Imperial College London

Pathways to Societal Impact

A review of Imperial College's technology transfer, translation and related activities

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Executive Summary

Many in Imperial College's community expect to see the results of their work put into practice. They know that turning knowledge into useful outcomes can generate wide ranging benefits. This is why Imperial enjoys a reputation for innovation, for successfully applying new ideas.

This report provides recommendations from a review of technology transfer, translation and related activities at Imperial College. The review was motivated by a desire to understand the mechanisms through which research and education create lasting benefit in society and the economy, and to:

- Measurably increase College's societal impact;
- Support a culture and incentivise activities that lead to impact;
- Grow and diversify funding for research and education;
- Create opportunities for expanding research, innovation and translation capabilities.

Pathways, mechanisms and levers

The review defines three pathways to impact: **People, Knowledge, and Technology**. It explains four mechanisms supporting engagement with partners: **Convening, Commercialising, Collaborating, and Challenge-led**.

Recommendations for improvements to the College's activities are predicated on enhancing the quality and reputation of Imperial's research and education. This review has identified distinct levers through which the College can improve its impact agenda:

- **Supply**: to increase the scale and volume of activities that promote societal impact
- **Demand**: to increase Imperial's interactions with external organisations through a broader range of external engagements and student placements
- **Effectiveness**: to deliver more impact through existing activities
- **Novel pathways**: to create new mechanisms through which ideas may generate useful applications by devising new staff or student innovation projects, for example, with the Dyson School of Design Engineering and by developing HackSpace facilities
- **Communications**: to develop a strategic approach to greater awareness, positioning and recognition of Imperial's impact.

Recommendations

The review provides evidence of current performance with recommendations for improvement in five areas, which directly map to the College's strategic priorities, outlined in College Strategy 2015-2020: collaboration; strengthening and diversifying revenues; staff community and student experience; sharing the wonder and alumni relations; informing decision-makers.

The recommendations focus on increasing societal impact as a strategic priority for the College. They are not intended to be exhaustive:

1. **Latent potential:** make visible and mobilise areas of latent potential, particularly with regard to Intellectual Property (IP)
2. **Private sector partners:** increase the number and type of private sector partners funding research
3. **Public and third sector collaborators:** diversify funding by engaging with new public and third sector collaborators
4. **Force multiplier: coordinate**, **measure** and **communicate** to ensure activities are coherent and to inform strategic choices; make successes deliver more impact through outreach and wider engagement with external **stakeholders, networks and communities**; develop a systematic approach to engaging **alumni** with the impact agenda
5. **Culture, incentives and rewards:** recognise and celebrate members of the College who contribute to generating impact.

① INTELLECTUAL PROPERTY

The challenge for the College is to maximise the potential for, and benefits from invention, without diminishing our reputation for research collaboration and world-class publications

Recommendations	Current performance	What excellence might look like	Implementation pathway	Potential benefit	Implementation timescale
Expand the role of TTO grant support and entrepreneurs-in-residence systematically throughout the College		Large number of students and staff involved in entrepreneurial activities.		Increased opportunity to attract corporate investment in research, because of proximity to visible, adjacent ideas and IP.	
Improve timelines and systematic approach to disclosures by academics, and work with the UK Intellectual Property Office to explore whether there are conflicts between publishing and patenting		Thematic, diversified approach to managing IP, licencing, Angel and VC investment and corporate interests, aligned with College strategy.	Create new mechanisms for experimenting with ideas that have not been commercialised, but that may have future potential use: proof of concept and incubation.	Development of wider range of new entrepreneurial ventures.	
Work with the TTO to determine how to optimise the cost/benefit trade-off for the intellectual protection of our assets	Good within defined parameters of patentable IP.				
Provide a periodic refresher of IP law and Imperial policy to the College faculty and staff		Tactical: A managed Internet portal to an 'Ideas and IP Exchange', providing visibility to patents and those ideas that have not been invested in.	Further work needed to establish mechanism as part of review of role of TTO, Technology Pipeline Agreement and IP	Encouragement of wider pool of VC funding.	2015 – 2016
Explore bold, innovative ideas to maximise the external visibility of, and create a market for, our library of IP assets on a continuous basis	Poor: there are no mechanisms for activating latent potential.			Attraction of business to lease from Imperial College ThinkSpace due to visibility of portfolios of ideas in a growing eco-system at White City campus.	

The challenge for the College is to develop partnerships with a strategic portfolio of international private sector companies

Recommendations	Current performance	What excellence might look like	Implementation pathway	Potential benefit	Implementation timescale
Articulate a strategic portfolio of size and shape that will deliver a step-change in industrial research income in 2015-2020			Bring the majority of corporate funding within the management of Corporate Partnerships (currently c30%), expanding the role and resources of Enterprise as necessary.	Expansion of academic research income from £46m/yr to £65m/yr within 5 years.	
Prioritise development of collaborations in industry sectors where we are under-represented		International recognition for being the world's best university for industrial partnerships.		Development of long-term sustainable partnerships with leading technology companies in sectors where growth is likely over the next two decades, e.g. data science, Internet of Things, biomedical, pharmaceuticals, new materials, clean technology, energy, design, infrastructure systems, financial services.	2015 – 2020
Establish broader, more extensive UK and global industry ties and pursue strategic international partners			Develop strategic approach to sourcing partners, identifying and targeting those with potential for long-term collaboration aligned with College strategy.		
Engage more broadly and proactively with our current and target industry partners, beyond the Imperial Business Partners (IBP) programme	Good: Corporate Partnerships team performs well and has potential to move from "good" to "great".	A portfolio of strategic research partners and new industry networks aligned with the College strategy. Tactical: IBP of double the size with capabilities to influence and attract new strategic partners.			
Set out a clear roadmap for transition to deliver the strategic portfolio, with milestones and financial targets			Provide support, mentoring and incentives to develop a new cadre of academic leaders with the skills and interests to lead collaborative partnerships.		

③ PUBLIC + THIRD SECTOR COLLABORATORS

The challenge for the College is to create a strategic portfolio of public and third-sector partnerships

Recommendations	Current performance	What excellence looks like	Implementation pathway	Potential benefit	Implementation timescale
Establish a database of existing collaborations and relationships across the College	Fair: College has strong relationships with the agencies it knows well, but lacks a strategic approach to cultivating new organisations. This area is weaker, disparately managed and under-resourced compared to Corporate Partnerships.	International recognition for being the world's best university for working with public and third-sector science, engineering and medical institutions, trusts, charities, foundations and agencies.	Cross-College strategic coordination and management of public and third sector partnerships.	Major room for improvement for impact agenda and potential increase in research income, but recovery of Full Economic Costs a potential problem.	2015 – 2016
Define clear financial and non-financial objectives for these partnerships and the ways in which collaboration will achieve these			Need to develop strategy and capability to proactively target and manage new funding e.g. from charitable sector.		
Create a strategic portfolio of potential collaborators across public, third and community sectors		A portfolio of strategic sponsors aligned with the College strategy, particularly in health and wellbeing, energy and environment, education and outreach.		Expand income from Foundations and Trusts to at least an additional £15m over 5 years.	
Establish central responsibility for coordinating and managing College-wide collaboration with key partners			Provide support, mentoring and incentives to develop a new cadre of academic leaders with the skills and interests to lead collaborative partnerships.		

