Imperial College London

Turn your ideas into a reality

3,000 makers, hackers, inventors, entrepreneurs, start-ups and commercial partners under one roof.

ADVANCED HACKSPACE
Elements for today

Outline the Advanced Hackspace
Your thoughts on how we can serve Imperial’s teaching
Outline one of our teaching programmes
Your thoughts on the relevance of this for your context
Outline some future options and explore together
Objectives for Today

Familiarize you with the Advanced Hackspace

Put the idea of new possibilities for courses with the Hackspace in your minds

Test some of our ideas and come up with new ones together.

[Make Imperial the best place in the world to develop an idea]
Aim of the Imperial College Advanced Hackspace (ICAH)

- **CORE**: To make it as easy for any college member to realize their ideas as it is for an academic.

- To make Imperial the best place in the world to develop an idea.

- **Implication**: Imperial becomes a population of 20,000 scientists, inventors and innovators.
Aim of the Imperial College Advanced Hackspace (ICAH)

• **CORE**: Gives everyone the means of innovation

• Turns a population of stakeholders into a population of innovators

• Permeabilizes communities: slicing through their activities and creating a much greater surface area for stakeholder interaction.

• For industries moving towards more collaborative approach ….new and dynamic mechanisms for interactions

• **Use our strength**, innovation, as mechanism for stakeholder engagement.
Have in mind

- How can this help UG education? I’ll be asking you to discuss.
An Opportunity

Academics tend to teach like they are preparing future PhD researchers

Simultaneously we:
- provide limited tools to UGs to perform research
- suppose that the way to perform research after university is to be a professional researcher (in academe or R&D)

But we know that research projects, embodied, collaborative and independent learning help even conventional learning objectives.

Shouldn’t we just do what we love and make University education much more about what we do: research and exploration?

This doubles-down on Imperial’s research-led edge.
How to massively increase research and exploration within our curricula?

• Perhaps the Advanced Hackspace (ICAH to some) can be part of a solution.
What is the Imperial College Advanced Hackspace? (ICAH)

- Exploits advanced skills of a university to create citizen-driven cross-faculty idea prototyping space

- Hybrid of commercial prototyping technologies and pioneering advances within the college ecosystem

- Provides pull for de-skilling of these technologies and push for new platforms

- **Prototyping capabilities across 6 spaces**: metal work to bio-hacking to 3D printing to electronics

- **Passport model**: free access and training to college members
ICAH Virtual Network

- Cross faculty participation

The ICAH Facilities

- School of Design Engineering
  - 10 Princes Gardens - 3rd Floor
  - Digital manufacturing

- Skempton Building
  - 1st Floor - Room 314
  - IDEAS lab - product design and services

- Electrical Engineering Building
  - 5th Floor - Room 516
  - ICIS Lab - Electronics

- Chemistry Building
  - Lower ground
  - BioFitsLab

- Heart and Lung Institute
  - ICTEM building, Hammersmith Hospital
  - White City
Supporting a multi-disciplinary community

- >2300 members of college have joined ICAH
- Largest grouping in the college (UG/PhD/MRes/PDRA/Academic Staff)
- Organic growth
- Engineers, medics, life scientists, mathematicians, physical scientists all under one roof
- People with common interests in device prototyping, computers, machining, science, synthetic biology, digital art, robotics, automation or diagnostics; can meet, socialize and collaborate

100 new members per month
What does ICAH provide?

**Prototyping facilities**
Bring ideas to life through prototyping using dedicated maker spaces and equipment

Support and enhance general research/start-up activities:
passport system breaks down barriers
What does ICAH provide?

**Prototyping facilities**
Bring ideas to life through prototyping using dedicated maker spaces and equipment

**Maker Events**
Hackathons, competitions, ideation support, classes

**Hackathons**
Community led
Industry challenges

**Classes**
Click Programme
Broader UG/PG programme

**Competitions**

**Tech Elevator**
Challenge Wall
Translation Framework

**Re-Design Lab**
Can you break an invisible security system? Maybe you consider yourself a hero - can you be able to break the any system undetected? If it's from an untraceable location will you use the chance to demonstrate all your skills?

Photos courtesy: Imperial College London and the N.F. Foundation
ICAH Courses

Courses open to college members and external partners.
Imperial Festival
Hackathons-BP Voice Activated Tech
What does ICAH provide?

Prototyping facilities
Bring ideas to life through prototyping using dedicated maker spaces and equipment

Maker Events
Hackathons, competitions, classes and other events

Members Network
Meet and collaborate with other people, work on projects together and share your knowledge

Free access
Graded Passport Access

UG / PhDs  PDRAs  Staff  SMEs  Alumni  Large industry  General public
What does ICAH provide?

