The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific
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Economic Development for Physicists from Developing Countries

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SPIN-OUT AND SME'S

Peter Dobson
Director, Begbrook Science Park, Oxford

Spin-Out and SMEs

Professor Peter Dobson

Oxford University Begbroke Science Park

Trieste 27th November 2006

Outline

- What are SMEs?
- Why we need to “spin out”
- The Innovation process
- How a spin-out system works in Oxford
- Examples from Oxford
- Can this be applied generally

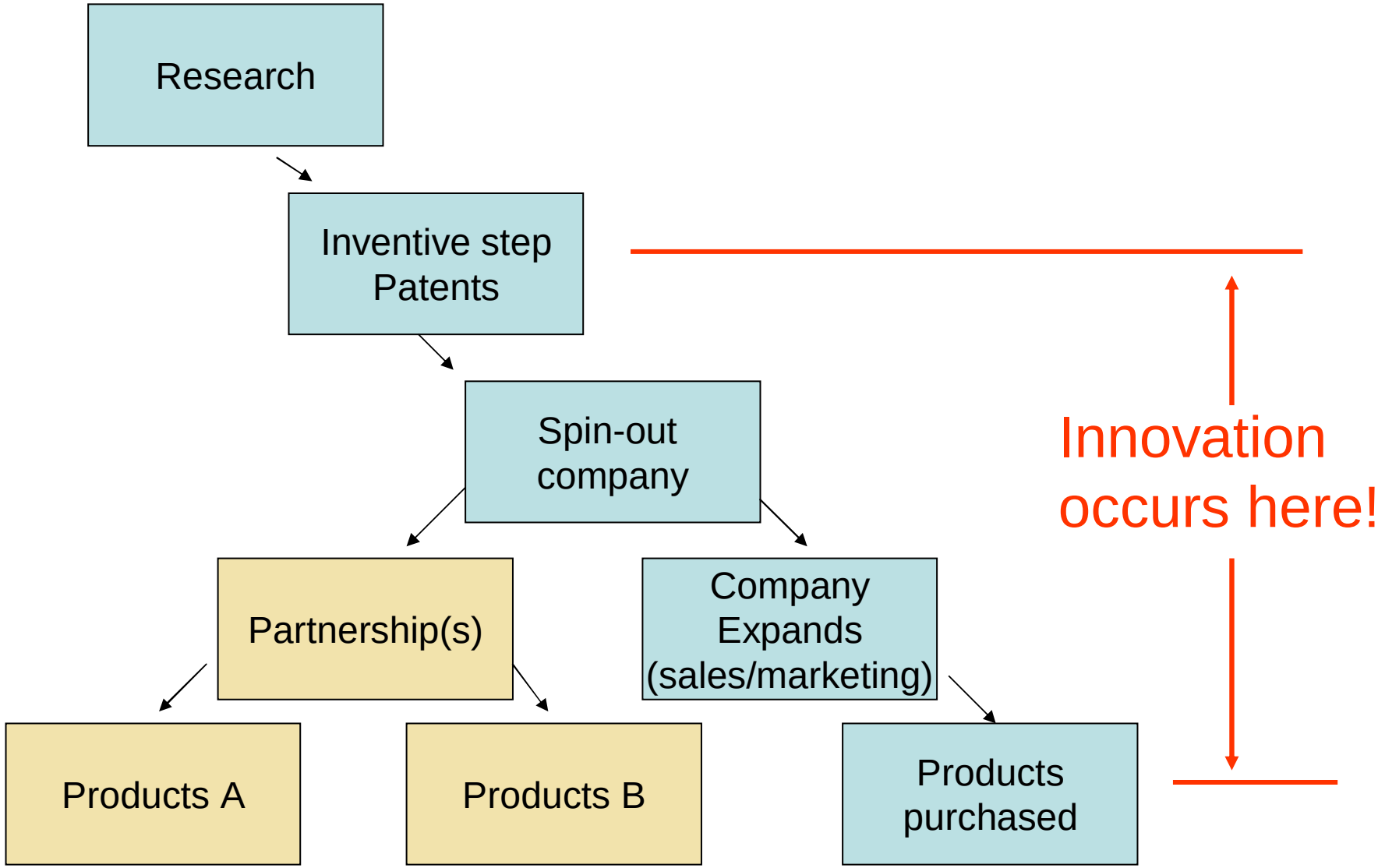
Spin-out and SMEs

- “Spin-out” means to take and idea (usually) arising from research and build a business or revenue stream
- SME is the term used to describe Small/Medium Enterprise to distinguish such a company from the larger corporations

Why Spin-out?

- Why not simply license the idea or technology to someone or an existing company?
- Spin-out does give more control and the possibility of real wealth creation
- New (local) jobs are created, a new skill base can be developed

The Innovation chain



What is Innovation?

- Invention happens and IP is created, Patents filed etc…
- The IP has to be converted into a business or a product: this is the innovative step.
- Managing innovation is a new and poorly understood topic.
- We introduced Enterprise Fellowships to do this

Enterprise Fellowships

- Industrial Research Fellow

  exploit recent research by post-grads/docs
- Business Development Fellow

  assist Isis Innovation team with the above, with help from Said Business School
- Knowledge Transfer Fellow

  work with Continuing Professional Development unit to develop new modular courses in topical key areas.

2003/4/5 Enterprise Fellows

- Terry Sachlos: Formed TEOX Ltd, Synthetic bone structures
- Tiancun Xiao: Formed Oxford Catalysts plc, novel low Temp catalysts
- John Topping: Formed MFN Ltd, thermal control layers
- Cathy Hua Ye: Artificial tissue,now at Imperial College
- Stephen Bell: Artificial flavours & fragrances, license deal 2006
- Jamie Patterson: Novel imaging techniques, company just formed
- Tim Rayment: several patents then joined a company
- Wolfgang Denzer: formed Oxford Medical Diagnostics Ltd
- Chris Padbury: filed patents, now works for TTP, Cambridge
- John Laczik: formed a diffractive optical element company

2003/4/5 Enterprise Fellows

- Terry Pollard: assisted several industrial fellows, now at Isis.
- Liz Kirby: based in Isis and developed courses on IP, now at Reading KT office
- Andrea Mica: worked with Isis now with IP Group
- Giles Dudley: Business development with Isis Innovation, now at Edinburgh University Innovation

Stuart Wilkinson: NanoBasics and NanoCert courses, based at Begbroke

Jenny Knapp: ClimateBasics and other courses, now at Bristol Univ tech transfer.