④ a. FORCE MULTIPLIER: COORDINATION, MEASUREMENT + COMMUNICATION

The challenge for the College is to enable visibility and coordination of its impact on society and the economy, without introducing unnecessary workload or bureaucracy

Recommendations	Current performance	What excellence looks like	Implementation pathway	Potential benefit	Implementation timescale
Define what we mean by societal impact and set out our goals, providing internal coherence and external thought-leadership	Poor coordination and measurement: there is no active mechanism to coordinate and measure impact across College.	The College becomes recognised as the world's best university for making a positive difference to the communities it works with and serves.	Establish coordination across teams, including Corporate Partnerships, Outreach, Academic Partnerships, International Relations Office, Advancement, TTO, Development and Innovation, Finance and Strategic Planning.	Potential benefits through influencing policy, improved and wider reputation leading to higher success in funded proposals, and in attracting and retaining staff and students.	2015 onwards
Position societal impact as a central strategic activity across the College community					
Lead the HE sector in defining and capturing performance measures of impact					
Establish a systematic mechanism to capture impact from research projects and education programmes, providing an evidence-based, data-driven approach to coordination and communication	Fair communication: College publicises success on an ad-hoc basis.				
Implement central light-touch coordination of the societal impact agenda whilst the recommendations herein are delivered	Room for major improvement.		Recruit new role as single point responsibility for "Impact Agenda": College Impact Officer.		
Deploy a communications strategy to increase awareness of the College's impact					

④ b. FORCE MULTIPLIER: STAKEHOLDERS, NETWORKS + COMMUNITIES

The challenge for the College is to make more of its successful projects in a targeted and systematic approach to stakeholder engagement

Recommendations	Current performance	What excellence might look like	Implementation pathway	Potential benefit	Implementation timescale
Identify and prioritise influential stakeholders who might assist the College's mission	Poor: but improving, with new Outreach and Academic Partnership leadership and activities.	A community of highly influential stakeholders prepared to engage and work with Imperial College to reinforce and magnify impact from research and education.	Strategy to be developed as part of Outreach and Academic Partnerships.	Potential for intangible/ secondary benefits through improving community relations and influence of policy relating to the HE sector.	2016
Establish a systematic approach to engagement for each of the stakeholders, incorporating new activity such as 'road shows' and coordination of communications					
Lead the HE sector in providing evidence to support external engagement					
Define a mechanism by which to measure and monitor influence, such as an impact tracker					

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④ C. FORCE MULTIPLIER: ROLE OF ALUMNI

The challenge for the College is to define and implement activities to involve alumni in increasing the College's impact, as part of a broader advancement strategy

Recommendations	Current performance	What excellence might look like	Implementation pathway	Potential benefit	Implementation timescale
Create greater alumni involvement in the College's 'people pathways', such as with mentoring for entrepreneurs Cultivate Imperial alumni, employed by existing and targeted industry collaborators to support research and education activities Explore innovative social media models through which alumni can help 'share the wonder' of our societal impact Extend these models to the College sharing the wonder of our alumni's societal impact	Poor: alumni periodically express desire to become more engaged in support of the College's impact agenda but no mechanisms currently exist.	Imperial College alumni associations around the world engage in supporting and promoting the College's impact agenda.	To be developed as part of Strategy for Advancement and Alumni Relations.	Systematic alumni engagement with student projects, development of IP, White City campus etc. Additional potential benefit through alumni giving, following deeper engagement.	2016 onwards

⑤ CULTURE, INCENTIVES + REWARDS

The challenge for the College is to recognise and reward efforts by its staff towards societal impact

Recommendations	Current performance	What excellence might look like	Implementation pathway	Potential benefit	Implementation timescale
Introduce formal and consistent recognition of societal impact in promotion and PRDP criteria for all staff	Poor to fair: there are no systematic processes to reward impact.	The desire to succeed in gaining impact from research and teaching is embedded fully within the culture, career development and employment criteria at Imperial College.	Develop processes for implementation with HR.	Benefits in attracting high profile academics wishing to demonstrate impact of their work.

Benefits in providing improved student experience and satisfaction. | 2016 onwards |
Introduce high-profile 'Impact Awards' to publicly celebrate leaders in impact					
Explore mechanisms to provide greater time flexibility to all staff so that they can pursue societal impact					
Continue to build, support and celebrate a culture of student entrepreneurship					

This review reveals a potential funding gap because of the projected decrease in HEFCE and Research Council funding. We believe this can be more than matched if the recommendations are implemented. We suggest targeting a year-on-year increase in revenue from corporate partners and Foundations and Trusts of +£6m, thereby expanding revenue by at least £30m per year by 2020-2021.

From analysis to implementation

The College will need to make choices as to which recommendation(s) to focus on, and conduct detailed planning prior to implementation.

Much of the capability to increase societal impact exists within College, but, as multi-disciplinary working becomes more pertinent and extensive, the level of internal coordination and oversight must also improve. This may be achieved by embedding individuals within the four Faculties to oversee, champion and incentivise impact – perhaps supported via the already embedded Faculty Operating Officers, Corporate Partnerships Managers and Development Officers, and through a regular 'spotlight on Impact' communications piece in The Reporter, or other Imperial publications.

Our final recommendation is to appoint a **College Impact Officer** to oversee implementation, focusing on internal coordination, measurement and communications.

1. Context

The need to clarify, promote and manage *pathways to societal impact* has grown in importance. Imperial College President's Executive Group commissioned this review in December 2014. It sought to understand the mechanisms by which Imperial College gains impact through its research and education, beyond the traditional publication of research results and education of talented people.

The review provides recommendations for implementation in five areas, which directly map to the College's strategic priorities, outlined in the College Strategy 2015-2020:

- **Collaboration** – providing access to sources of new research ideas
- **Strengthening and diversifying revenues** – increasing and diversifying sources of income, by strengthening relationships with corporate partners, foundations and trusts; managing new facilities through Imperial College ThinkSpace to generate revenue from incubation, start-ups and technology businesses
- **Staff community and student experience** – providing conditions for staff to flourish in applying their ideas and for students to gain practical, entrepreneurial experience
- **Sharing the wonder and alumni relations** – extending outreach by engaging with local communities, schools, alumni and friends
- **Informing decision-makers** – developing performance standards for impact and excelling in external reputation and assessment.

Leading the way

Imperial College is an acknowledged leader. The application of new ideas is a core part of its mission and the value of engagement between research, education and practice is well recognised.

The decision to list Imperial Innovations on AIM (Alternative Investment Market) in 2006 was radical at the time, establishing a third party technology transfer office (TTO). Its success in creating a venture fund to develop university intellectual property (IP) has produced a portfolio of businesses, particularly in therapeutics, creating value for Imperial through its equity holding. Imperial Innovations also invests in ventures from UCL, Cambridge and Oxford universities. This model has proven successful, but has also exposed gaps in provision of support for ideas in their early stages of development at Imperial, in widening direct access to other venture capital providers and in promoting ideas that were not chosen for investment.

There are numerous other examples of Imperial College's impact corroborated by the ranking as the top UK multi-disciplinary university for impact through the research (Research Excellence Framework REF 2014).

Initiatives such as Imperial College Create Lab, an Imperial College and Imperial Innovations partnership, have gained recognition as a leading UK start-up community. Since launching as Imperial's first Venture Catalyst Challenge in February 2012, Create Lab has: provided a platform for +3000 students/year to participate in programmes and events; intensively supported +80 ventures, involving 200 students; delivered 80 events/year through six different initiatives; engaged 400 members/year of London's tech and investment community during the Imperial showcase events, highlighting leading student teams; awarded £50k in grants to teams; established a mentoring network of 220 mentors who actively support teams; and enabled 70% of teams to raise a total of over £6m proof of concept funding (including 3 exits).

The Althea-Imperial programme, launched in 2014 provides unique support for women entrepreneurs: with results from its first competition attracting international attention. Imperial is leading the way in science outreach in primary schools through an innovative partnership with Twig World, a digital education company. There are also bold proposals for Advanced HackSpace activities and facilities to support design, proof-of-concept and prototyping by staff and students at Imperial's White City campus.

The College seeks to maintain its leading position in the global higher education sector. The environment is, however, likely to become more competitive as funders, governments and universities themselves set, and strive to meet, new standards.

Societal Impact: beyond technology transfer

Application of academic research through technology transfer has long been recognised as a means of potential economic and broader societal advancement. Since the establishment of TTOs in universities during the 1980s and subsequent professionalisation of these operations, there has been increasing scrutiny of their effectiveness. In the majority of cases, this is gauged through output metrics, such as patents filed, start-ups formed and licensing income. Periodic government and Research Council comparisons of national and international performance are commonplace, for example as part of HEFCE's annual Higher Education-Business and Community Interaction survey.

