The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

2140-3

Workshop on Entrepreneurship for Physicists and Engineers from Developing Countries

3 - 7 May 2010

Scientists and Engineers as Entrepreneurs - career options and choices

Peter Dobson
Oxford University Begbroke Science Park
Oxford
UK

Scientists and Engineers as Entrepreneurs-
career options and choices

Professor Peter Dobson

Oxford University Begbroke Science Park

Trieste 3rd May 2010

Outline

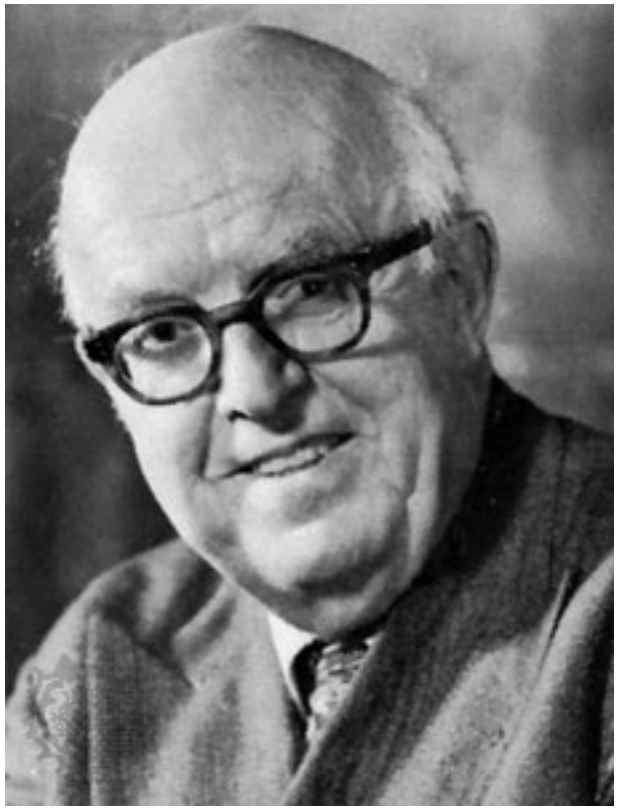
- Science and technology cultures
- Invention and Innovation
- Time gaps to commercial products
- Examples from Oxford

- Oxonica
- Oxford Biosensors
- Can we learn from this experience?

Oxford University Begbroke Science Park

CP Snow recognised the science/technology gap in his 1959 “Two Cultures” Essay

- “I think it is fair to say that most pure scientists have themselves been devastatingly ignorant of productive industry…”
- “pure scientists and engineers often totally misunderstand each other”
- “pure scientists have by and large been dim-witted about engineers and applied science”
- “engineers have to live their lives in an organised community…..They are absorbed by making things….”



2009 was the 50th Anniversary of this essay

Oxford University Begbroke Science Park

The New “Two Cultures”

- Basic Science Research
- Applied research – Technology

- “Basic research….build a bridge wherever it strikes the builder’s fancy. Applied research…..a bridge built where people want to get across the river” *Willis R Whitney, GE Labs, USA ~1920*

Under his influence GE became world-leading in Innovation

Oxford University Begbroke Science Park

Scientific Research
the motivation

- Scientists view things on a short time scale! Their measure of success is simple: publications in top peer-reviewed journals
- Technologists have a longer, more tortuous time scale. Measure of success is to manufacture and sell into a market
- There is a culture gap
- There is also a time gap between invention and commercialization

Oxford University Begbroke Science Park

Invention: what is it?

- It is often confused with “discovery”, which is “making something known for the first time”.
- Invention can build on discovery
- Invention is the new, useful and non-obvious improvement to a process, object or product.

Oxford University Begbroke Science Park

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.
- In Oxford we introduced Enterprise Fellowships to do this

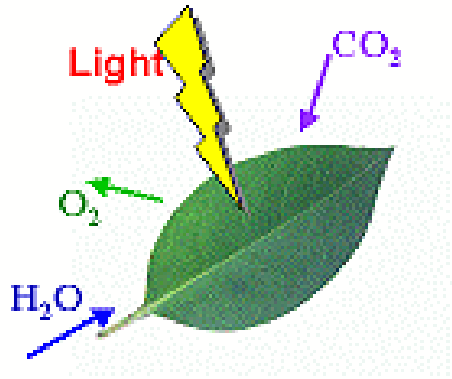
Oxford University Begbroke Science Park

Examples of Discovery and Invention

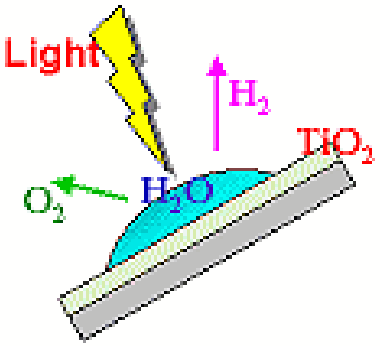
- Take the example of titania as a photocatalyst for self-cleaning surfaces
- Discovery was: Fujishima (Nature vol 238, 37, (1972) but had published in Japanese in 1969.
- Invention was filed in 1990's as PCT/JP96/003684 by Toto Ltd.