Simon Nee: GRID-service course, now in banking..

Two distinct approaches
Technology push vs Market Pull

- Take a particular technology
- Find new things that the technology enables
- Try to sell these

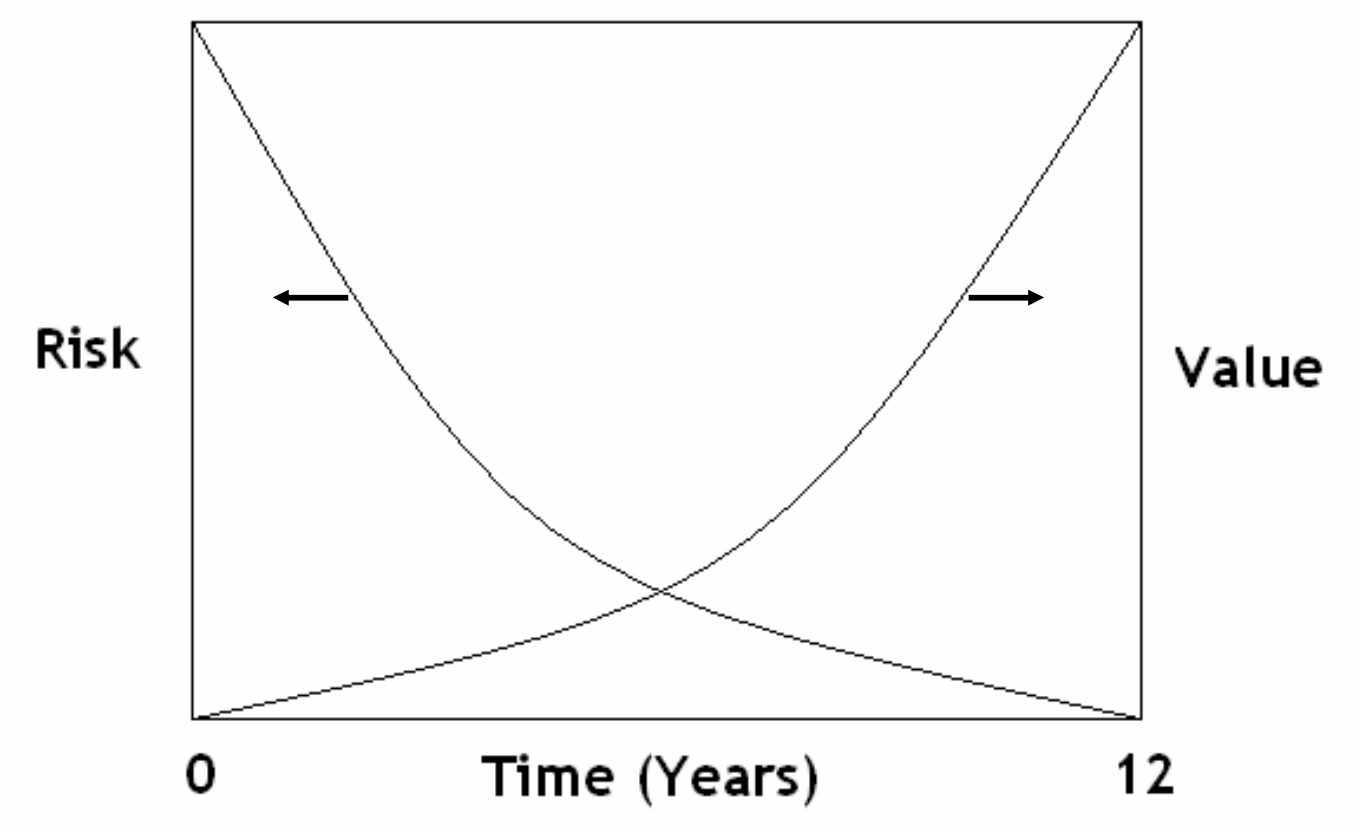
This is high risk and could be “disruptive”.

- Identify a market need
- Provide a solution to satisfy the need.

  This might use several technologies
- Sell

This approach is lower risk

Time Gap in the Innovation



Can we quantitatively predict these curves and determine investment profile?

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Science and Technology
The time gap

There is a time lapse between first scientific publications and commercialisation

Transistors (10 years)
Liquid Crystal Displays (12+ years)
Tungsten filament light bulbs (10 years)
Semiconductor lasers (12+ years)
Enzyme-based glucose biosensor (10 years)

Why this time lapse? What goes on during this period?

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What goes on in the “Time Gap”

- Patents filed and substantiated
- Market assessment to establish a business case
- If a business case can be made: process and production issues addressed
- “scale up” may pose problems, and the real costs will emerge
- Market may change for better or worse!

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The Time Gap

- Development takes longer than you think! It also costs around 10x research costs
- Is there a market/business to be had?

  Too many scientists ignore this
- Manufacture is capital intensive and it takes time.

  The skills are completely different from scientific research

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The Time Gap
Can it be shortened?

- Money needs to be available for the risky development stage.

  This must come initially from Govt.
- The risks and market dynamics need to be understood (and controlled).

  A role for Business Schools (and Banks?)
- A new “culture” of entrepreneurism and acceptance of this needs to be instilled.