The evidence shows that most universities fail to generate income from their IP [W. D. Valdivia, 2013]. A few have been successful, but revenues are often much smaller than is perceived and many universities make a financial loss. For Imperial College, technology transfer outcomes are important: equity held in Imperial Innovations has created value in Imperial's Endowment and an effective TTO helps external application of research. Technology transfer is, however, only part of the system. Emphasising a few select commercialisation 'pathways' neglects a myriad of other routes by which research and education interacts with and can have beneficial impact for society.

A systems approach to impact

The College has an opportunity to lead a broader vision of societal impact in the Higher Education sector, whilst developing the more narrowly defined pathway of technology commercialisation through its TTO.

We propose an innovative model that encapsulates application of research and experiential education across the private sector, public sector, third sector (charities, foundations, trusts and NGOs) and broader community. This is a dynamic system in which exchange of ideas occurs through interactions and flows of people, knowledge and technology. We call these the *pathways* to societal impact (Figure 1). Developing, encouraging, measuring and rewarding participation in these pathways should be inherent in everything that we do, in the same way that research and education are fundamental to the College's mission (Figure 2).

- **People**: developing, educating and engaging talented people is the largest direct impact that the College has on society, perhaps followed by treating patients at our hospitals; including full-time and part-time students, permanent and temporary staff (professional services and academic), as well as internships, Adjunct Professorships, those in further education, alumni, partners, clients (e.g. of executive education), donors, advisers, and friends.

- **Knowledge**: dominant through scientific publishing, albeit this may have less direct or immediate impact on society; includes pathways such as consulting and problem solving, data sharing, conferences, influencing policy, outreach, and defining new research domains.

- **Technology**: the core mission of the College's TTO includes pathways such as patent filing, licensing, entrepreneurial start-ups and spin-outs, as well as less common routes of standards setting.

This wider systems approach is becoming recognised by other major institutions as research councils, government departments and private corporations are exploring their relevance and impact on society.

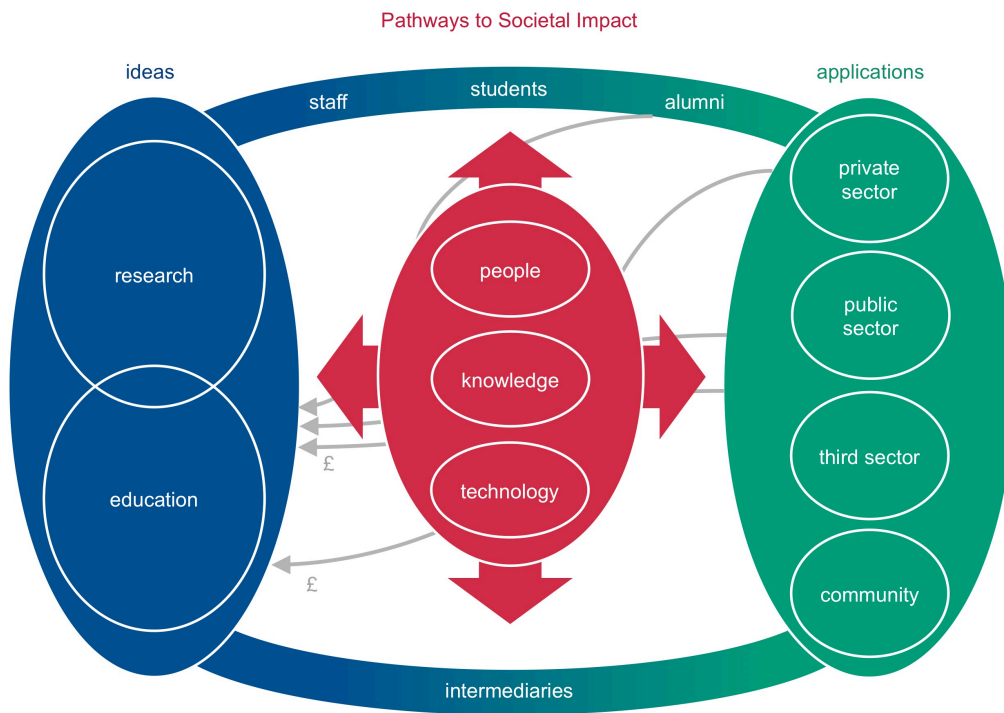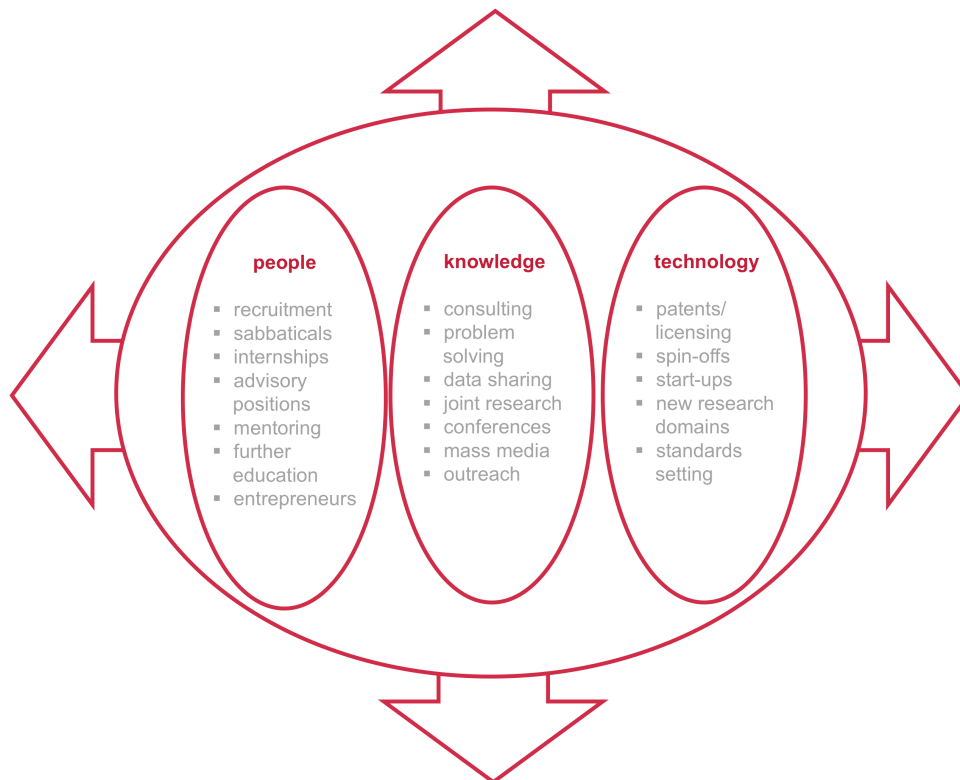**Figure 1:** Societal impact system [A. Hughes et al, 2013]

Pathways to Societal Impact

ideas

applications

staff students alumni

research

education

people

knowledge

technology

£

£

private sector

public sector

third sector

community

intermediaries

Figure 2: Pathways to societal impact

people
- recruitment
- sabbaticals
- internships
- advisory positions
- mentoring
- further education
- entrepreneurs

knowledge
- consulting
- problem solving
- data sharing
- joint research
- conferences
- mass media
- outreach

technology
- patents/ licensing
- spin-offs
- start-ups
- new research domains
- standards setting

Mechanisms through which ideas flow

Each of the four mechanisms, through which ideas flow (Figure 3) are important for Imperial College. They are essential for realising the vision of multi-disciplinary collaborative work in facilities at White City, where new configurations of space are being designed to encourage ideas to collide productively between many different parties.