Oxford University Begbroke Science Park

Titania (n-type) and light

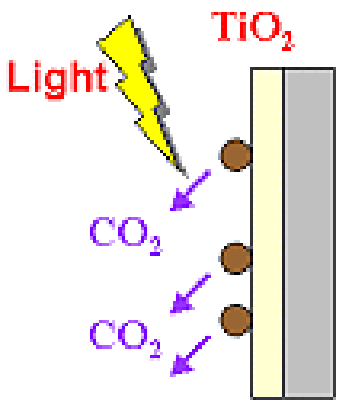


・Light is absorbed by chlorophyll.

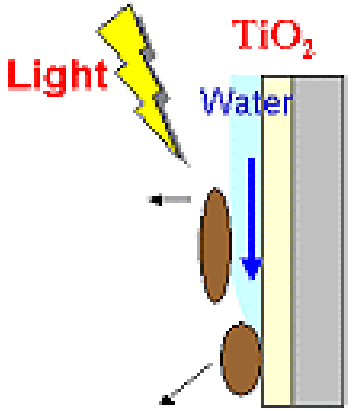


・Light is absorbed by titanium dioxide.

The decomposition reaction of water is slow; thus organic materials, if any, are decomposed preferentially.



(1) Oil gradually adhered on TiO_2 film is decomposed through its strong oxidation.