  Education at all levels

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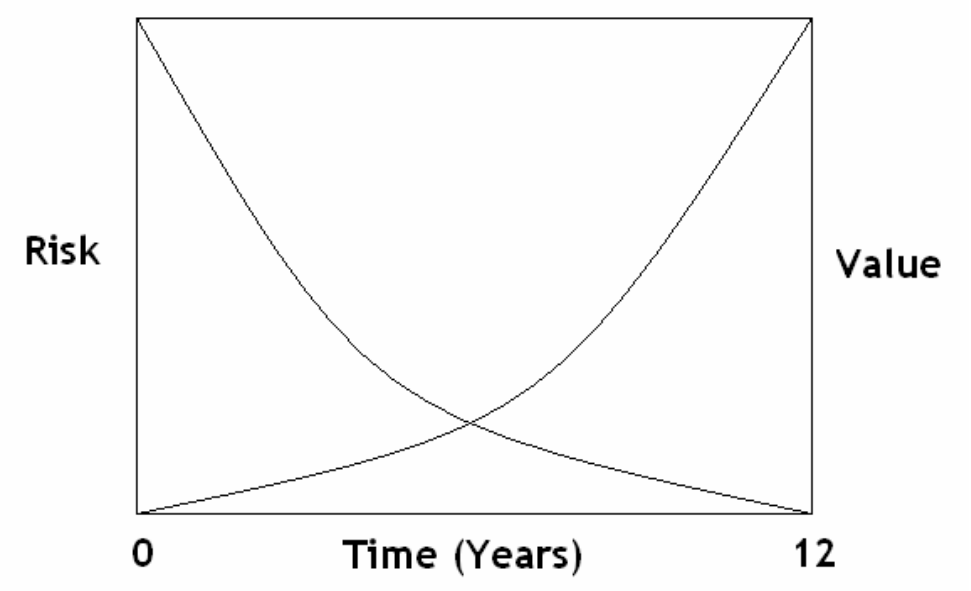
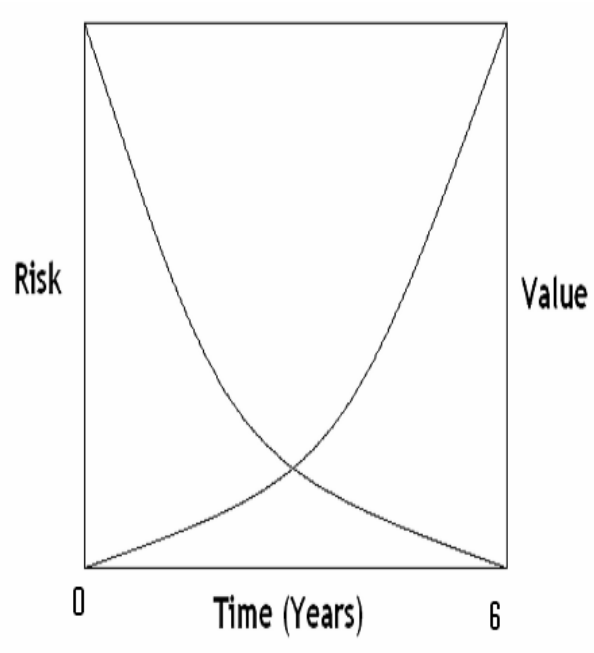
Can we shrink the timescale?



Form partnerships with other companies

Use toll manufacturing

Use other sales/marketing



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Typical Cost/Time Profile of a Spin-Off

- University research phase £120K, 2 years
- £1M start-up funds, 2 years with milestones
- £5M-£10M over ~3 years with milestones

- Discovery, invention, IP filed, some market info. Find a future CEO
- Acquire premises, build team (10-12), equipment, serious market info. Generate IP, retain University contact.
- Move/extend, restructure Board, build team especially sales/marketing and retain University contacts

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Examples of Oxford spin-outs at Begbroke

•Oxonica: formed in 1999, from Engineering Science. Invented nano-phosphors, sunscreens, diesel fuel additives and biotags. Floated on AIM July 2005. cap. £60m

•Oxford Gene Technology: formed in 1995 from Biochemistry, came to site in 2000: gene array technology.

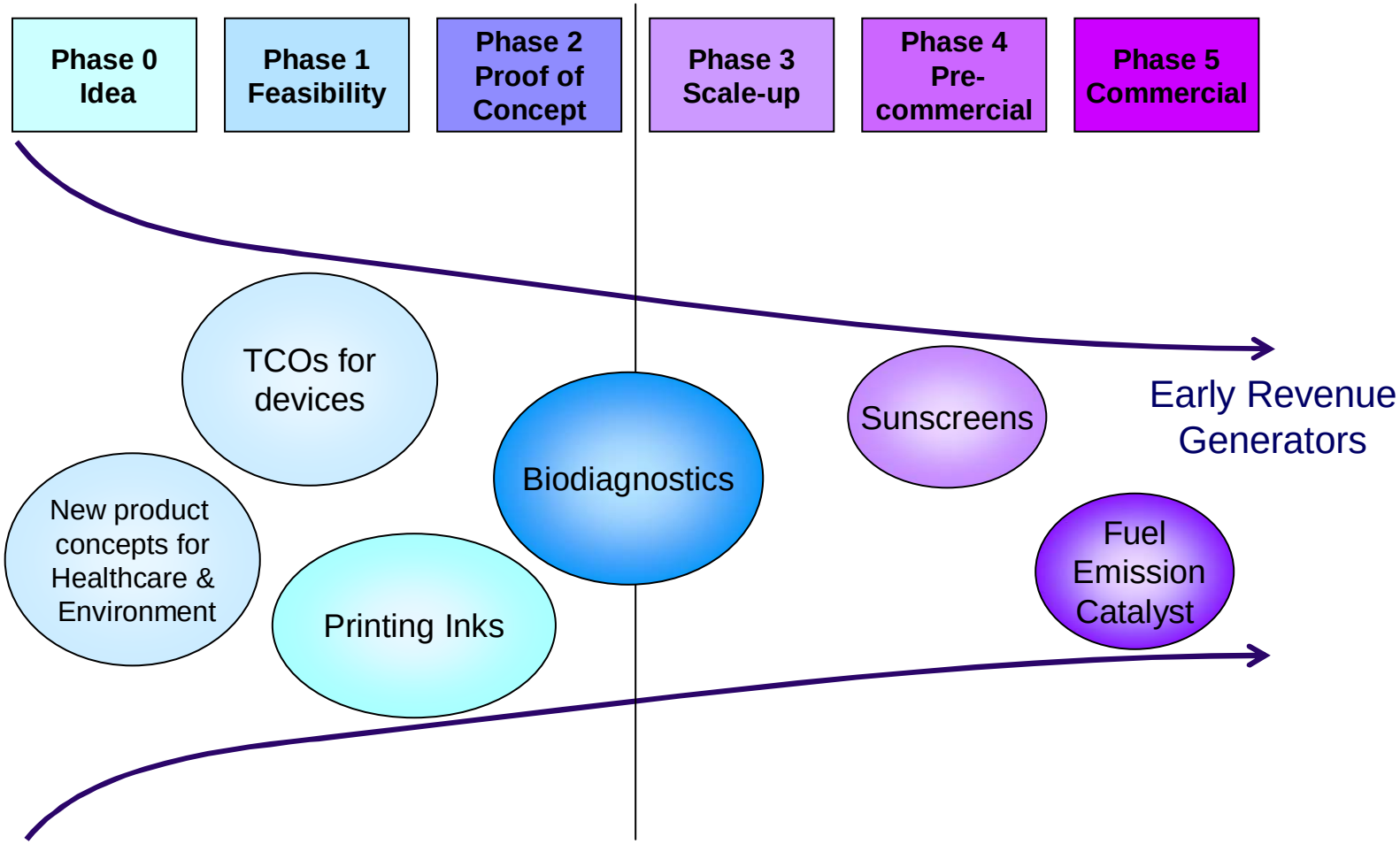
•Oxford Biosensors: formed in 2000 from Engineering Science and Chemistry, makes point of care sensors based on enzyme electrochemistry and microelectrodes. Moved to Yarnton in 2004 to manufacture.