Figure 3: Mechanisms for societal impact
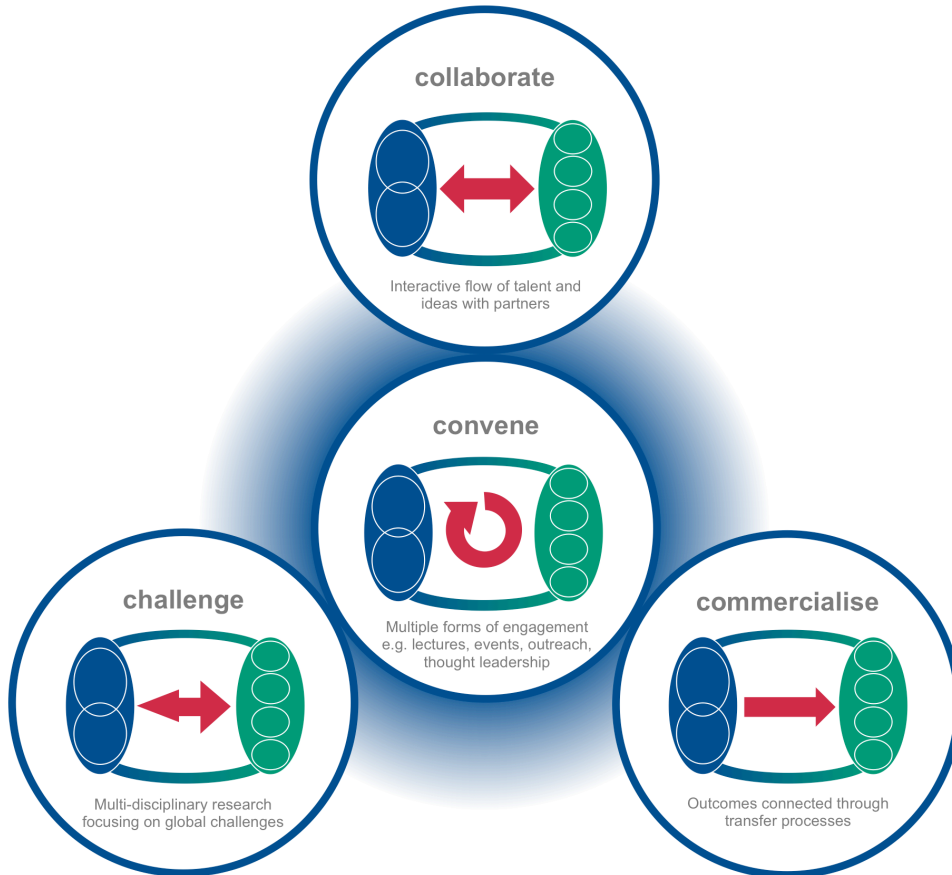
- **Convene:** Universities have traditionally played a role in stimulating debates, hosting conferences and providing public lectures. MIT's *Solve* initiative – convening technologists, philanthropists, business leaders and policy-makers – is a current example of the convening power of universities to tackle grand challenges. The development and exchange of knowledge is a fundamental activity of any university. Imperial acts independently of political, business and other interests, providing impartial, trusted advice and space to bring parties together to discuss ideas and policies, sharing knowledge about problems and their solutions. These facilitative activities sometimes target specific participants such as through the Imperial Business Partners (IBP) programme, Tech Foresight Practice and the many special interest groups that meet on campus. They also involve a wide range of ad hoc, transactional relationships at public lectures, regular events such as the annual Imperial Festival and through the Outreach programme. The Internet and social media provide the potential to extend and scale facilitative activities significantly, widening the opportunity for engagement.

- **Commercialise:** The traditional technology transfer approach employed by universities is a research- or technology-push function. The pathway is used as a means to exploit research outcomes when ideas developed in laboratories and elsewhere are thought to

be of potential value. Intellectual property disclosures are protected and return is sought through licensing, starting businesses and their sale. Imperial College has generated a range of examples from Ceres Power to Circassia.

- **Challenge:** Research projects aim to discover and solve problems, sometimes tackling global challenges, often with participation of research users from business, government or third-sector institutions i.e. technology- and knowledge-pull. Projects are sometimes commissioned to deliver specific outcomes. Articulation and understanding of problems and challenges in everyday settings are a familiar source of fundamental research questions, often stimulating academic endeavour. This has resulted in the growth of multi-disciplinary research institutes targeting seemingly intractable challenges in areas of global health, energy, climate, environment, and data sciences. More granular examples include initiatives such as Imperial's Rio Tinto Sports Innovation Challenge, or HRH The Duke of York's Pitch@Palace 4.0 focusing on smart cities and Internet-of-Things.

- **Collaborate:** The collaboration mechanism involves longer-term closely coupled interaction between universities and external partners, working together on programmes that further the body of academic knowledge with outcomes that benefit business and/or society. In this model, external partners may sponsor the development of the university's research expertise, sometimes in new areas; support the deployment of novel technology solutions, and provide the talent required for successful application through education programmes. For example, Imperial's Qatar Carbonates and Carbon Storage Research Centre (QCCSRC) successfully operates in all three of these ways. Well-established partnerships often include two-way secondments and co-location of research staff. The College's Corporate Partnerships team focus much of their effort in establishing and sustaining sponsored collaborative work with technology companies, offering an optional service to academic staff to facilitate and build relationships with industry, identifying areas of mutual interest and designing appropriate, bespoke models for engagement.

Status quo is not an option

A better understanding of the landscape in which College operates is needed to inform its long-term strategy and realise the expectation that it will continue to excel in the application of new ideas. At present, no framework exists within which to assess the College's societal impact, future opportunities, resources, risks, benefits or competitors. Current activities have evolved in a piecemeal and opportunistic manner with no overall coordination, measurement, communication or plan for growth. This hinders opportunities to gain buy-in for initiatives across the College, resulting in failure to realise the full potential for delivering societal impact.

Government policy and industry demands are shaping this landscape, highlighting a need to place greater emphasis on the quality of student experience, external engagement, collaboration, technology transfer and translation.

There is explicit government focus on demonstrating the impact of research, and growing expectation of accountability for use of public sector expenditure. Quality-rated funding from HEFCE to underpin research is forecast to decline, despite Imperial's strong performance in the REF 2014. In successor REF exercises, the government is expected to maintain or increase the weighting given to impact, following the recent explicit recommendation [A. Dowling, 2015]. Funding from Research Councils UK is also likely to become more competitive over the next five years with budgets capped or reduced and with an unprotected UK government higher education budget (Figure 4).

Competition for research and translation funding is increasing with a growing number of 'intermediaries'. These facilitate delivery of impact in the ecosystem that spans both College activity and the wider environment. These can be internal, inter-institutional, or fully external.

- Wholly College 'owned' intermediaries play an important role in supporting the College's societal impact, including through helping to provide funding, brokering demonstration sites and building relationships with users. These may be multi-disciplinary centres and

institutes (e.g. Centre for Blast Injury Studies) or research consortia (e.g. PharmaCat – an Imperial-industry consortium to promote stronger collaboration between chemistry and chemical engineering, working with AstraZeneca, GlaxoSmithKline, Pfizer, Syngenta and Lilly) where different faculties work together, often with external partners, to focus on solving specific problems.

- Institution-spanning intermediaries, only part led by the College include European Institute of Innovation and Technology (EIT Health, Digital and Climate) Knowledge Innovation Communities, the Francis Crick Institute, and the Sir Henry Royce Institute for Materials Research and Innovation. Our role, influence and direct impact in these can vary substantially.

- External national and international intermediaries such as the Catapult Centres (High Value Manufacturing, Digital, Transport Systems, Future Cities, Cell Therapy etc), and European Innovation Partnerships (Agriculture) support similar challenge-oriented research and innovation programmes. The number, range and roles of these external parties in the university technology transfer system is expanding; for example, there are a growing number of student-led and third party incubators, entrepreneurship competitions and accelerators.

