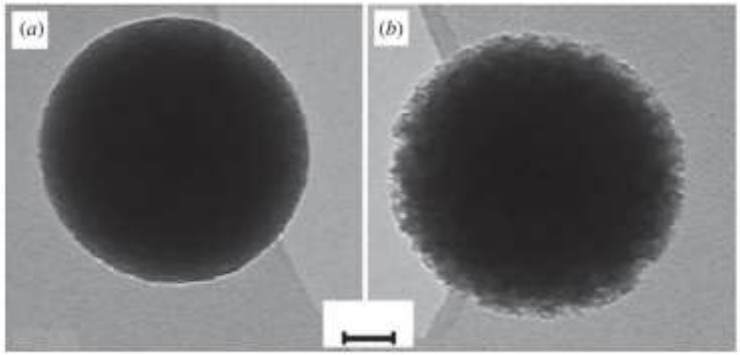




Figure 9. (*a*) TEM image of a 250 nm silica particle coated with a 50qPDMA-PDEA micelle monolayer. (*b*) A single 250 nm silica particle following deposition of four alternating 50qPDMA-PDEA and PDEA-PMAA micelle layers. Scale bar, 50 nm.

Addison et al, *Phil. Trans. R. Soc. A* (2010) **368**, 4293–4311

**Block co-polymer micelles deposited on latex or silica particles**

- Stable to laundry wash cycles
- pH triggerable release of actives?

"It has been shown that **block copolymer micelles** can selectively encapsulate and release hydrophobic materials; therefore, the incorporation of such responsive species within films has the potential to offer increased functionality. "

Addison, Cayre, Biggs, Armes & York: *Langmuir*, 2008, *24* (23), pp 13328–13333
*Phil. Trans. R. Soc. A* (2010) **368**, 4293–4311

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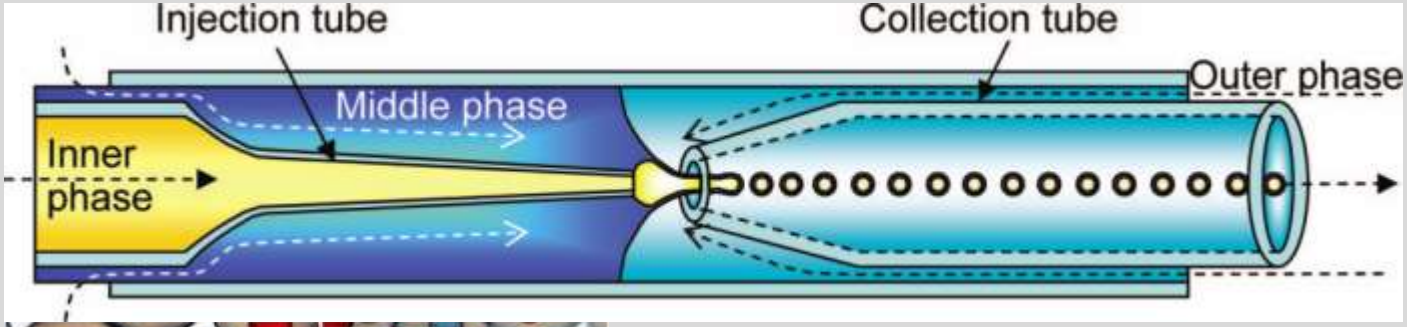
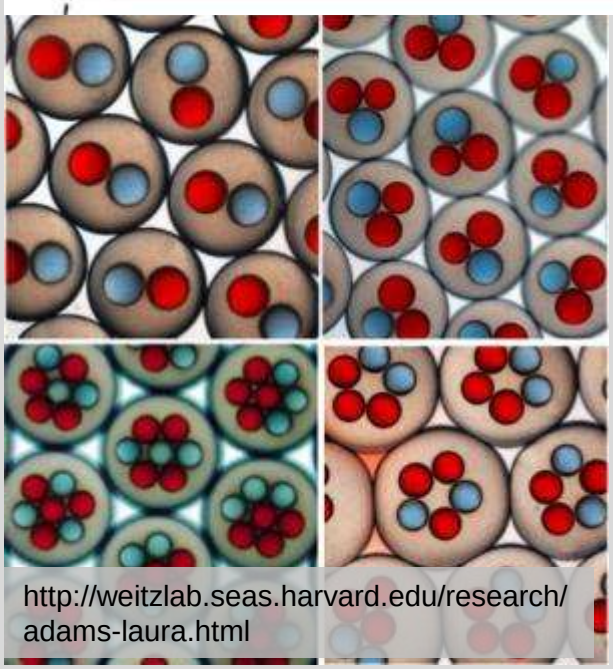
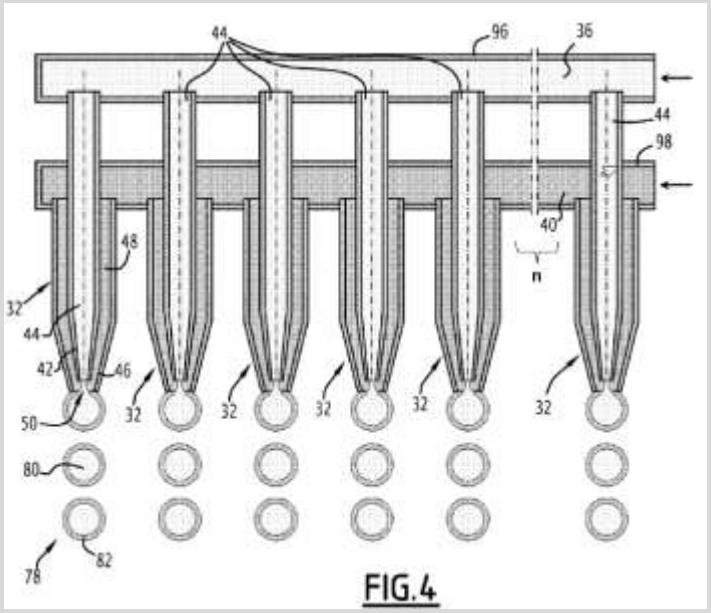
# Formulation Example:
# Polymersomes: Complex Uniform Capsules Drop-by-Drop




