Enterprise-University Partnership
The university point of view

Professor Mary Ritter; Pro Rector for Postgraduate and International Affairs
June 2008
• Introduction to Imperial College London
• Links with enterprise
• Doctoral training programmes
• University-enterprise interactions
• Conclusions
Agenda

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Setting the context – Imperial College London Science, technology and medicine at Imperial
Prince Albert’s vision
Plan of Estates
in the parishes of
Kensington and
St. Margaret's Westminster.
In the county of
Middlesex.

Purchased by
Her Majesty's Commissioners
for the
Exhibition of 1851.

Note.
The green color indicates the Commissioner Estates, the different properties by assessment being marked in boundary lines of various colors viz.
Gore House Estate Blue
Villars Estate Red
Harrington Estate Yellow
Smith's Charity Estate Brown.
The light brown color indicates the different roads intersecting and bounding the Estates the whole of them with the exception of the Kensington Road on the North, having been newly constructed by the Commissioners.

Scale of Feet.
The Crystal Palace – Great Exhibition of 1851
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Scale of Feet.
00 100 200 300 400 500 600 700 800 900 1000
1851-1890
Constituent Colleges formed, realising Prince Albert’s vision for the pursuance of science and learning following the Great Exhibition

1907 – Imperial College founded by merger of:
City and Guilds College
Royal College of Science
Royal School of Mines
Our History

1988-2000 Mergers with London Medical Schools:

St Mary’s Hospital Medical School
National Heart & Lung Institute
Charing Cross/ Westminster & Royal Postgraduate Medical Schools
Kennedy Institute

2007 – Our Centenary: 100 years of living science
Our Charter and mission

Our Founding Charter in 1907...to give the highest specialised instruction and to provide the fullest equipment for the most advanced training and research in various branches of science especially in its application to industry

Our mission now: Imperial College embodies & delivers world-class scholarship, education and research in science, engineering and medicine, with particular regard to their application in industry, commerce and healthcare. We foster interdisciplinary working internally and collaborate widely externally.
Imperial is focused on Science, Technology and Medicine
Research strategy

College

Addressing societal needs

Faculties

Integrated solutions to sectorial needs

Departments & Institutes

Fundamental science and technology
Integrated research strategy

Technological core strengths

- Mathematics & computation
- Sensor & imaging technology
- Materials & nanotechnology

Fundamental science & technology

- Medical Imaging
- Climate Change
- Earth reservoir modelling
- Earth observation
- Alternative energy sources
- Sustainable development

Quality of life

Bioengineering & NanoBiotech
Our staff

8,200 staff and visiting staff

- 3,000 academic and research staff
- 3,000 support staff
- 1,700 honorary staff
- 700 academic visitors and visiting researchers
Our students

- 13,000 students
  - 8,300 undergraduates
  - 2,200 taught postgraduates
  - 2,500 research postgraduates

- 30% are from outside Europe
- Students from 123 countries

- 32% of staff non-UK nationals
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Royal Charter of 1907 states purpose of College as:
“giving…highly specialised instruction… providing…advanced training and research in… science…especially in its application to industry”

Today:

<table>
<thead>
<tr>
<th>Imperial College Consultants (ICON)</th>
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<tbody>
<tr>
<td>Problem Solving</td>
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<tr>
<td>Scientific Services</td>
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<td>Expert Advice</td>
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<th>Business Development</th>
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<td>Mission to increase the quantity, size and quality of research collaborations</td>
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<th>THE ENERGY AND ENVIRONMENT OFFICE</th>
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<tr>
<td>Establishing strategic relationships with UK and international business and industry, government and NGOs to initiate research projects concerned with energy and the environment</td>
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58 spin-out companies  
> 150 licence agreements

**Examples of our spin-outs:**

<table>
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<tr>
<th>Company</th>
<th>Description</th>
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<tbody>
<tr>
<td>Nexeon Ltd</td>
<td>Novel battery technology</td>
</tr>
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</table>
| Heliswirl Technologies Ltd | Helical-flow pipe technology  
                        | Expected to improve transport of fluids  
                        | in applications including oil and  
                        | chemical industries |
| Ceres Power             | Fuel-cell technology company founded  
                        | by Imperial Innovations as a spin-out  
                        | in 2001  
                        | Technology to transform power  
                        | generation  
                        | Admitted to AIM in 2004 with market  
                        | capitalisation of £66M  
                        | Realised £2M for Imperial Innovations  
                        | Group |
Imperial Innovations became first majority university-owned technology transfer company to float in the UK (AIM)
Raised £26M August 2006
Market value: £150M
Our links with business