Figure 4: Imperial College funding profile
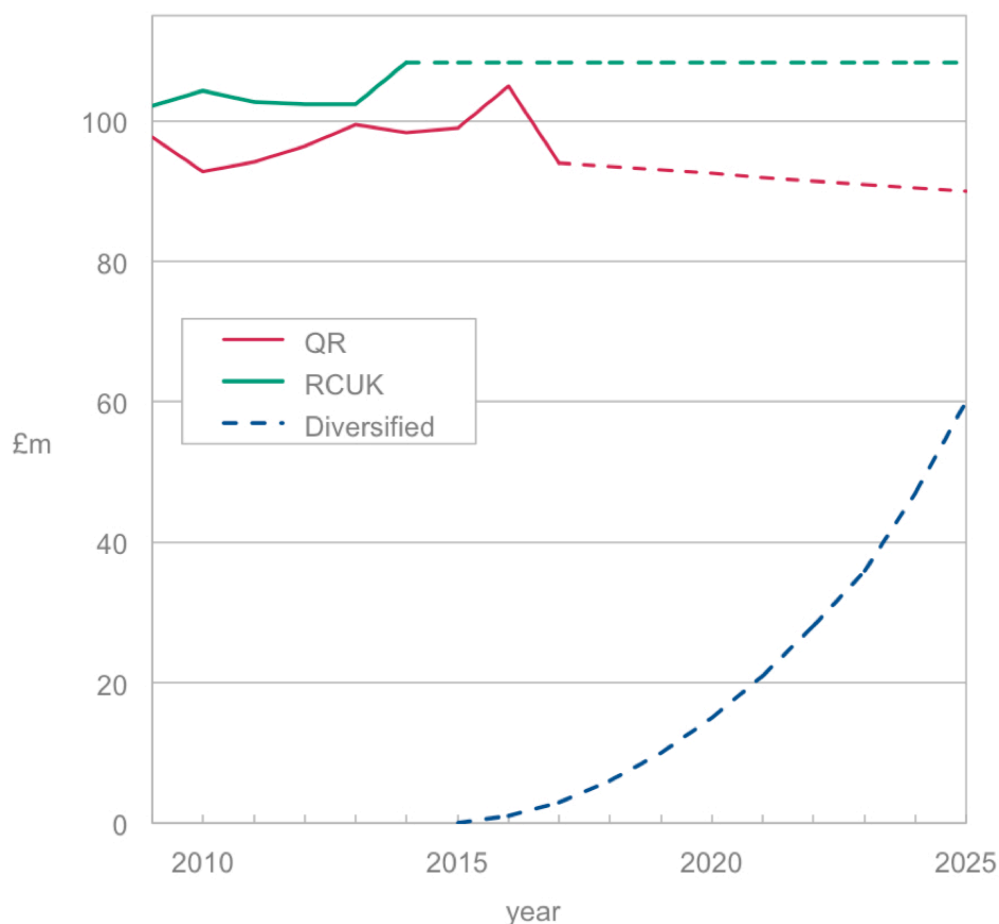
QR = mainstream QR (including London weighting) + QR charity support fund + QR business research element + QR RDP supervision funds + non-consolidated transitional funding for RDP supervision (2016) + non-consolidated transitional funding to mitigate removal of STEM protection (2016)

RCUK = funding from Research Councils UK including capital depreciation

Diversified = target increase in income from corporate partners (+£3m/yr full-FEC) + target increase in income from Foundations and Trusts (+£3m/yr) i.e. projected (most likely non-linear) additional income from diversified sources

As the ecosystem becomes crowded, participation in many intermediaries also requires matching funding from other sources: more institutions are seeking to participate by bringing

together diverse sources of funding with the offer of delivering targeted, impactful results. Imperial College is regularly approached to participate, often with requests to contribute its own resources to match funding from elsewhere, and to contribute to overheads of intermediary organisations. It would therefore appear useful for College to be able to frame its potential participation in new, joint intermediaries in the context of the mechanisms that link its research, education and societal impact system. This might assist in assessing how much, and what types of activity College can and should achieve on its own, versus in partnership with others.

Some of Imperial's current competitors are performing well in managing external engagement and new competitors are emerging. They compete for the best students who expect to gain hands-on experience as well as a top-class education, thus increasing their employability. The emergence of innovative approaches in education (e.g. MOOCs – massive open online courses) and in research (e.g. open access agreements) may erode some traditional sources of competitive advantage.

Standing still is therefore not an option. The challenge is to maintain and extend Imperial's leadership by integrating pathways for societal impact widely within research and education programmes whilst establishing new sources of sustainable funding.

A strategy is needed to provide coherence and insight into complicated and multi-facetted partnerships, particularly if the College is to build and participate in larger scale programmes in the future. This should encourage widespread involvement from across the College, with oversight and integration to make the whole greater than the sum of the parts.

Objectives

The review focuses on mechanisms to:

- Measurably increase the College's societal impact;
- Support a shift in culture – incentivising, recognising and rewarding activities that lead to impact;
- Grow and diversify funding for research and education;
- Create opportunities for success of expanded research, innovation and translation capabilities across all campuses.

The recommendations made across five areas are supported by evidence and discussion, providing prompts for further dialogue and development. The review recognises that there is no single 'right approach' and that new ideas need to be tried: experimentation is as important in testing new ways to gain impact as it is in scientific research.

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2. Latent Potential

As a leader in STEMB research, Imperial College has deep experience engaging with research funders, entrepreneurs, corporate partners and managing Intellectual Property. It has been innovative in its mechanisms for managing technology transfer, in its Corporate Partners programme and in launching Imperial Innovations as a publicly quoted company. This review identifies areas where there is potential to do more. This is not because of failure in existing mechanisms, but because of success in these approaches and growth in research activities in multi-disciplinary challenge-led areas where there are wider opportunities for engagement with research users and to develop IP. We refer to this as *latent potential* and show that more can be gained through a systemic approach to co-ordination and integration of activities across the College.

Intellectual Property

The disclosure of inventions and their exploitation through licensing-out or via spin-out companies is a well understood *technology pathway* to impact. Imperial College has gained much experience of this over the past two decades. Academics disclose inventions with perceived commercial value, through the TTO, with services provided by Imperial Innovations. The TTO assesses the possibility of intellectual property protection and commercialisation. This offers potential financial benefit for the College and the inventor, as well as the possibility of broader economic and social impact.

A general tension can exist between IP disclosure and publication of research results. In the UK, once research results are published in a scientific journal, becoming publicly available, there is limited scope to subsequently protect it as intellectual property (Figure 5). Imperial's academic culture and the ways in which academic performance is typically measured means that publication is usually dominant. This has contributed to the College's position as an international research leader, measured by the quality and volume of academic publications: it is ranked number three in the UK for scientific impact, as measured by mean citation score, behind Oxford and Cambridge respectively.

Figure 5: Basis for latent potential – simplified schematic
[Source: Expert interviews; team analysis]
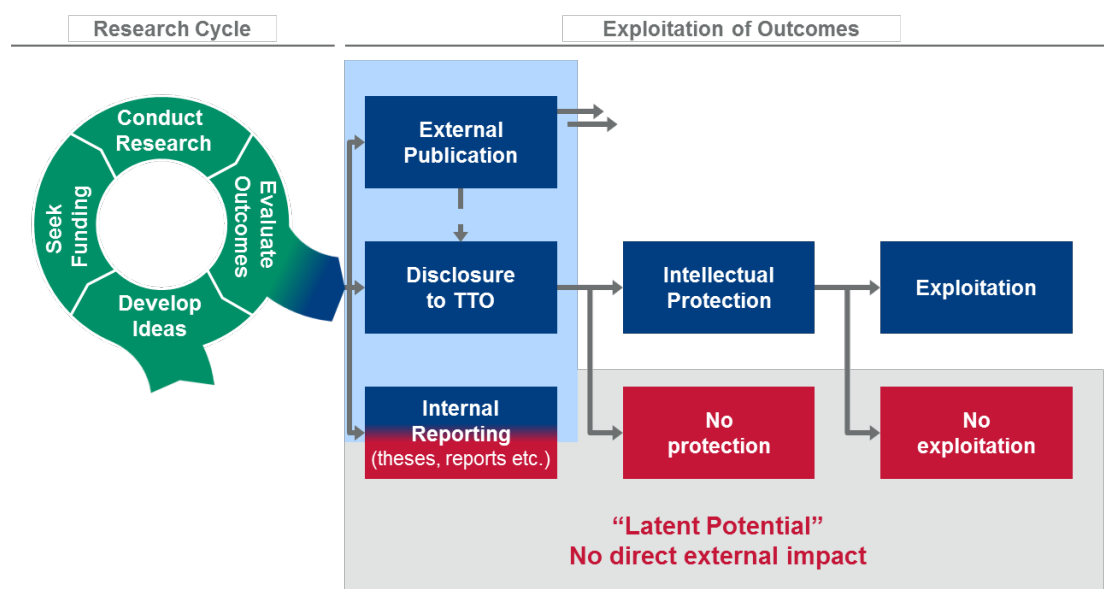
The College performs moderately by traditional measures of technology transfer. For example, invention disclosures to the TTO total 306 (2012-13), and the volume of this activity has grown ~5% CAGR over the last five years (Figure 6). Similarly academic spin-out activity appears healthy, if not spectacular, totalling 4-6 companies per year, with a few high profile later-stage successes such as Circassia.