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Meet and collaborate with other people, work on projects together and share your knowledge

**Funding / mentoring**
Booster grants / mentoring to members for prototyping projects

- **Booster grants**
- **Mentoring support**
- **Technology Showcases**
  - Invention works
  - Expo events

**Academics**
- Hackers in Residence
- Hackspace Fellows
- Senior Hackspace Fellows
Hackspace Fellows

- Vital to our Advanced Proposition
Hackspace Fellows

- Vital to our Advanced Proposition
- Either PhD’s or commercial R&D. 6.5 FTEs.
- Between PDRA/Technician and Teaching Fellow.
- Research: 1) evaluating and developing deskilled technologies of relevance to our spaces 2) bought out to do proof-of-concept filtration and early stage research projects (often at TRL3)
- Support: Assisting our community in developing their ideas. Training our community to maintain our kit – meta-technicians
- Teaching and events: 3 Horizons courses, inductions, hackathons.
Supporting Student Enterprise

blocks
choose. play. upgrade.

Haize
The Magical Bike Compass

LIFEBOX
The World’s Most Affordable Baby Incubator

GyroGlove

raised $1.6M

FreshCheck
Hackers in Residence Programme

SMILE – a smart vaccine cooling system for the last-mile journey in developing countries

Kitty Liao
A need for new spaces

• Exceeding bandwidth of virtual model…need for a new home

• Demand from industry and SMEs growing
  • Co-location opportunities
  • New ways of working
  • Training

• Disruptive technology development embedded into training programmes
• Proof of concept filtration
• Public engagement / outreach opportunities
• Direct conversations between industry and students

Tackling industry challenges

Hackathons

Challenge wall

Re-Design Lab

Prototyping tech

Early stage commercialisation

Training for industry

New education approaches
Imperial White City

Research and Translation at scale - 25 acres
Long-term £3bn, 15-year programme

Co-locating 1000s of researchers with entrepreneurs, corporates and start-ups. Bringing together Imperial’s global research, business, healthcare and academic partners.
Imperial White City

The Molecular Sciences Research Hub
GradPad
Offices
Residential building
Michael Uren Biomedical Engineering Research Hub
Forest House
The Invention Rooms

WHITE CITY CAMPUS NORTH SITE under construction
WHITE CITY CAMPUS SOUTH SITE
New £4.5M facility for ICAH, further £1.8M fit out in 2018

One-stop space for innovation and collaboration: training, outreach, research, translation under one roof

• Advanced Hack space
• Design studio / challenge wall
• Engagement space and expo centre: public engagement opportunities
• Hot-desking space for students and alumni
• Co-location with industry and SMEs
Invention Rooms

Advanced Hackspace
- Woodwork and metalwork
- Electronics and digital
- Design studio
- Bio lab

Reach Out Makerspace
- Ideation space
- Workshop
- OUTREACH 273m²

Interaction Zone
- Lecture and seminar space
- Reception
- Cafe and events space

Cutting-edge workshop facilities for staff and students to collaborate to develop working prototypes from original ideas.

A specially designed space where children and young people can get hands-on experience of prototype development.

A warm and welcoming venue for public events, where local people and College partners can connect with science and Imperial's research.

Upstairs : hot desking space
Invention Rooms: One Community

A local anchor and an international beacon

UGs  PGs  PDRAs  Staff

SMEs  Large industry  Alumni

Local community  Philanthropy/ foundations  Government
The Invention Works Framework / Multi-site Offering

- From ideation to business development to prototyping to early stage commercialisation to full scale spinout……modules working closely together….remove valleys of death

- Open source: add more modules with time

- Multiple ways in and through

- Deep integration of this culture into White City from the get go
Questions + Question for you

Questions for me?

In your group: how you think the Hackspace could best serve undergraduate education?

We have ideas for directions – which we’ll show shortly – but perhaps you have better ones first.
Our Horizons Courses

From Dr David Miller
- Courses ranging from 1st to 3rd year covering the technologies available at the hackspace.
  - Cover everything from microcontroller programming to working with genetically modified bacteria.
- Why are the Hackspace courses different?
  - We encourage multidisciplinary groups and a democratic approach to learning
    - e.g. use of Slack as an informal method of communication.
  - Taught by Hackspace Fellows (work across multiple disciplines)
- **Interdisciplinary groups** that work over the course of 8 weeks to design and build a fluorescent protein bioreactor.
- Short lectures and lessons followed by hands on, **hackathon** type approach.
- **Group based projects culminating in “challenge sessions”** (project briefs are kept deliberately vague to encourage novel designs and thinking)
- **Final Project**: Unrestricted
Making and Prototyping for Products and Research (Third year)

- **The Serious Hackspace course**
- **One Project**: Unrestricted, but guided, either for product development or tools for research
- 20 weeks of rapid development

*We encourage failure* through trying (fail fast)
How would you do it different?
Directions we can discuss

1) new undergraduate courses that put making and hands-on/interactive learning back into our curricula;
2) a touchstone college-wide yearly competition;
3) building interdisciplinary community capital including a new layer of social interaction called “Exploration Vessels”;
4) increasing opportunities for industry engagement and summer internships.
We propose a suite of new undergraduate courses. Each one developed with a department. Courses will either address core needs of that department or, instead, will offer core skills of that department more widely.