Imperial received Supporter of British Industry Award at Best of British Industry Awards 2006

• honours organisations that proactively engage with industry

“Imperial is on a very sharp upward trajectory. If we look at where it was ten years ago and where it is now, there is a massive transformation, especially in interaction with British industry.” Professor Sir David King, Government Chief Scientific Adviser, 11 February 2007
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Our postgraduate students

- ~4,700 postgraduate students
- 35% of total student population (~13,000) at Imperial
- >50% are doctoral candidates (2,500)
- 70% EU
  - 46% UK
  - 24% non-UK
- 30% overseas (non-EU)
- All masters and PhD students belong to one of the two Graduate Schools
Our Graduate Schools at Imperial

• Established to ensure quality and to further develop and enhance postgraduate training and excellence
• Graduate School of Life Sciences and Medicine, 1999
• Graduate School of Engineering and Physical Sciences, 2002
• Membership: all masters and doctoral students
• Role
  • Quality of training
  • Academic environment/Interdisciplinarity; distinguished guest lectures; student research symposium; etc
• Transferable skills programme (THES Prize 2006)
• Representation - an integrated ‘voice’ within the university
Graduate School of Life Sciences and Medicine

Faculty of Natural Sciences:
- Life Sciences
- Physical Sciences

Faculty of Medicine

Business School

Graduate School of Engineering and Physical Sciences

Our 2 Graduate Schools
Doctoral (PhD) training

- Evolution from a research apprenticeship to a multi-stranded education
- 3-4 years

Diagram:

- Taught elements
- Transferable/Professional skills
- Research element

Year 1 | Year 2 | Year 3
Direct University-Enterprise links (1)

2 main areas: Research and Skills training

Research
• University-enterprise collaborative research projects
  • University laboratory + enterprise/industrial laboratory
  • University supervisor (main) + enterprise supervisor (co-supervisor)
  • ~1 year at Imperial: 2 years in enterprise; but flexible according to nature of the project
  • Imperial College London PhD
  • Range of funding: government CASE, KTI; industry
• Collaboration, research 100% in university
• Collaboration, research 100% in enterprise (EngD, ‘professional doctorate’; EPSRC government research council funding)
• Consultation/advice: enterprise represented on Doctoral Training Advisory Boards
‘Transferable’ skills

• Role of Enterprise:
  • Direct participation in delivery
  • Consultation/advice with university
  • Consultation/advice at national level (e.g. UK GRAD Advisory Board)
What skills and why?

- Roberts review (and funding!)
- Input from stakeholders
  - students
  - staff
  - employers (e.g. enterprise)
  - data from University and national level
- Research
A review, chaired by Sir Gareth Roberts, into the supply of science and engineering skills in the UK
Review was commissioned as part of the UK Government's productivity and innovation strategy

“PhDs do not prepare people adequately for careers in business or academia”

• “in particular, there is insufficient access to training in interpersonal and communication skills, management and commercial awareness”
Roberts’ Recommendation 4.2

Recommendation 4.2: PhD training elements

Despite the welcome current moves by the Funding Councils to improve the quality of PhD training, institutions are not adapting quickly enough to the needs of industry or the expectations of potential students. The Review therefore believes that the training elements of a PhD – particularly training in transferable skills – need to be strengthened considerably. In particular, the Review recommends that HEFCE and the Research Councils, as major funders of PhD students, should make all funding related to PhD students conditional on students’ training meeting stringent minimum standards. These minimum standards should include the provision of at least two weeks’ dedicated training a year, principally in transferable skills, for which additional funding should be provided and over which the student should be given some control. There should be no requirement on the student to choose training at their host institution. The minimum standards should also include the requirement that HEIs – and other organisations in which PhD students work – reward good supervision of PhD students, and ensure that these principles are reflected in their human resources strategies and staff appraisal processes.

Furthermore, in order to assure employers of the quality of PhD students, as part of these standards the Review recommends that institutions should introduce or tighten their procedures for the transfer of students to the PhD. In particular, the Review believes that HEIs must encourage PhD projects that test or develop the creativity prized by employers.

...the training elements of a PhD – particularly training in transferable skills – need to be strengthened considerably.

