Presentation to

Universidad Politecnica de Valencia

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The University System in the UK

- Over 100 Universities with a range of missions
  - Global, National, Regional
  - Research Intensive, Research & Development, Training
  - Specialised (e.g. Science & Engineering), Multi-Faculty
- Government Funding managed by HEFCE (Higher Education Funding Council for England)
- Government Dept. is DfES (Department for Education and Skills) which covers all of education & training
  - Secretary of State – Charles Clarke
  - Minister for Higher Education – Margaret Hodge
  - Main current concern – to increase number of students from disadvantaged and lower socio-economic groups (fair access)

Main Structure of Degrees (England & Wales)

- Undergraduate
  - Bachelors (3 years long): BSc, BEng, BA
  - Integrated Masters (4 years long): MEng, MSci, …
- Postgraduate
  - MSc, MA (12 months long) Specialised Masters
  - MPhil (2 years long) Research Masters
  - PhD, DPhil (>3 years long) Doctorate
- Does not match easily with Bologna Cycles
  - 1st cycle: Bachelors (BSc, BEng, BA)
  - 2nd cycle: Masters (MEng, MSci, MSc, MPhil)
  - 3rd cycle: Doctorate (PhD)

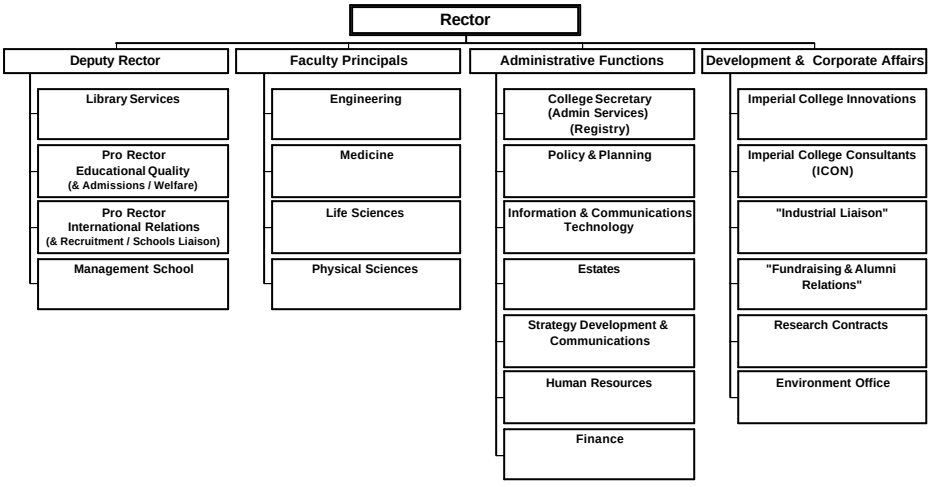
Imperial College London

- Science, Engineering, Medicine, Business
  - *10,000 students (1/3rd PG, 1/3rd from outside UK)*
  - *2,700 academic & research staff*
  - *Total income 600 M Euro*
  - *All departments rated 'excellent' for teaching quality*
- Research Intensive with a Global Mission
  - *Highest UK Research Income in Sci., Eng. & Med.*
  - *Highest UK Rating for Research Staff*
  - *Publications in Science & Nature comparable to MIT, Harvard, Stanford, …*
- Very well connected globally (Europe, US, Asia)
  - *IDEA League, CLUSTER, Unitech, CESAER, …*
  - *Strong strategic links with Georgia Tech, Singapore, …*
  - *Strong research links with many universities in US and Europe*

Main Engineering Degree Programmes

- BEng (3 Year Bachelor) in Electrical Eng, Biomedical Eng.
- MEng (4 Year integrated Master) delivered by Departments with the same name
  - Aeronautical Engineering
  - Biomedical Engineering
  - Chemical Engineering
  - Civil & Environmental Engineering
  - Computing
  - Electrical & Electronic Engineering
  - Information Systems Engineering
  - Materials Science & Engineering
  - Mechanical Engineering
- MSc (12 month specialised PG Masters)
  - About 30 in all areas of engineering & technology
- PhD (doctorate) in all areas of engineering & science

Our organisation



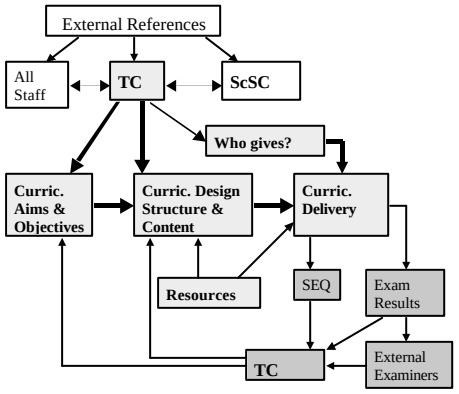
Design Principles of Degree Programmes in Engineering