In the period 2009-2012, Imperial College published a total of 21,300 scientific publications (10,063 if counted fractionally – i.e. collaborative publications count as a fraction, depending on the number of co-authors) according to the CWTS Leiden Ranking 2014. Given this volume of research activity and scientific output, there is a perception within parts of the College that there should be greater impact through technology transfer and translation.

In fact, the volume of disclosures to the TTO is high both by UK and US standards. Over the period 2009-2012, Imperial's academics made on average 105 disclosures for every 1,000 scientific publications, on a par with Stanford and significantly ahead of UK peers Oxford, Cambridge and UCL, although comparison with MIT shows that more can be done. Whilst this is only one indicative proxy measure, it suggests that Imperial's academics are aware of the potential impact of their research through commercialisation. This does, however, raise the question of where in the pipeline College needs to do more to maximise this latent potential (Figure 7).

Figure 6: Imperial College London invention disclosure to TTO. Absolute number of disclosures, 2009-2012 total
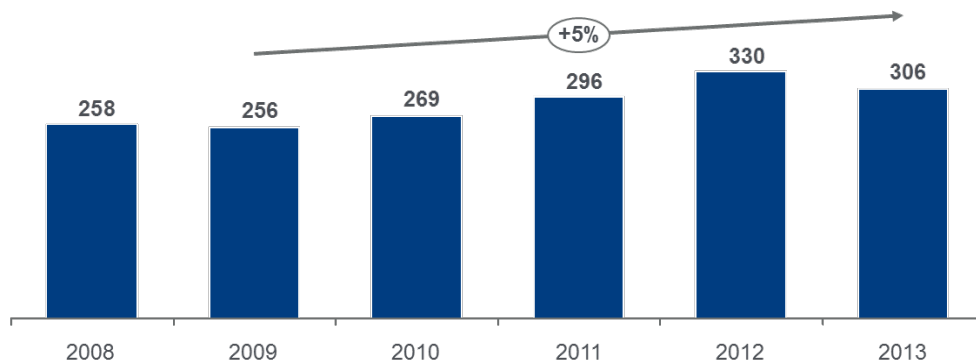[Source: Imperial Innovations; team analysis]

Figure 7: Invention disclosures per 1000 scientific publications[1,2]: 2009-2012 total
1) Total number of scientific publications 2009-2012; collaborative publications are counted fractionally between institutions
2) For Imperial and MIT, calculated based on 95% of total disclosures (to exclude impact of business school); for others this is based on 75% of total disclosures (to exclude impact of business school and non-science disciplines)
[Source: CWTS Leiden Ranking; HEIDI database; Imperial Innovations; literature research; team analysis]
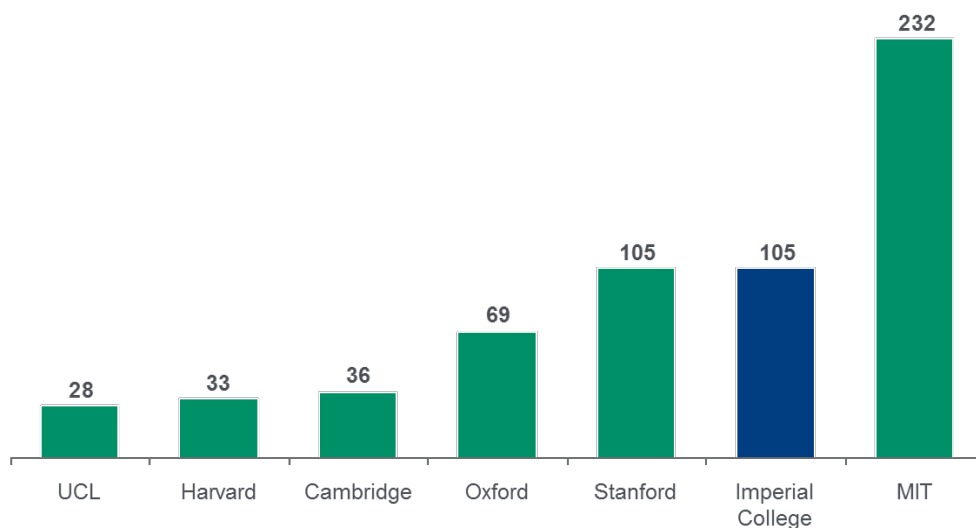
It is clear that Imperial College already has a UK-leading position in terms of invention disclosures from its research activity (Figure 7). However, recent analysis suggests that this is heavily concentrated within a small subset of the academic community [M. Perkmann, 2014]. Whilst certain disciplines, individuals and projects are predisposed to application, there could be even greater latent potential within the remaining 90%.

Not all companies formed by Imperial College academics have been created by the TTO and supported by Imperial Innovations. A recent survey of academic impact across the College found that 470 faculty members were company directors involved in 507 companies, of which 62 were classed as supported by Imperial Innovations [M. Perkmann, 2014]. Subsequent analysis found 560 companies operating with Imperial employees between 2001 and 2011. The majority of these were service companies or had no formal IP. Figure 8 shows the array of different types of company formed with Imperial staff.

Figure 8: Different types of company formed with Imperial College staff
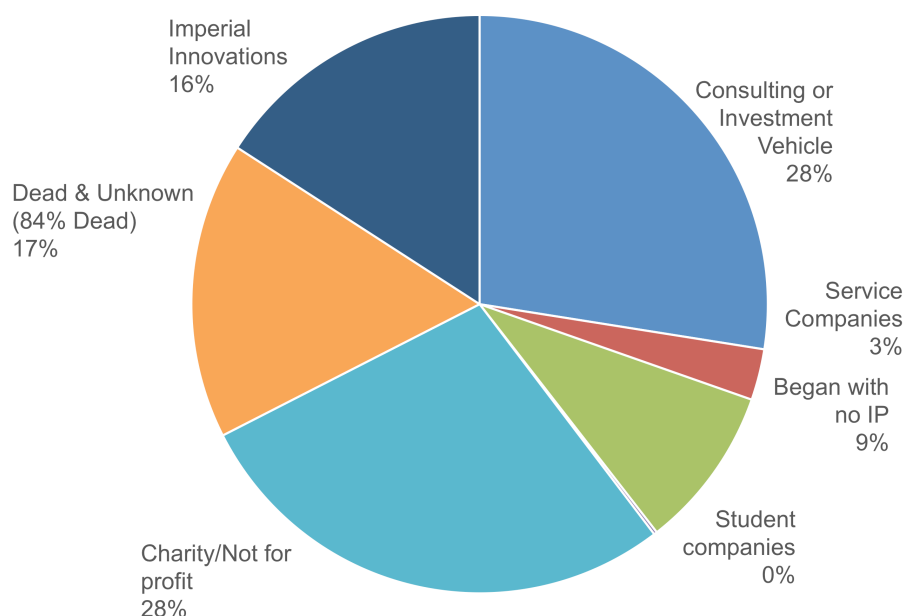
Private sector partnerships

There is significant scope to increase collaboration with industry with development of the White City campus and with plans to diversify and strengthen income streams.

Collaboration is important for broadening Imperial's societal impact and sustaining its financial strength. Private sector partners play a significant part in Imperial's collaborative research, creating opportunities to increase flows of *people*, *knowledge,* and *technology*.