...include the provision of at least two weeks’ dedicated training a year, principally in transferable skills,
Recommendation 5.3: A vision for postdoctoral researchers

It is important for postdoctoral researchers to be able to develop individual career paths, reflecting the different career destinations – Industrial, Academic and Research Associate – open to them, and that funding arrangements reflect the development of these career paths. The Review believes that enabling the individual to establish a clear career path, and a development plan to take them along it, is critical to improving the attractiveness of postdoctoral research. The Review therefore recommends that HEIs take responsibility for ensuring that all their postdoctoral researchers have a clear career development plan and have access to appropriate training opportunities – for example, of at least two weeks per year. The Review further recommends that all relevant funding from HEFCE and the Research Councils be made conditional on HEIs implementing these recommendations.

HEIs take responsibility for ensuring that all their postdoctoral researchers have a clear career development plan …

… and have access to appropriate training opportunities – for example, of at least two weeks per year.
What do we mean by transferable skills?

UK Research Councils/UK GRAD Programme

• Joint skills statement 2000
Transferable skills training - 7 major areas identified

- Research skills and techniques
- Research environment
- Research management
- Personal effectiveness
- Communications skills
- Networking and team-working
- Career management
The range of skills

Research skills and techniques

Research environment
  • Ethical issues - peer review, pressure for results, conflicts of interest, secrecy, obligation to the public
  • Commercialisation

Research management
  • Time management, prioritisation, realism
  • Project management, milestones etc
  • Data management, IT skills
The range of skills

Personal effectiveness
  • Self-discipline, motivation, initiative
  • Awareness of self limitations, training needs

Communication skills
  • Writing
  • Oral presentations: brief, long
  • Professional audiences, public understanding
  • Teaching, media
The range of skills

Networking and teamworking
  • Within research group, institution, wider research community
  • Understand behaviour, impact on others

Career management
  • Ownership, realistic goals, identify development needs
  • Insight into transferable nature of research skills, range of career opportunities within/outside academia
  • Effective presentation - CVs, applications, interviews
Stakeholders - What Do PhDs Do?: Key Occupations

- Scientific research, analysis & development occupations: 18.1%
- Teaching professionals: 22.2%
- Business & finance professionals and associate professionals: 3.5%
- Health professionals and associate professionals: 5.0%
- Engineering and IT professionals: 8.2%
- Commercial, industrial & public sector managers: 6.6%
- Marketing, sales, media advertising occupations: 3.2%
- Other professional, associate professional and technical occupations: 29.8%
- Other occupations: 3.3%
Stakeholders - Skills and attributes essential for researchers

Project management

Critical thinking

Interpersonal skills

Personal attributes

- Setting targets
- Prioritising
- Working to schedule
- Analysing information
- Problem solving
- Decision making
- Presenting information
- Team building
- Listening
- Sensitivity
- Assertiveness
- Negotiation
- Self-confidence
- Enthusiasm
- Initiative
- Flexibility
- Self-knowledge

Academia’s view

Non-academic view
2003 Study: PhD career paths 6-8 years on
[50% private sector / 35% academia / 15% public sector]

Skills that could have been given more emphasis:

- project management: 32%
- leadership: 23%
- financial management: 23%
- time management: 21%
- teamwork and communication: 19%
- organisation and planning: 13%
Transferable skills training - 7 major areas identified

- Research skills and techniques
- Research environment
- Research management
- Personal effectiveness
- Communications skills
- Networking and team-working
- Career management
Additional key skills

Skills to operate in an intercultural, global context
Skills to operate in an entrepreneurial commercial/industrial context
Outreach; the next generation; sustainability

Not just about gaining new skills
Recognition of skills you already have
Transferable skills – examples of some of the >40 different training workshops

Science, research and integrity
Time management and personal effectiveness
Communication and presentation skills
Writing skills
Science and the media
Commercialisation of research
Information retrieval
Statistics
Teamwork
Negotiation skills
Motivation
Career planning
Thesis writing and completing the PhD

3-day residential workshop; Easthampstead Park
Residential 3-day workshops for all students in their 1st and final year

Easthampstead Park, Berkshire
- Space for team activities and informal interaction
- Distance from their lab/department!

Year-1 course:
- Designed for students early in their research careers, with long term career effectiveness
- Ethos: enhancing personal and research skills

Final year non-residential course
- Career focus

*Collaborative residential workshops with: IDEA League; NUS & NTU*
Day 1: Research Skills

Planning and Project Management
  • The framework MPhil ➔ PhD

Individual Research Degree Planning
  • Gant and network charts

Creativity
  • Attitude and skills

Resources
  • Technical, analytical, social
Day 2: Self Awareness and Relationships

• Group Dynamics
• Introduction to Myers Briggs
• Conflict and Collaboration
• Course Dinner
Research Collaboration

Research Challenges

• Student – supervisor relationship
• PhD planning
• Motivation
• Networking
• Stress management
Who delivers this training?