•Hardide: formed in 2000 from Russia, making hard coatings, moved to Bicester

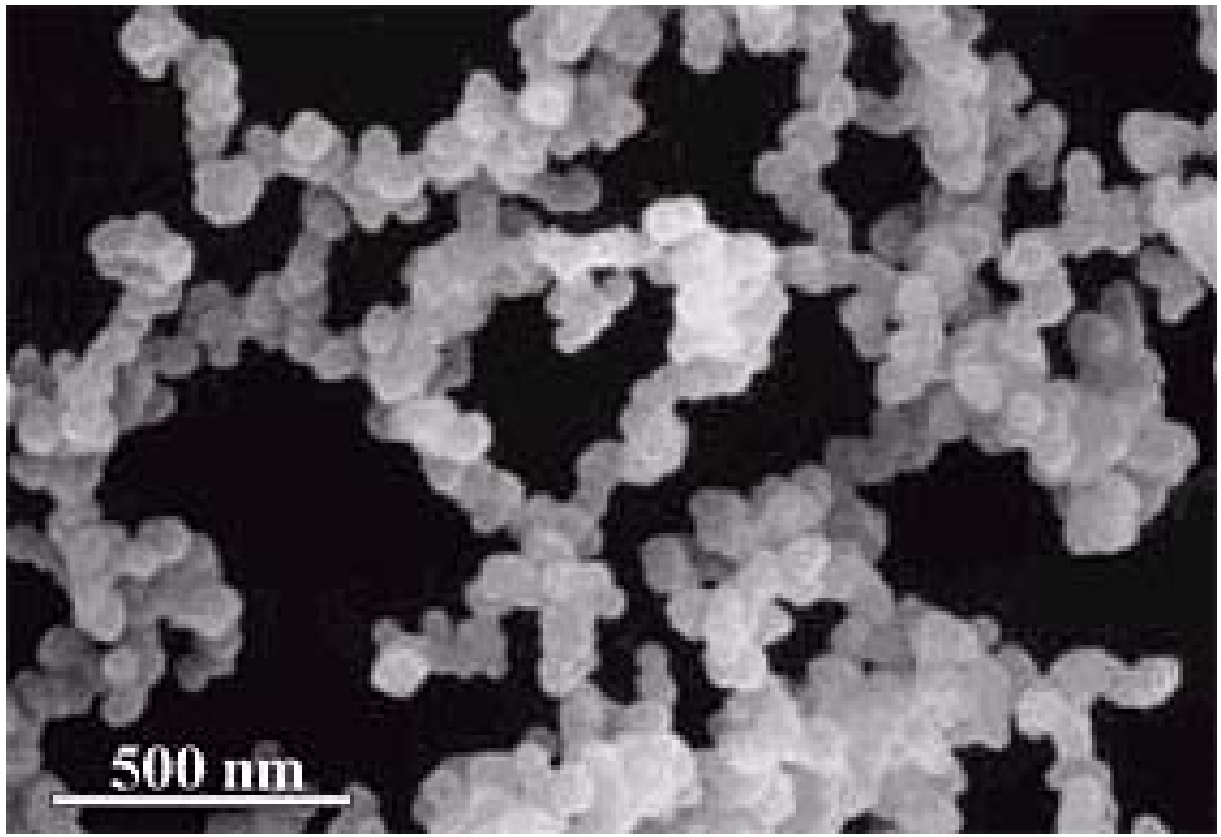
Oxonica plc

- University of Oxford spin-out formed 1999 after 7 years background research
- Focus on Energy, Environment and Healthcare
- “Solution Provider” ethos
- £2.3M from Angels and DTI awards
- £8.2M from Institutional Funding
- Revenue generating from 2002
- Tailoring nanoparticles for customer applications, building revenues based on IP generation
- Floated on AIM 20-7-05, market cap. £35M
- Took over Nanoplex (US) 20-12-05
- ~55 Employees, strong commercial and industrial experience and expanding!