- **People:** Imperial College's students and staff contribute to the human capital of industrial partners, through the recruitment of students, placements, internships and employees; they influence industry, via advisory positions and visiting appointments; they inform industry challenges and approaches through workshops and conferences; they help train leaders through executive education. There are significant opportunities for the College to expand these activities, many of which are ad-hoc and small scale at present.

- **Knowledge:** Two-way flows of knowledge result in solutions to partner's problems, for example through consulting (Imperial Consultants, ICON), IBP and through publications, thought leadership and standards. In parallel this helps to inform our research and engagement agendas. There is an opportunity for the College to build on this work and ensure its future relevance through listening, responding and leading.

- **Technology:** Imperial has a strong portfolio of research collaboration, much of it built on long-standing relationships with leading technology companies such as Rolls Royce and Shell. This provided more than £46million in private sector income (2012-13), amounting to 14% of all College research income. These relationships and the activities and revenue they generate are increasingly important for delivering the College's research and for leveraging other funds, particularly as government and research council funding continues to be under pressure. There is additional scope to grow this stream significantly, whilst redefining the College's modes and scale of collaboration associated with the development of the White City campus. Examples of multi-disciplinary opportunities at White City which can enable the volume of our industry collaboration to increase significantly include: the Molecular Sciences Research Hub; Translation and Innovation Hub; Data Science Institute; School of Public Health; and the Michael Uren Biomedical Engineering Research Hub.

The College's model for private sector partnerships has traditionally been academic-led, wherein areas for collaboration have been identified within existing or adjacent research activity, often after a potential partner has approached the College. This has been consistent with the College's focus on academic excellence and the academic lead's relationship management and negotiating skills should continue to be respected, and their role encouraged.

Some of the College's private sector relationships are managed by the central Enterprise Division through its Corporate Partnerships team. These relationships provide research income as well as broader funding support, for example, the establishment of new institutes and provision of equipment. Many industrially funded research projects are managed directly by individual academics (and respective departments) through their personal networks, in which Corporate Partnerships plays no role. Over the past two years, Corporate Partnerships was engaged on approximately half of the industry-funded awards (by monetary size, not number of contracts). This review uses data from both groups, as appropriate.

The College's industrial research income has increased at ~12% CAGR over the last three years; however over the last five years it is broadly flat (2012-13 £46.1mn vs. 2008-09 £45.7mn). Compared to UK peers, Imperial College remains number two in terms of industrial research income (on a like-for-like basis, using REF 2014 submissions and excluding arts and humanities funding), slightly behind Oxford and significantly ahead of Cambridge and UCL. Note that this research income data is comprised of a mix of 'collaborative research' and 'clinical trials' income; Oxford's significant growth in research income can be attributed to a small number of large clinical trials contracts with Merck (£100m+ in combined contract value). Imperial's US peers show that a step change is possible: MIT, for example, had a private sector research income of £84mn in the same year (Figure 9).

Figure 9: Research income from industry, commerce and public corporations (GBP mn; 2008-2009 to 2012-2013; as submitted to REF 2014)
[Source: REF 2014 submissions (only including assessment units – i.e. departments - #1, 2, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 19); team analysis]
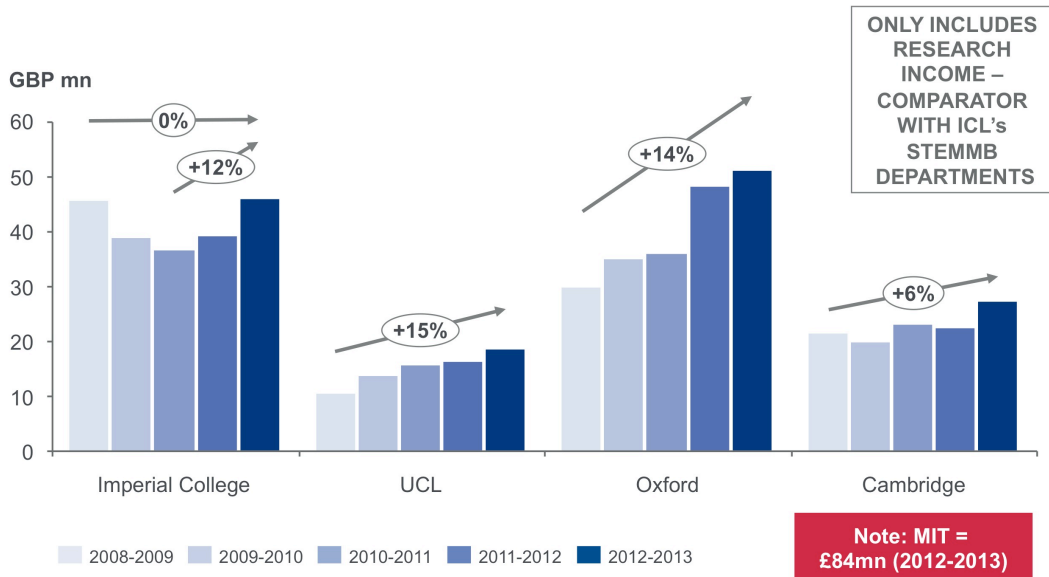
Global industrial research and development (R&D) has grown at ~6% CAGR in the period 2010-2014. The total R&D spend of the top 1000 technology firms was about $643bn in 2014 (Figure 10). Of this, only a small proportion may be dedicated to research, as opposed to development, and in turn, only a small proportion is invested in universities. Estimates suggest that the overall market for industry-funded research is in the region of $5bn. The current market share of Imperial – and indeed leaders such as MIT – is a small proportion, particularly given its international ranking for research and its reputation for industrial relevance. The question is, in terms of market conditions, resource and reputation, is it feasible for any one dominant university to take a substantive share of global industry-funded research? We think there are opportunities for Imperial to expand substantially.

Figure 10: Total R&D spend of Top 1000 Global Spenders (USD bn, 2005-2014)
[Source: Strategy& 2014 Global Innovation 1000; team analysis]
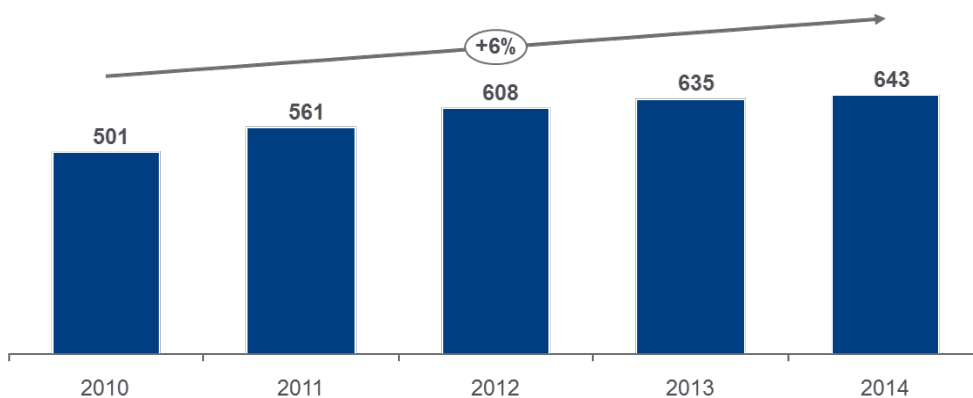
The Corporate Partnerships team offers a thorough assessment of the quality of potential partners and the possibility of securing a more favourable deal and delivering a faster route to contract than is often the case when left to academic leaders.

Nevertheless, there is the perception that the College is reactive in its approach to identifying new industry partners. With respect to the inclusion of emerging high-growth companies, SMEs, scale, and sectoral dependencies, the partnerships portfolio is in places outdated and sub-optimal in composition.