Internal professionals
• 2 Senior Lecturers in Transferable Skills (2004)
• Science Communication Group, Humanities Department
• Business School staff

Training-the-trainers
• Cohort of ~50 internal academic staff (from Science Departments)
• Communications and presentation skills
• Teamwork

External professionals (very few)
Imperial’s Graduate Schools won the Times Higher Awards 2006 in the category of Outstanding Support for Early Careers Researchers.

More than 90 of the UK's universities took part.

The judges felt that

- 'Imperial College has taken an innovative and integrated approach to supporting early-careers researchers.'
• Research-led development of transferable skills programme
• Skills development is no longer viewed as something that is bought in or tagged on, but rather something that staff across the College work together to produce
• Is skills training effective?
Are we doing the right thing? Are our programmes effective?

Short term metrics
- Students score workshops/courses highly
- On a scale of 0-5, all workshops score >4 for both usefulness and tutor quality

Long term metrics e.g.
- Employment rates
- Employers’ views
- Benefit to the economy?
- Benefits to society?
- More difficult and too early to assess
Are we doing the right thing? Are our programmes effective?

Is the training useful and effective?

An important area of research in itself!
SKIPI: a Skills Perception Inventory for Evaluating Postgraduate Transferable Skills Development

- Evaluation inventory; questionnaire
- Designed to provide quantitative feedback on effects of training
- 3-day residential RSD course for 1st year PhD students
- Measures students’ perception of their skill levels in 4 skills domains:
  - Group work
  - Communication
  - Project management
  - Personal awareness
- 5th area measures students’ attitudes to benefits or not of Transferable Skills training
- Statistical analysis (Crobach alpha calculation) to refine this; all 5 scales have good reliability
- Administered at start and finish of course, and 5-6 weeks later
- 10 courses; 298 participants

Sample Questions (36)

Marked 1 (v uncomfortable) to 5 (v comfortable)

• Recognising excessive stress in myself
• Co-ordinating a group project
• Being able to enthuse a non-expert about my work

• Having a good understanding of research ethics
• Describing the good attributes of a conference poster
• Focus of this research/analysis was on student confidence and beliefs

• Significant improvement in all 4 domains when pre- and post course data compared; maintained at 5 weeks
• Similar improvement in perceived value of skills training
Pre- and Post-Course Differences?

(a) (b) (c) (d)

\[
\begin{align*}
&[3.60] \quad [4.06] \quad [3.54] \quad [3.94] \quad [3.34] \quad [3.71] \quad [3.41] \quad [3.89] \\
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\end{align*}
\]

$p < 0.001$ for all cases

✓ control Q’s: no differences
• Gender differences seen in perceptions on 'group work' and 'communication' pre-course but post-course differences not significant

• Subject area differences
  • Students from Faculty of Natural Sciences believed the value of skills training was lower than their counterparts in Engineering and Medicine

• Country of residence

• The project itself has raised student awareness of the skills that they already have and need to develop
Future work

• University context:
  • Refine analysis; in depth analysis of specific skills domains
  • Longitudinal study – to determine long-term efficacy
  • Focus groups, interviews, case studies
  • Future course development in light of these findings

• National context
  • UK GRAD
    » Research Councils UK
    » Advisory Board
    » Centre of Excellence; Incubator; Regional Hubs
  • “Rugby” Team
    » A Sector working group (many stakeholders)
    » working on the evaluation of skills development of early career researchers
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Research training and the knowledge society

Key ingredients:
Specialist research skills and knowledge
Ability to use and transfer these skills and knowledge to
• Career path
• Society
Doctoral training: some conclusions

• Recognise the continuum from Bachelors to Masters to PhD to postdoctoral scientist
• Need appropriate modes of delivery: ranging from skills acquisition embedded in specialist academic training to ‘total immersion’ residential transferable skills workshops
• Need to cater for wide range of careers, not just academia and industry
• Need to involve doctoral candidates, postdoctoral researchers and employers in developing the repertoire of skills training
Doctoral training – some conclusions

- Ensure that PhDs and postdoctoral researchers gain both the specialist and transferable skills they need – in consultation with the stakeholders/employers.
- Ensure that PhDs and postdoctoral researchers know and understand what specialist and transferable skills they have.
- Ensure that employers know and understand what specialist and transferable skills our PhDs and postdoctoral researchers have.

BUT PhD is still a training in research by research!
“the product that the PhD researcher creates is not the thesis – vital though that is to their subject area through the creation of original knowledge – no, the product of their study is the development of themselves”

Sir Gareth Roberts
Thank you