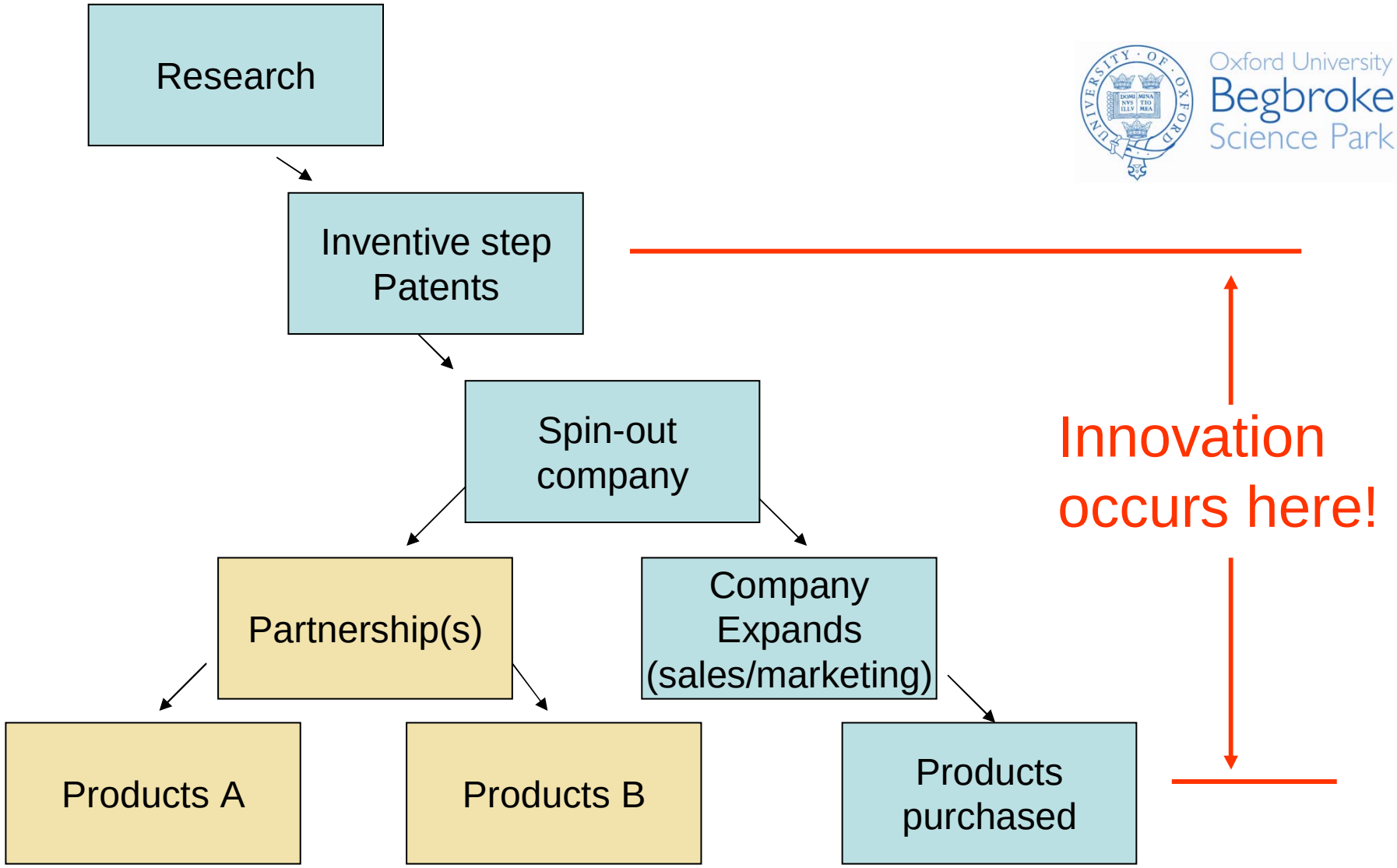


(2) Oil adhered on TiO2 film can be washed with water through its superhydrophilicity.

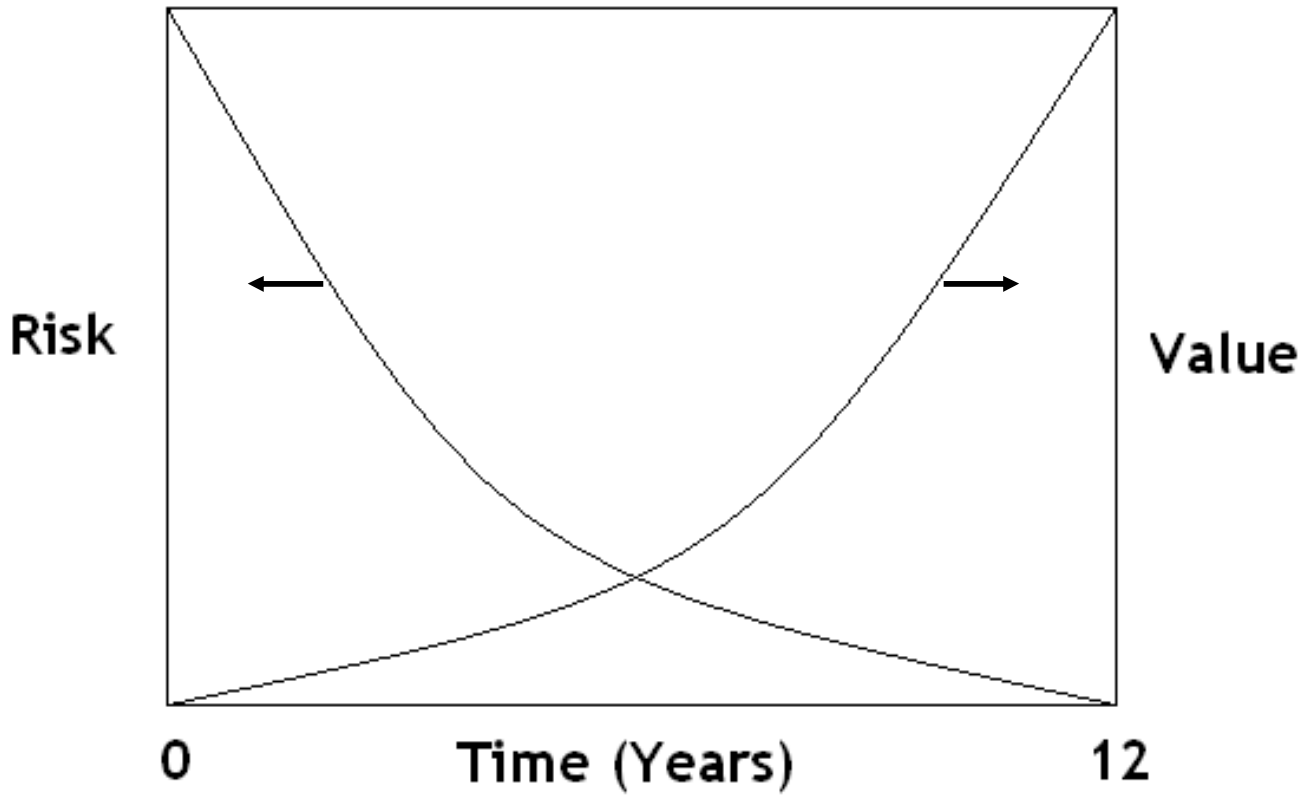
http://www.nanonet.go.jp/english/mailmag/2005/044a.html

Oxford University Begbroke Science Park

The Innovation chain



Time Gap in the Innovation



Can we quantitatively predict these curves and determine investment profile?