Oxonica product pipeline



Cleaning up diesel exhaust



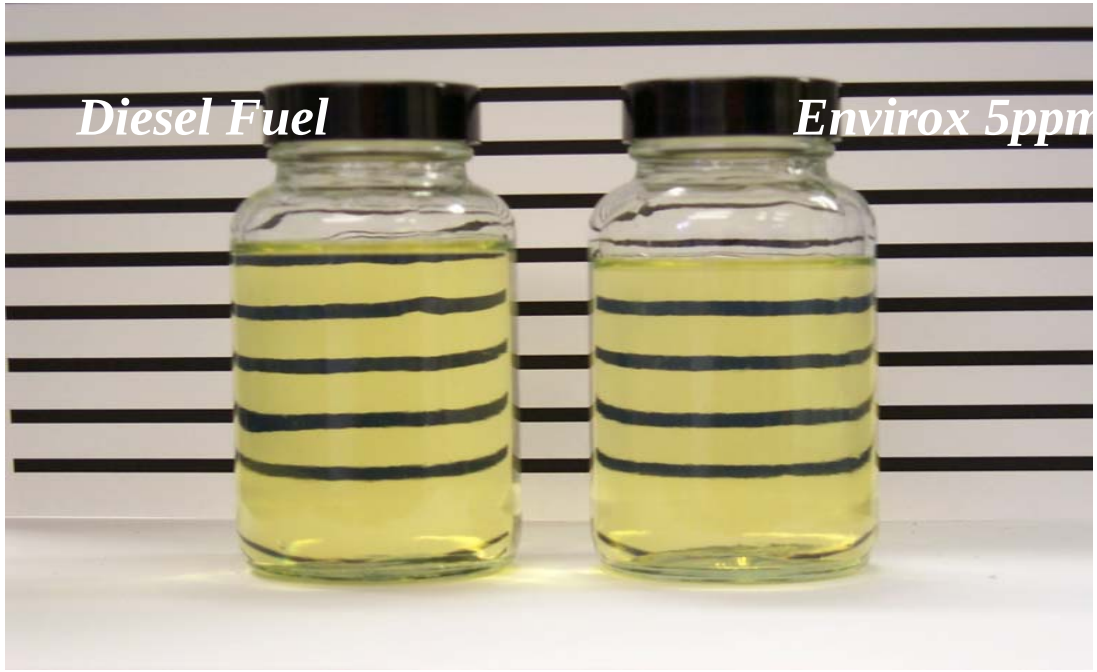
Examples of diesel exhaust particles

Envirox Technology reduces diesel particulates

- **Based on a Cerium Oxide dispersed in hydrocarbon solvent**
  - Fuel-borne additive
- **Nanoscale particle size**
  - Extremely high catalyst surface area
- **Direct addition to diesel fuel:**
  - Fuel-borne catalysis
- **Approx. 5ppm Cerium Oxide**
  - Low application rate – only 1 litre of Envirox to 4000 litres of fuel
  - No engine modifications required

OXONICA

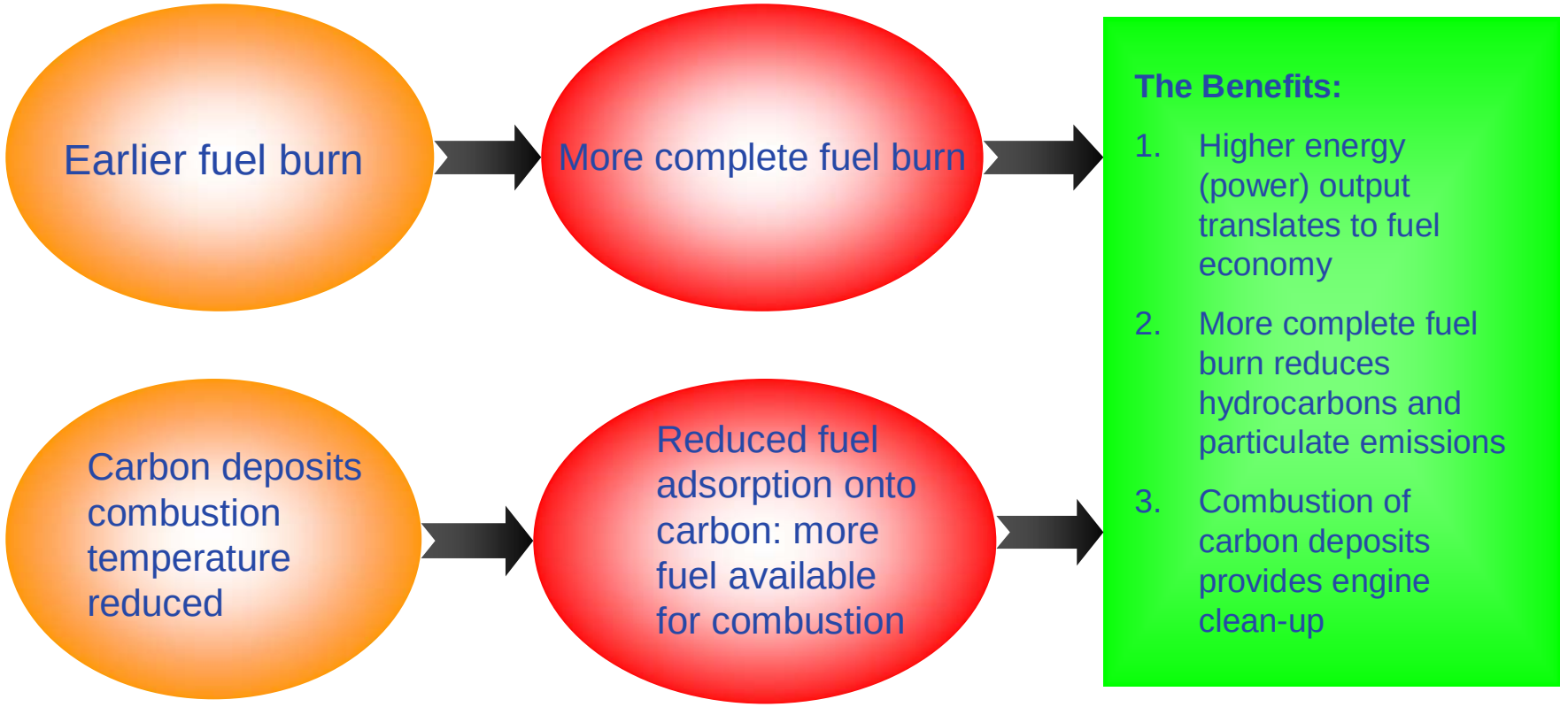
Envirox additive is a stable suspension



Diesel fuel with Envirox 5ppm 10nm particles added. Key point is that fuel must be stable and remain haze free.