- Firm foundation in underlying science & mathematics
  - Emphasis on applications in engineering
  - High academic starting level because of student selection
- Real engineering introduced early, e.g. design exercises
- Emphasis on development of professional skills
- Emphasis on realistic problem solving
- Advanced and specialised topics mainly in 3rd and 4th years
- Major project in final year and smaller projects in earlier years
- Overall aim is to produce high quality engineers able to take on leading roles in implementation of large projects and to advance technology through research

Degree Programme Design & Review

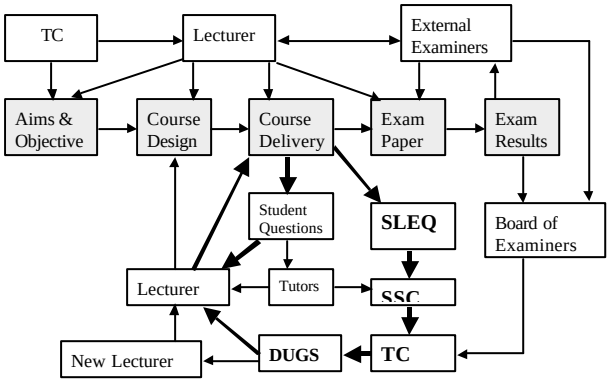
- Mostly done by Academic Departments
- Key Role of Departmental Teaching Committee
  - Led by Director of UG Studies
  - Input from staff & students
  - Often prompted by internal reviews & external developments
- Approval by Engineering Studies Committee
- Approval by Undergraduate Studies Committee
- Approval by Senate

Imperial College - Curriculum Level Processes



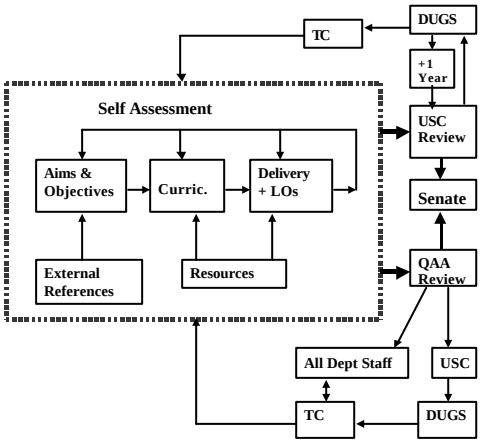
TC = Teaching Committee
ScSC = Science Studies Committee (or Eng. Stud. Com)
SEQ = Student Evaluative Questionnaire
External References include: Accreditation requirements, national and international discussions on curricula, etc.
The shaded boxes represent the key processes.
Resources allocated to teaching are determined by the Head of Department in consultation with the Director of Studies.

Imperial College - Individual Course Level Processes



TC = Teaching Committee
SSC = Staff-Student Committee
SLEQ = Student Lecturer Evaluation Questionnaire
DUGS = Director of UG Studies
The shaded boxes represent the key processes
Aims -> Design -> Delivery -> Exam -> Results
The key feedback loops are represented by thick arrows

Imperial College - Review Processes



TC = Teaching Committee
DUGS = Director of UG Studies
LOs = Learning Outcomes
USC = Undergraduate Studies Committee
QAA = Quality Assurance Agency
The USC Review involves 3 external experts chosen by IC
The QAA Review involves about 5 external experts chosen by QAA. Both operate on a 5-6 year cycle.

Examples of Successful Practices

- **1. Selection of incoming students**
- **2. Good relations between staff and students**
- **3. Small Group Tutorials**
- **4. Staff-Student Committee**
- **5. Feedback Loops**
- **6. Emphasis on relevance in curriculum**
- **7. Review Process**

Student Admissions

- UG admissions through national system - UCAS
  - Students can apply to 6 universities
  - Each university considers application (includes school reference)
  - At Imperial College pre-selected students are interviewed
  - Offers of places are conditional on getting A grades in Maths and Physics and an A or B in a 3rd subject at A-level
  - Students must accept (by May) one place firmly
  - In August places are confirmed when A-level results are known
- PG admissions are by our own system
  - Need 'good' first degree
  - Need strong supporting references
  - Most applicants interviewed