Oxford University Begbroke Science Park

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?

Oxford University Begbroke Science Park

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! (Oxonica started to make phosphor nanoparticles for a display device that failed to capture market share)

Oxford University Begbroke Science Park

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
- Manufacture costs can cost 10x development!

Oxford University Begbroke Science Park

The Time Gap
Can it be shortened?

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

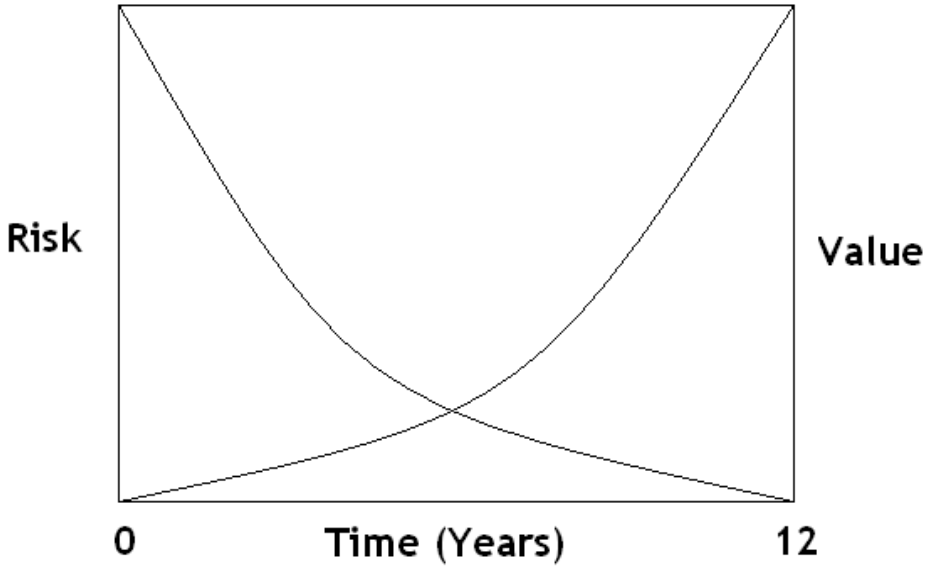
  This must come initially from Govt.
- The risks and market dynamics need to be understood (and controlled).

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

  Education at all levels

Oxford University Begbroke Science Park

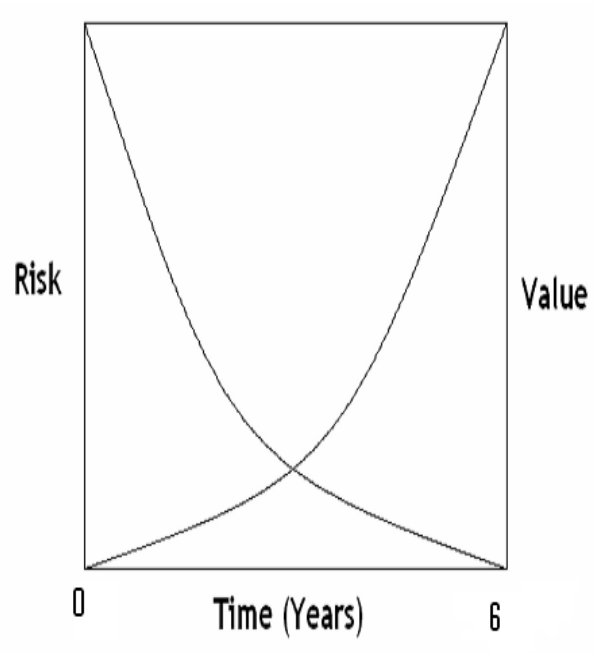
Can we shrink the timescale?



Form partnerships with other companies

Use toll manufacturing

Use other sales/marketing



Oxford University Begbroke Science Park

How should we try to commercialize anything?

- We could take a “technology push” point of view, eg: nanotechnology has the key to everything.
- We could look at the market and understand what customers want and why they want things.
- This market driven view leads to a “solution driven” approach and then draws upon the appropriate technologies.