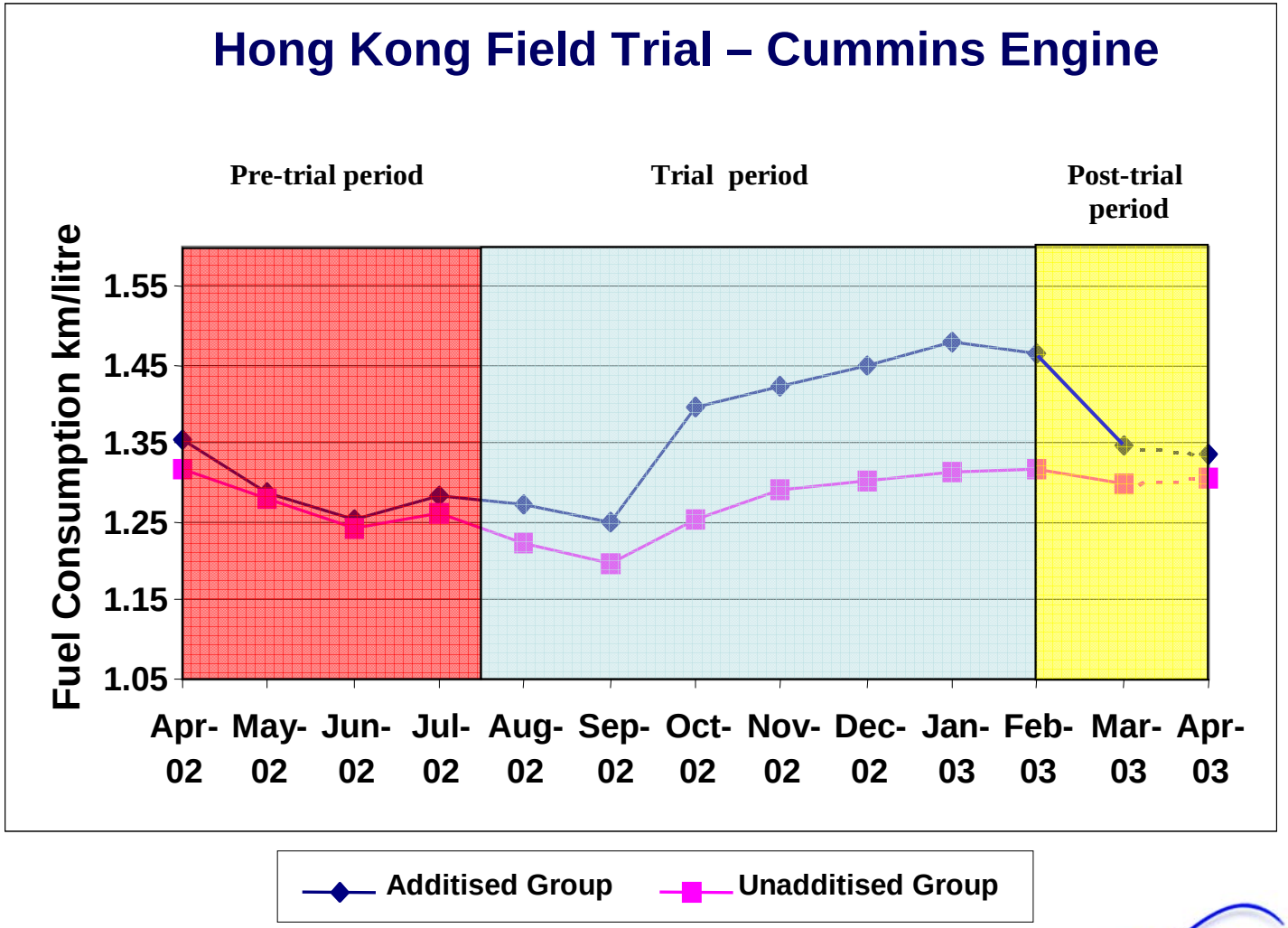
OXONICA

Envirox™: The Process



OXONICA

Envirox™: Fuel Economy Performance



OXONICA

Envirox™: Emissions Reduction

- Tests carried out at a range of independent laboratories

  Immediate reduction of up to 14% in particle and hydrocarbon emissions – may further improve over
  time

- No increase in ultra fine particles emitted

- Potential to enhance Diesel Particulate Filters performance – lower emissions and reduced regeneration temperature

OXONICA

Optisol TM based on nanoparticles of titania

Photostable UV absorption with enhanced UVA protection for skincare & materials applications

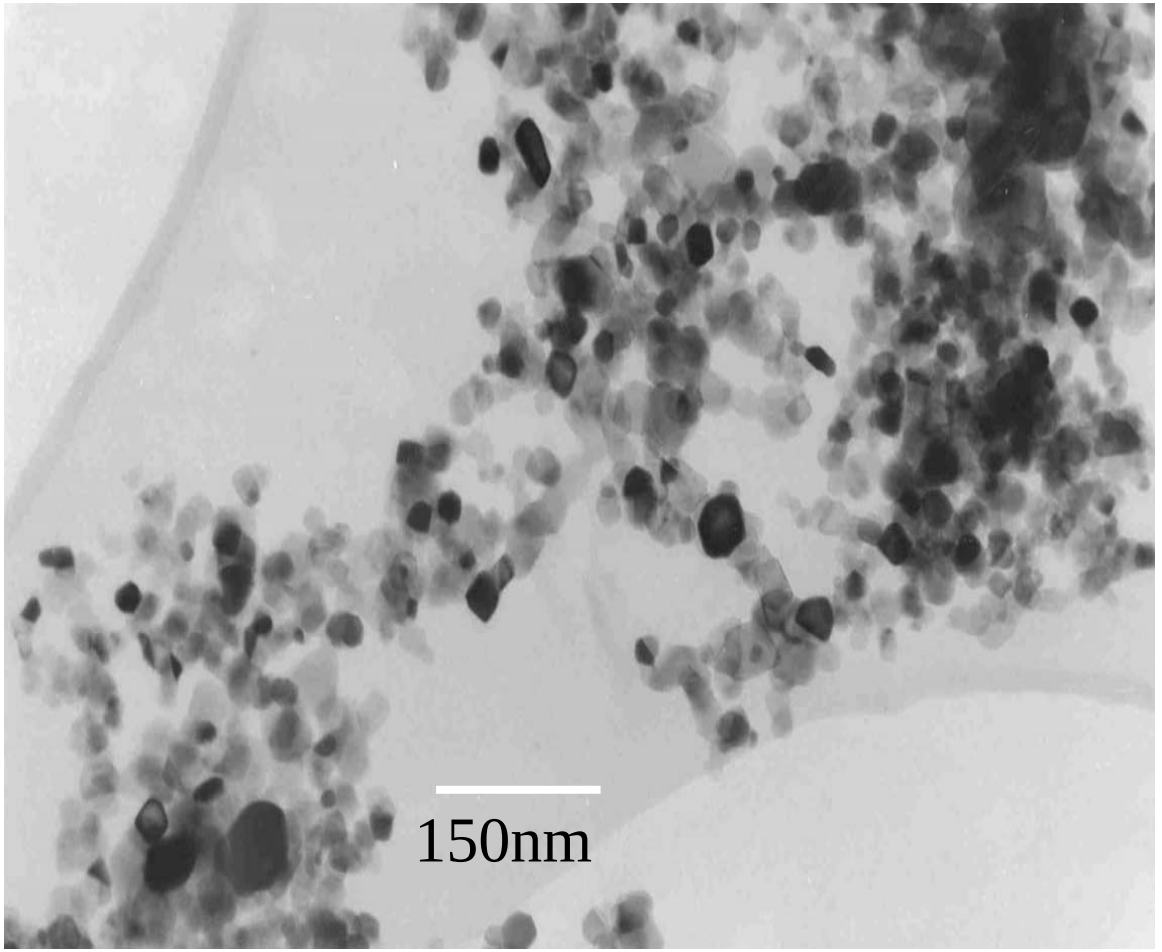
- Safer sunscreens and cosmetics
- Anti-ageing properties
- Skin-lightening applications
- Formulation enhancement
- Extended in-use product lifetime