Teaching and Learning

- Lectures by research active academic staff
  - 50 min long, about 10/week
  - Questions encouraged (office hours)
- Problem Solving Classes
- Tutorials
  - Personal (support & guidance)
  - Academic (small group)
- Seminars
- Laboratory Classes
  - Measurement & experimental skills
  - Communication & presentation skills
- Design Exercises & Projects (individual & group work)
- Humanities, Business and Management courses
- Total workload about 22 hrs/wk contact + 15-25 hrs/wk private study

Assessment of Students

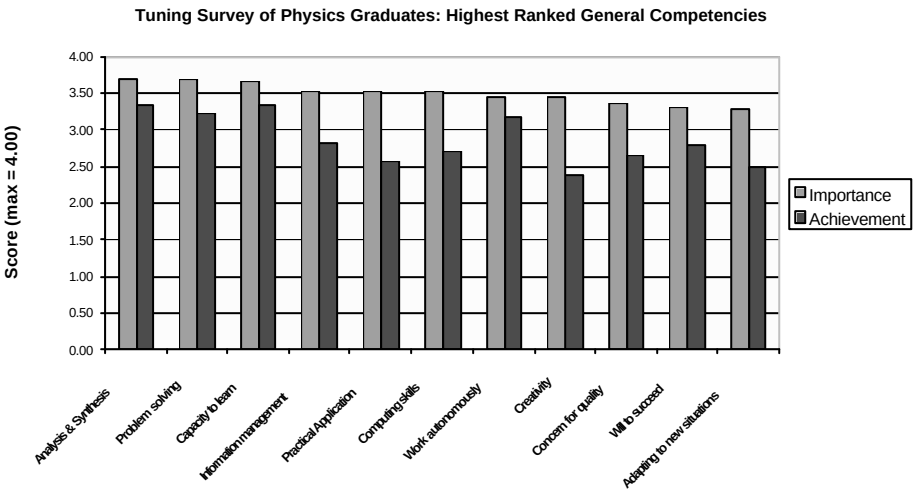
- Laboratory, Design and Projects
  - Continuous assessment, reports & presentations
- Lecture Courses
  - End of year written exams
    - range of questions involving knowledge and problem solving
    - each exam results in a % mark - full range used
- Progression to next year depends on exam results
- Degree results depend on weighted results in all years
- Classified degree -1st, Upper 2nd, Lower 2nd, 3rd Class Honours
- Almost all (90%) of students graduate on time

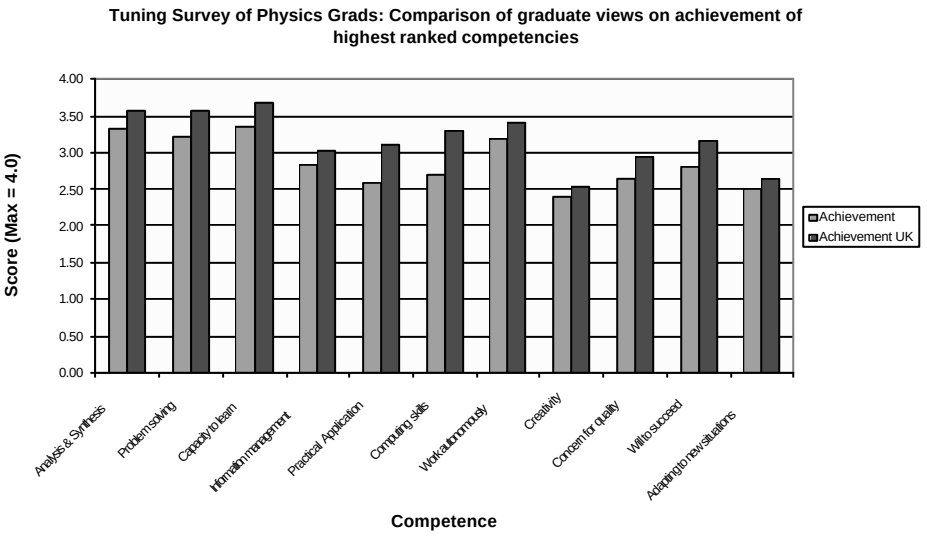
Example of Programme Specification

Attributes	**Teaching/Learning Strategies**
Knowledge & Understanding	**Lectures** **Tutorials** **Seminars** **Reading**
Analysis & Synthesis	**Lectures** **Examples Classes**
Thinking Skills	Tutorials Private Study
Practical Skills	Laboratory Courses Project Work
Design Skills	Project Work