Oxford University Begbroke Science Park

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

Oxford University Begbroke Science Park

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

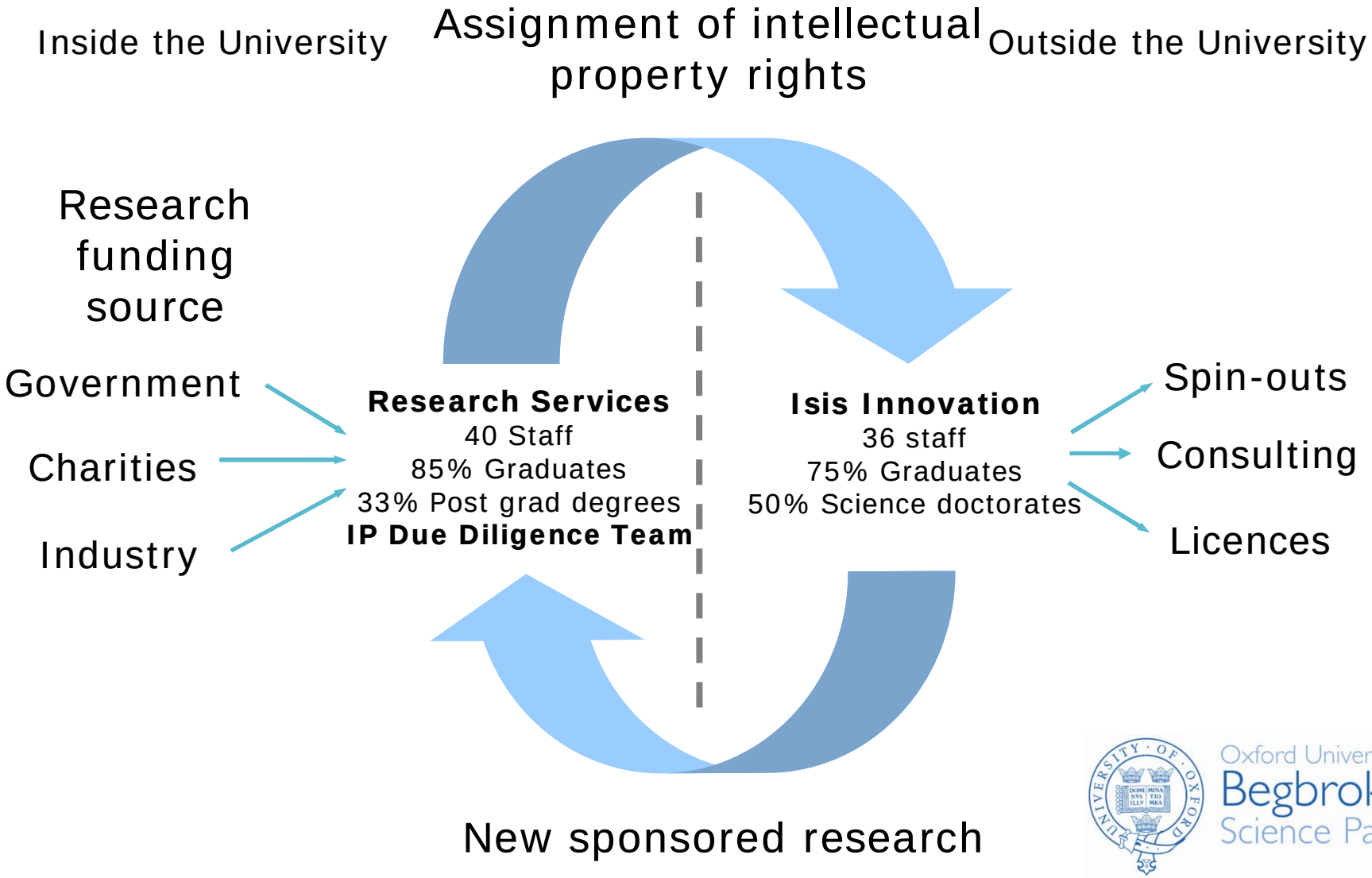
Oxford University Begbroke Science Park

Overall Conclusions
How can we speed up Innovation?

- Never “push technology” but look for market-led solution provision
- Develop a balanced team, especially help with sales/marketing, but do not neglect the technical team
- Try to shorten the time from invention to revenue generation by partnerships
- Treat investors’ money as your own and respect their risk and confidence

Oxford University Begbroke Science Park

Transfer of Intellectual Property in Oxford University



Oxford University Begbroke Science Park

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

Oxford University Begbroke Science Park