Shum, Kim and Weitz, J. Am. Chem. Soc. 2008, *130, 9543–9549*



http://weitzlab.seas.harvard.edu/research/adams-laura.html




www.capsum.eu

NeoShell™
Beautiful polymersome

Hydrophilic actives
Copolymer di-block bio compatible

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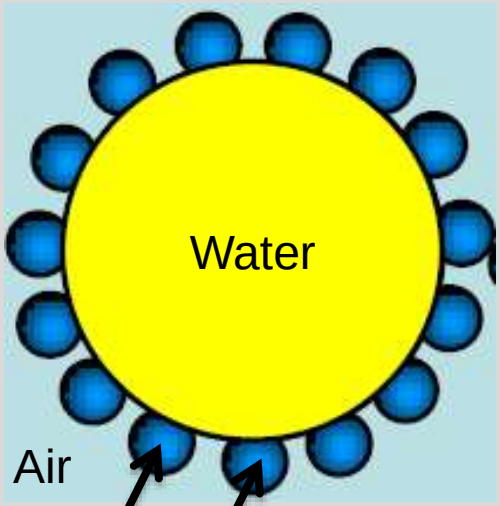
# Micro- to Macroencapsulation Example: “Dry Water” - Particles Stabilising Droplets


Hydrophobic silica particles


Prof. Bernie Binks, Univ. Hull
http://scg-hull.theory-sfb569.org/impact-of-our-research/

UNIVERSITY OF Hull

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# How Could Ideas Be Translated Across Industries?

- **Open Innovation** is a growing trend
  - e.g. HPC, Food…
- Making use of ideas, expertise and technologies from **outside your organisation**
- **Benefits:**
  - More ideas
  - Better ideas
  - Faster development
  - Risk sharing

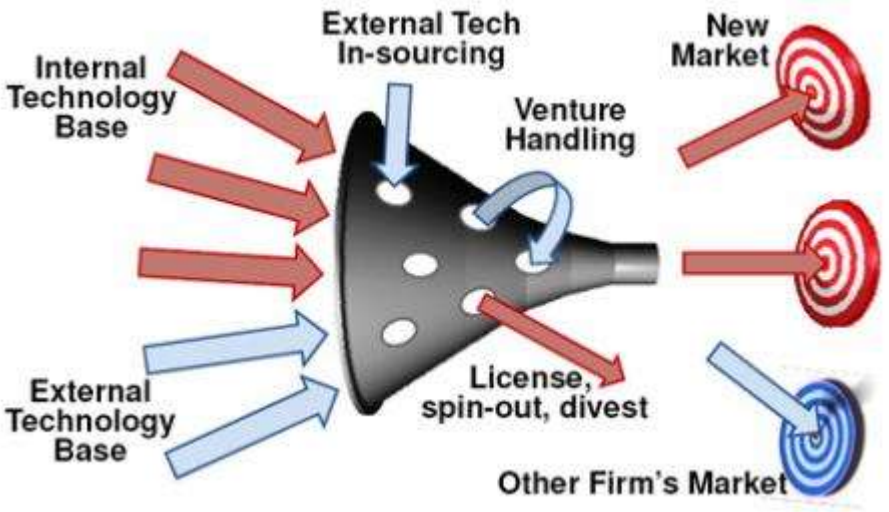


Image: www.chemicalsnorthwest.org.uk after Chesbrough

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# How Could Ideas Be Translated Across Industries?