Content versus Competence is a non-diagonal matrix

	Competence					
Content	Knowledge	Analysis & Synthesis	Problem Solving	Computing	Practical Applications	Creativity
Mat1	50	30	20			
Mat2	30	40	30			
Phys1	50	20	10		20	
Lab1	10		20	20	40	10
Comp1	10	10	10	60		10
Project 1	10		30	10	20	30





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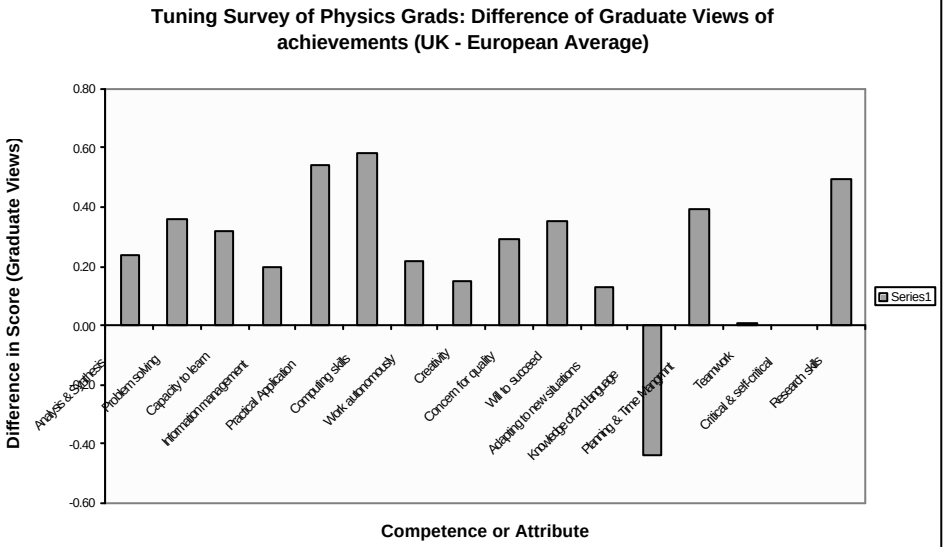


Imperial College London

Quality Assurance, Accreditation, Recognition

- Internal QA done by Dept Teaching Committee and by Undergraduate Studies Committee (USC)
  - Student questionnaires, various other student feedback
  - Monitoring of progression rates and degree results
  - Review by USC involving external experts (every 5 years)
- External QA done by Quality Assurance Agency
  - External experts review quality, standards and procedures
  - National subject 'benchmarks'
- Accreditation by Engineering Institutions
- Recognition
  - in UK, USA and Asia no problem
  - Europe, e.g. CLUSTER convention on Recognition

Quality Assurance by ENQA? Criteria for Programmes

- Goals for core competences are clear and realistic
- Goals are developed considering the needs of the labour market
- Goals include development of generic skills
- Content is consistent with goals
- Subject related competences are achieved through compulsory subjects
- Programme characterised by progression
- Assessments enable learners to demonstrate achievement of learning outcomes

The “Joint Quality Initiative Descriptors”

- Masters graduates
  - can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader contexts;
  - have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, that includes reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements;
  - can communicate their conclusions, and the knowledge and rationale underpinning these, to specialists and non-specialist audiences clearly and unambiguously;
  - have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

UK Experience of Masters Level Study

- MSc = specialised, advanced PG course
  - advanced lecture courses + major project
  - research or employment oriented
  - 12 months long intensive course
- Integrated Master: MEng or MSci
  - Emphasis on high level competence for employment or research
  - Final year broader than MSc
  - 4 Years in England, 5 Years in Scotland
- Learning outcomes oriented
  - Focused: less time on excessive detail
  - Good staff -student contact from start
  - Selection of students

The Post-Bologna Model

- Bologna Declaration: 1st Cycle degrees give access to
  - European labour market AND to
  - Graduate cycle leading to Masters and/or Doctorate
- Post-Bologna: B ∅ M ∅ D based on assumptions
  - Bachelors provides foundation and pivot
  - M level needed for research/design oriented engineers
    - but specialised or broad?
  - To produce same competencies as old degrees need 5 years?
  - Final M project needs 1 Year so M stage needs 2 years?
  - Doctoral stage is employment as "assistant"

Use of ECTS as an accumulation tool

- Canonical model: B+M = 180+120
  - Tuning Project proposes lower limit of 90 for MSc and allows UK MSc
- But should express in terms of 'learning outcomes'
- Learning outcomes depend on
  - Curriculum design and teaching methods
  - Resources available
  - Capabilities and motivation of students
  - Student workload (ECTS credits)
- Student selection at input makes a big difference to course design and rate of progress