OXONICA

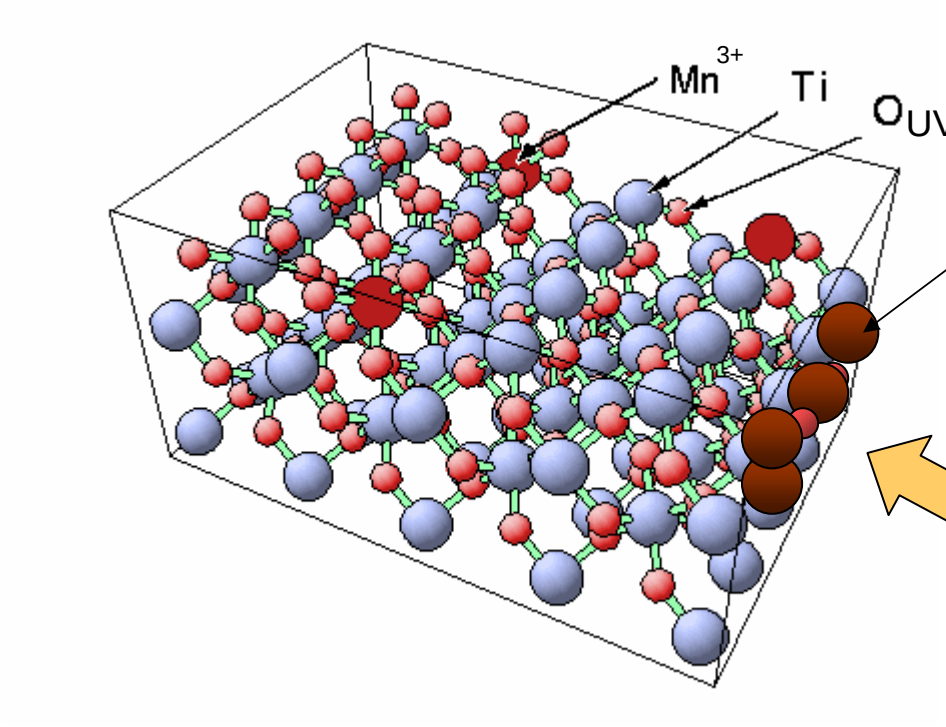
Optisol TM

- Nanoparticles of titania are used so that they appear transparent to visible light on the skin, but block UV
- The titania is doped in a special way so that it does not behave as a photocatalyst (that would cause skin damage)
- The new titania particles prevent the formation of “free radicals” and hence the formulation lasts much longer in sunlight and protects the skin.

Titania sunscreen nanoparticles

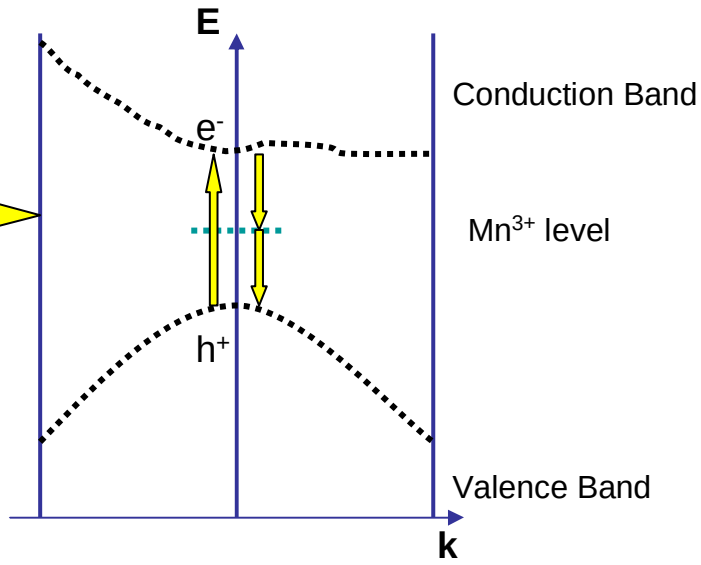


OPTISOL: Mode of action



Rutile $P4_2/mnm$ Titanium Oxide lattice

Schematic band structure



Surface Mn^{2+} free radical scavenging

$Mn^{2+} \Leftrightarrow Mn^{3+} + e^-$

$Mn^{2+} + OH^{\bullet} \Rightarrow Mn^{3+} + OH^-$

$Mn^{3+} + {}^{\bullet}O_2 \Rightarrow Mn^{2+} + O_2$

Optisol TM: Independent performance verification

- Excellent UVA/UVB ratios achieved with Optisol alone:
  - >0.9 in the Boots Star Rating
  - **Optisol meets the new 5 star Boots category consistently over 2 hours after application**
- Superior UVA/UVB ratios demonstrated for Optisol mixed with Avobenzone compared to undoped TiO_2

Source: Skinnovation

OXONICA

Oxonica, new lessons!