**Some Pitfalls of Open Innovation model**

- Concerns on IP and secrecy – how open can it be?
- Disparity in stakes, size, objectives, approach of partners
  - Typical model is large multinational seeking new technologies from (small) technology providers
  - What is “life or death” for the small provider might be “just another interesting project” for the multinational
- How to build trust?

Images: David Castillo Dominici at freedigitalphotos.net

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# How Could We Avoid the Pitfalls of Open Innovation?

**Sharing Challenges**

- Each party must contribute and benefit in equal measure
- Each party is risking the same

**Parties from non-competing industries**

- Participants with common challenges
- No interest in IP for other industries
- Make ground rules clear

**Trust**

- Take time to get to know your opposite numbers and understand their businesses

Image: jscreationzs at freedigitalphotos.net

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# How We Made It Happen

**iFormulate: Open Innovation Roadshows in Formulation 2012-2013**

**Invitation only workshops**


**Four participant companies**

- Multinationals with depth in science and engineering
- Could work with smaller companies - need to be comparable and compatible – parity is important

**Four different industries – not competing**

- Food
- Pharmaceuticals
- Crop Protection
- Home and Personal Care

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# How We Made It Happen

## iFormulate: Open Innovation Roadshows in Formulation 2012-2013

**iFormulate developed format with companies**

- No NDAs at this stage. Use “Chatham House Rule”.
- Each company acts as host in turn – attendees from other companies
- Host sets (technical) challenges relevant to their businesses
- Small group sessions enable idea and experience exchange
- Develop areas of common interest for collaboration

**But it’s not just about the purely technical**

- Host provides dinner for attendees – building trust, networking.
- Scene-setting keynote presentation from host side – business – the big picture
- Opportunities for lab / plant visits during day

“When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.” http://www.chathamhouse.org

Image: piyato at freedigitalphotos.net

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# iFormulate: Open Innovation Roadshows in Formulation 2012-2013

**Outcomes of first round**

- 108 “attendances” at four workshops over 11 months
- Mainly R&D scientists and engineers, but also commercial, supply chain, manufacturing and OI practitioners.
- 15 company challenges worked on
  - Varied topics including stabilisation, formulation microstructure, delivery, formulation processing and manufacturing, end-user experience
  - Experience sharing, contact sharing
  - Idea generation
  - Follow up options suggested
- Six concrete project areas defined for potential collaborative projects to be worked up
- Countless 1:1 discussions and several “offline” meetings” between participant companies.
- Provisional plan to repeat as concentrated annual event or to bring in additional companies

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# iFormulate: Open Innovation Roadshows in Formulation

**Observations and Some Surprises**

- Participant companies need to be committed and have a named “leader” for the Roadshows.
- Selection of topics and participants managed carefully before Roadshow event.
- Seen as highly effective (and cost effective) by participant companies.
  - High degree of openness and trust demonstrated
- Beneficial technical exchange between specialists was expected
  - but companies also used Roadshows as a development opportunity for less experienced employees
  - Roadshows also enhanced communication within companies
- Discussions much more wide ranging than expected
  - Customer experience, regulations, manufacturing, supply chain…as well as R&D.

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# iFormulate: Open Innovation Roadshows in Formulation

**How could you benefit?**

- Bring in **new ideas and technologies** to your business
- Help **solve** intractable **problems**
- Build **collaborative projects**: “A problem shared”
- Get **fresh insights** from other industries
- Build corporate and personal **networks**: “Phone a friend”

**How to get involved**

- iFormulate is now canvassing company interest for second round
- Could be completely new set of companies or involve some participants from first round
- Potential for smaller company consortium
- Could move outside original “formulation” brief” depending on company needs

Images: stockimages at freedigitalphotos.net

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# Other Ways We Can Help You

**Technology Scouting Assignments**

- "we need some new ideas for our development programme"
- "we want to know about the pros and cons of technology x, and who we should talk to"

**Problem solving assignments**

- "we want some help solving a problem with our formulation"
- "we want some help developing a new formulation"

**Training in Formulation**

- Custom "in-house" training designed with client
- Open training courses

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# Conclusion

Other industries and applications may be **facing the same challenge** as you

Understand their challenges and **look at their approaches and solutions**

Formulation has a **“universal language”**

- Colloids, particles, dispersions, emulsions, encapsulation…
- …and the manufacturing technologies too

Adapt and perfect…and think about **our OI Roadshow option**

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# Thank You!

## And a Quick Plug for some Forthcoming Courses:

**Solid State Stability of Formulations: *The Underlying Science and New Approaches For Rapid Determination***

One-Day Training Course, UK - Nottingham/East Midlands – May 8th 2013

**iFormulate*4Nano*: Formulating Nanoparticles**

One-Day Training Course, UK- Manchester – June 18th - in collaboration with the NanoFormulation2013 Conference

**See www.iformulate.biz or e-mail info@iformulate.biz for details.**


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