Academic Level and ECTS

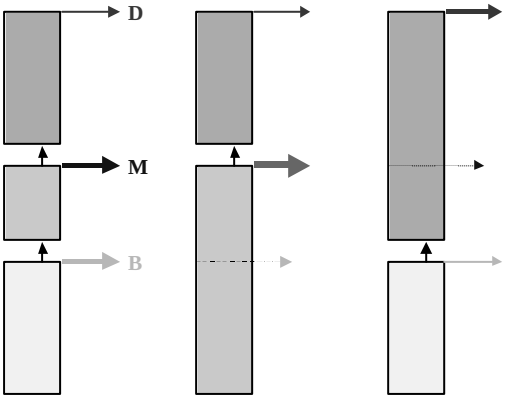
- The academic level reached by a given student does not just depend on the amount of work done
- High ability students understand difficult things quickly.
- Only in ideal circumstances does change of potential energy (i.e. level) = work done, e.g. climbing a mountain is not like this, neither is studying engineering!
- Conclusion: Need flexibility in setting ECTS limits

Structuring Degree Programmes at Research Intensive Universities

- The political drive behind BaMa is to provide early exit points to the labour market
  - Well defined Bachelor stage which includes development of skills
  - Followed by Masters stage for some
  - But integration of Bachelors and Masters is more efficient
- Can also consider integration of Masters and Doctoral stages
  - Graduate Schools (as in many US and UK universities)
  - Advanced courses, research training, real research
- Can structure to allow student choice by having split after two years with 3rd year different depending on choice
- Problems of funding of students and universities

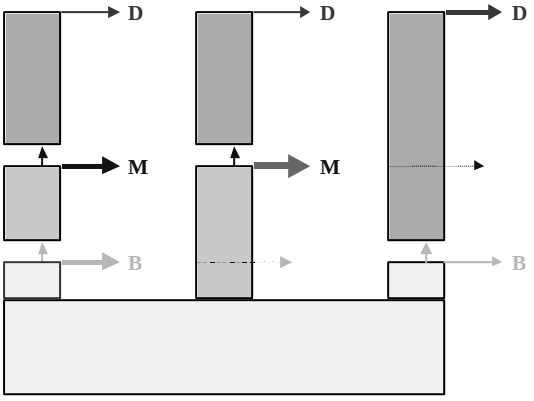
Structure and Organisation of Degree Programmes

Post Bologna | **Integrated Masters** | **Graduate Schools**



Structure and Organisation of Degree Programmes

Post Bologna | **Integrated Masters** | **Graduate Schools**



Selection & Training of Academic Staff at Imperial College London

- Academic Staff are either
  - Lecturer = Assistant Professor
  - Senior Lecturer/Reader = Associate Professor
  - Professor = Full Professor
- All Academic Staff have to be good at both research and teaching
- Staff are appointed to a particular research group
- Posts are advertised internationally: we recruit world-wide
- Publications and references are key factors in short-list selection
- Short-listed candidates give seminar and are interviewed
- Initial appointment is probationary (serious) and all staff go on >3 teaching training courses
- Promotion depends on achievements in research and teaching

Departmental Organisation

- Head of Department (Appointed by Faculty Principal)
- Management Committee - HOD + 4 Senior Profs
- Heads of Groups Meeting - HOD + 10 HOGS
- UG Teaching Committee - 10 Ac Staff + 1 Stu.
- Student/Staff Committee - 10 Students + 5 Staff
- PG Teaching Committee - 5 Ac Staff + 1 Stu.

Research Groups in Physics at Imperial College London

- Astrophysics
- Condensed Matter Theory
- Experimental Solid State Physics
- High Energy Physics
- Photonics
- Plasma Physics
- Quantum Optics and Laser Science
- Space and Atmospheric Physics
- Theoretical Physics

Research and PhD Training

- Most research involves collaborations, often international
- Each research group is led by a Head of Group and will have several sub-groups
- A typical research group might have 10 academic staff, 25 Post-Docs, 25 PhD students, 5 technicians
- PhD students selected internationally (most from UK and Asia)
- All PhD students have a Supervisor and in1st Year do:
  - Advanced lectures and techniques training
  - Research project definition and small research task
  - Assessment at end of 1st Year to confirm PhD registration
- Main research done in years 2 and 3 usually as part of a team
- Thesis is usually written at end of 3rd year and start of 4th
- PhD exam takes 3-4 hours with 2 external examiners