Our courses will not be introductory but “leading-order” in that they seek to deliver a self-contained baseline competence and confidence by building hands-on, experimentation-led, familiarity in a range of technologies.
BioHacking and ChemoHacking: opening biology and chemistry to the rest of college.

HackingForTheorists: experimentation and hardware for theoretical physicists, CS, Mathematics, Business School -- and fitting into a proposed Quantitative Science Degree.

LifeLongOpenScience: empowering students to use open science, open source code, open hardware and shared equipment in hackspaces to continue to explore in science and engineering for their whole lives (even if they are not in industrial R&D or academe).

ReDesign: joint with industry, taking to pieces and redesigning 3 products for 10 lectures each. Since we hope our courses will be particularly innovative we would seek to makes these open to PGs and PDRAs.
Your thoughts?

In your groups: how would you make a course like this work in your discipline? Is it feasible?
Specific for PG/PDRAs we will develop and refine our existing PG/PDRA courses strengthening links to the grad-school and Post-doc development Centre by providing residential courses in prototyping. These will be expanded to include bespoke courses and team-building events for CDTs increasing success rates for new applications and renewals in 2018.
We propose a giant, yearly, college-wide, inclusive, competition, “THE Comp”, which is open to anyone but which gives course credit (e.g. via a Horizons course over two terms). This would drive interdisciplinary team-formation, networking across the college, yield genuine progress on technical challenges and would be linked to the “Exploration Vessels”.

We think this could be seen as an exploitation of the synergies of the FoNS MAD competition, the Enterprise competition and CDT Den, but which importantly gives both course credit and time/resource for all teams to develop solid underlying science and technology.

We think the best competition would be open to all college members (but with a specific set of rules, and sub-competition, for those taking course credit) merging researchers with students.
What do you perceive as advantages and disadvantages of a college-wide idea development competition?
Exploration Vessels: We believe there is a unique community-building opportunity for Imperial that allows it to create a structure equivalent to collegiate universities (Durham/Oxbridge) while socializing and reinforcing the educational objectives of the college.

We would like all new college members to be assigned as “crew-members” to one of 25 Research or Exploration “Vessels” or “Ships” designed to contain an even mix of disciplines from across the college. The unit, 120 people, will thus be on the size of Dunbar’s number: a village in which everyone can know each other’s role, and analogous to Colleges in Collegiate Universities or the Houses in some schools.
Undergraduate Community Building

Each vessel would be assigned a small budget for experimentation, have a theme: e.g. Robotics, Medical Devices, Clean-Tech, and contribute teams to THE Comp. We would seek to fuse THE Comp with the Vessels -- so that one reinforces the other. This is a cross-college cohort-building exercise which is explicitly oriented towards technology development and problem solving.

Academics might choose to be affiliated with different ships and likewise accelerators (like the Synthetic Biology Accelerator or the Centre for Cleantech Innovation).

Vessel membership could be extended to PGs, PDRAs, and Alumni Startups to create cross-cutting mixing. Our fellows could advise 5 vessels each. Competitive opportunities could be provided for each Vessel team to win their own garage/shed-style huts on the White-City site: building a box-park of inventive undergraduate communities.
Undergraduate Community Building

This is ambitious obviously.

In your groups: What do you think is a good baby step? Is there another way in which we can build cross-disciplinary communities across college while exploiting its research-orientation?
**Undergraduate Community Building**

**UG-lates:** ICAH runs 9-6 but we hold weekly HackMondays that run until midnight. We find that demand for evening work is extremely high because this is a time for creative-learning play outside the heavily scheduled UG day. We would seek to have late-opening every day of the week and, by these means, provide more opportunities for our undergraduates to build skills and social capital.

**UG-garages:** ICAH is currently organized like a teaching laboratory -- but this means that we have limited project storage or opportunities for people to work for a sustained time of a fixed piece of equipment. There is thus a need for garage-like spaces which could be linked to the Exploration Vessels.

**My Summer of Hack:** running an equivalent of UROP but oriented towards an autonomous prototyping project. b) My Summer Hacker-in-Residency: twinning UGs with our Hackers-in-Residence (these are college alumni that have start-ups) so that they can experience being in a start-up themselves.
Thank-you!

Have you considered attending an induction for our spaces?

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