- Make use of core technology to provide solutions
- Provide solutions where there is a market
- Early revenue generation
- Balance the team, remember sales/marketing
- Collaborate with many universities
- Form strategic alliances to speed time to market and reduce costs

Oxford Biosensors

- Based on electrochemical sensing using enzymes coupled to microelectrodes
- Enzymes provide for high selectivity of important biomolecules
- Microelectrodes give a fast response time and simplified interpretation
- Proof-of-concept done with silicon-based structures
- Current technology is based on printed ink-on-plastic
- Target is 3%CV with 4 analytes for cardiac risk

Oxford Biosensor's Multi-Analyte Platform

PROFESSIONAL (POINT OF CARE) DIAGNOSTIC SYSTEM - CLIA waived:

- Hospital
- Doctor's Office
- Clinics (diabetes, renal etc)
- ER

FUTURE MARKETS:

Consumer - 'Empowering the patient'

e.g. Management of Cardiac Risk

"More than 200 million people worldwide meet the criteria for treatment, but fewer than 25 million take statins." Dr.Eric J. Topol, "Intensive Statin Therapy -- A Sea Change in Cardiovascular Prevention", New England Journal of Medicine, April 8, 2004.

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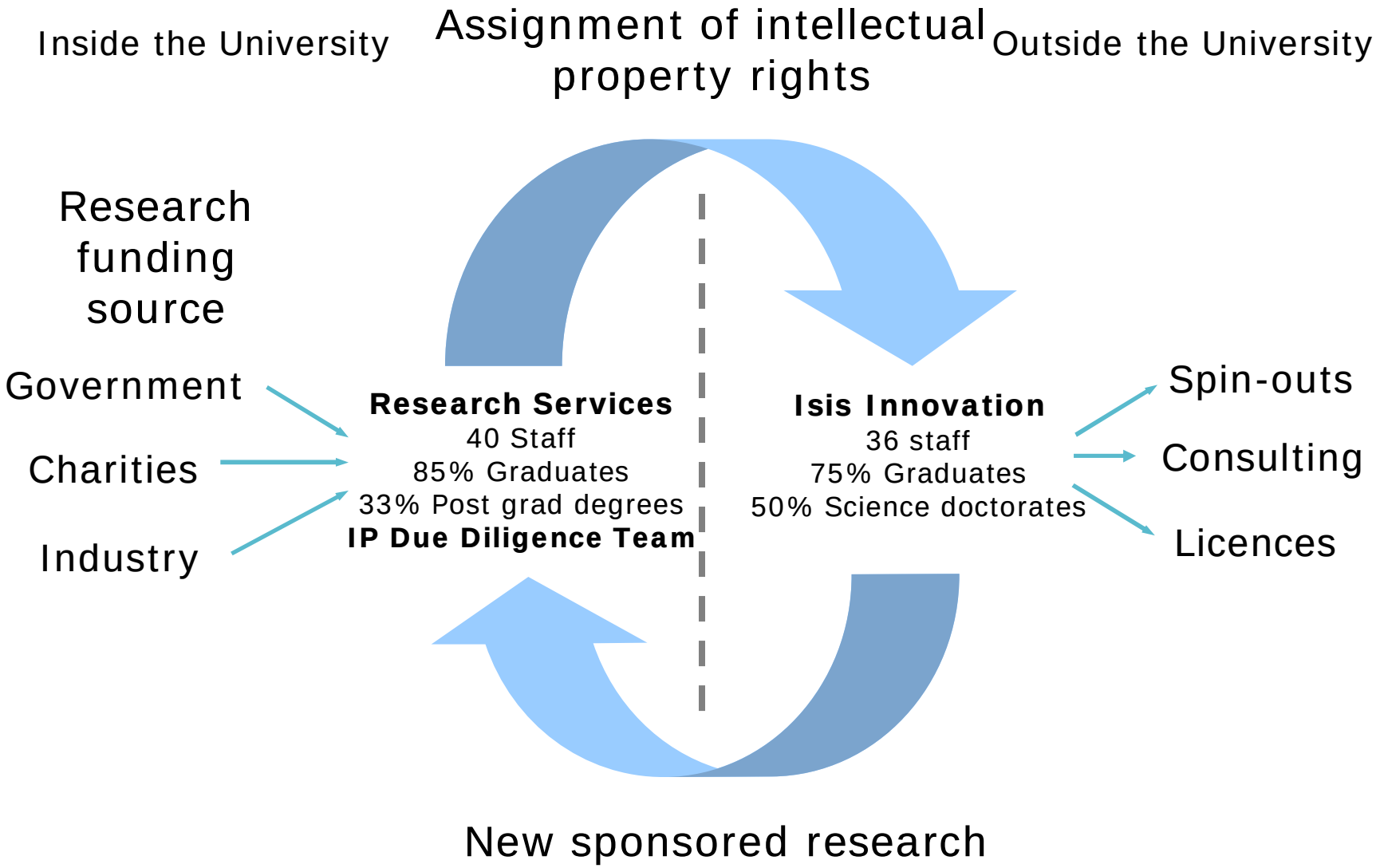
Oxford Biosensor lessons

- The technology was too “disruptive” for any license deal
- The time to market is long because of FDA approval issues
- The complexity increased as the improvements to performance to achieve a 3% CV were made
- Many questions of basic science and technology have been identified, eg: polymer cutting, machining, bonding, surface wetting, drying, printing…

Transfer of Intellectual Property in Oxford University



Can the “Oxford experience” be applied elsewhere?

- A large University with diverse skills is not essential (but helpful!)- it can provide a good environment to make things happen
- Need to establish at the outset, the way IP is managed
- Remember that the innovation stage is crucial (and we don’t have the optimal solution yet!)
- Sales and marketing are as important as the technology
- Scale-up of manufacturing/partnership important
- Sources of investment are essential
- Government fiscal policy is important

For further information: peter.dobson@begbroke.ox.ac.uk