Public and third sector collaborators

Collaboration with *private sector* partners well-established at the College. There are many strong relationships with non-governmental organisations, particularly trusts, charities, foundations and institutional funders, such as the Wellcome Trust, Wolfson Foundation, Hamlyn Foundation, Cancer Research UK, Bill and Melinda Gates Foundation, and Rockefeller Foundation. Imperial, however, is not strategic in its approach to collaborations with third sector partners; a new approach is required to coordinate and pursue a strategic partnership portfolio

Imperial's partnerships with not-for-profit organisations take various forms, including

- **Philanthropic giving:** led by Vice President – Advancement, a recent appointment, and the growing Advancement Division, which signals the importance the College is rightly placing on central coordination and relationship management of individual giving

- **Sponsored research and translational funding:** supported by departments/faculties, Strategic Planning, Research Office, Enterprise Programme Management Office, and Corporate Partnerships

- **Individual relationships** between key foundation/trust stakeholders and academics (in Advisory positions and/or as policymakers and/or in their academic capacity): supported by departments/faculties and Advancement. There is anecdotal evidence to suggest that many foundations and trusts prioritise building relationships with high-profile Imperial academics (after which funding may follow), rather than focusing on backing particular areas of research or practice.

Many of the larger public and third sector organisations operate on the basis of structured funding calls with routine application procedures and deadlines, similar to the Research Councils. In some cases, funding proposals will be submitted from different departments and groups across the College – often leading to a number of separate contact points and successful grant recipients, but without one overall relationship manager. The risk to the College of continuing this fragmented approach is the missed opportunity for long-term strategic discussions to take place at an institutional level that could unlock larger amounts of funding.

To date, the College's approach to managing public and third sector partnerships has been on a case-by-case basis, as opportunities arise. This is due to historical gaps in the College leadership structure spanning these areas, and because it is harder to define a clear financial benefit case for central coordination of such partnerships, particularly if it is not possible to recover full economic costs. Nevertheless, public and third sector partners offer a significant source of additional research funding, and it is in this area where many new opportunities lie.

However, as with most other HEIs, the opportunities with foundations/trusts are often overlooked due to lack of a clear institutional 'owner': the College typically does not coordinate centrally, or have central visibility of the breadth and depth of its public and third sector relationships, many of which are conducted at arms-length through research grant funding processes. It should also be noted that in some cases our current/target private sector and public or third sector partners might not be distinct entities. For example, Tata Group is a member of Imperial's Business Partners programme, and has affiliated Tata trusts. Furthermore, the College does not have staff dedicated to securing and managing public and third sector sponsored research/translational funding. Although rare, there are some positive examples of institution-wide coordination of public and third sector stakeholders amongst other HEIs, with responsibility tending to sit within their Advancement Divisions. For instance, the role of a Trust and Foundations Manager at the University of Bath, reporting to the Deputy Director of Development and Alumni Relations and Head of Major Gifts.

The academic and societal benefits of including public and third sector partners in a new, strategic approach have the potential to be very large. Private sector partners are ultimately driven by financial value creation, whilst public and third sector partners are typically

motivated by social goals and solving global challenges, through translation of ideas into practice.

Integration and visibility across the organisation

As part of the Research Excellence Framework exercise in 2014 (REF 2014), College documented and submitted case studies. In aggregate, Imperial College was ranked as the leading multi-disciplinary institution in the UK for research impact. Imperial was ranked first in the UK and Europe in the Reuters World Top 100 Most Innovative Universities 2015. Imperial, however, has not been strategic in its approach to coordinating, measuring and communicating its impact beyond the requirements of the REF.

From REF 2014 and other forms of formal impact assessment it is clear that Imperial delivers impact. It is also clear that College regularly generates numerous tangible examples, highlighting the social and economic difference Imperial's research and education makes. For example, in 2015 there were instances as diverse as:

- The launch of the multi-disciplinary Dyson School of Design Engineering, providing public visibility and a focal point for expansion in an area where Imperial can make major contributions;
- The selection of student start-up FungiAlert – designed to improve crop yields through early disease detection – as winner of the Imperial Create Lab Showcase entrepreneurship awards;
- The announcement of collaboration with the Chinese University of Hong Kong to develop next generation biomedical robotic technology to tackle issues in global health;
- A public exhibition celebrating the work of women staff and students at Imperial, providing greater visibility for the College's equality agenda;
- Visit of President Xi and signing of three new collaborations;
- Leading and influencing at the World Economic Forum, Dalian, including keynote addresses by President Gast and Professor Klug, the design and delivery of a bespoke Tech Foresight Practice 'Ideas Lab' session, and participation from Dr Li and Dr Veselkov (named among the WEF's '40 extraordinary scientists under 40');
- Imperial-affiliated teams awarded first and third place in HRH The Duke of York's UK-wide entrepreneurial competition, Pitch@Palace 4.0.

College recognises it lacks a strategic approach to coordinating, measuring and communicating this impact, limiting the effectiveness with which it can differentiate itself from other universities and build a reputation that would improve success in fund-raising.

- **Coordinating:** The current fragmented and opportunistic approach reduces the ability to gain buy-in for initiatives across College and can result in confusing or diluted messages externally. It is difficult to assess and make decisions on priorities, future opportunities, resource implications, risks and benefits.

  For example, when attempting to capture and understand interactions with private-sector partners, there is often disparate information on which industry leaders and companies engage with College and which do not. There is no single, accessible cross-College system for capturing this. The Research Office logs grants awarded via Oracle, some of which have named industry partners associated with them. The Enterprise Division records relationships on Salesforce. The Alumni Relations unit, within the Advancement Division, keeps records of some senior corporate leaders who are prospective donors in their database, Raiser's Edge. Individual events teams, Departments and Institutes across College have their own databases on activities relating to industry partners (e.g. guest lectures). Often those from outside the College attending public events are not recorded. In-kind contributions to College, such as Advisory and Board positions are also not logged centrally.

  In consequence, research and fund-raising material is often produced without full knowledge of adjacent activities. Staff responsible for fund-raising and winning new

grants are often working in response mode, reacting to requests from others rather than identifying strategic opportunities and pursuing them.

- **Measuring:** As the College places a greater emphasis on the role and importance of societal impact in its mission, it is important that somewhere within the institution there is a holistic overview of what that impact is, particularly if the College chooses to position itself externally as a leader in impact. It is not practical to continuously undergo a periodic, internal "mini REF" exercise to collate case studies and success stories: there is currently limited oversight or coordination of our societal impact activities. Thus, in 12 months' time, for example, visibility of College's impact will be out-dated. Furthermore, College is not capturing valuable evidence of how impact has changed over time.

- **Communicating:** High profile impact examples are championed by College's leadership and publicised by the Communications Division but many other examples across departments and centres have very limited visibility beyond their immediate stakeholders. It is therefore difficult to provide systematic visibility and to ensure that there is sufficient support, coherence and celebration of a wider portfolio of activities from across the community.

Stakeholders, networks and communities

Beyond the *direct* benefits of communicating impact, the methods employed and the audiences reached in doing so can provide significant secondary and often unforeseen *indirect* benefit. This, in essence, is a 'force multiplier'; much of which is delivered via College's communications activities. For example, a direct impact of the College's outreach CPD programme into UK primary schools may be brand awareness amongst prospective students and future alumni, and therefore an increase in undergraduate applications several years later. A secondary benefit may be the impact on the science teaching methods of up to 200,000 teachers. Sharing awareness of that indirect impact is a valuable *influencing* tool for College, which may result in guiding the public perception of Imperial; reaching individual stakeholders who shape science policy; supporting the teaching of science in schools in emerging economies; increasing engagement with Board-level executives in international corporations; strengthening existing research collaborations with partners.

Despite Imperial's status as a world-leading university and reputation for excellence amongst certain subsectors of the academic community, holistic awareness of the Imperial College brand is not as extensive as many other leading multi-disciplinary competitors. For example, The Times Higher Education World *Reputation* Rankings, based on the opinions of fellow academics, has placed the College at number 13 or 14 for the last three years. Cambridge is ranked number 4 and Oxford number 5 (2014). Harvard, MIT and Stanford make up the top places (Figure 11).

Similarly, broader interest in College from outside the academic community also appears somewhat lower than UCL and Oxford (closely tied), and Cambridge and MIT. This is based on Google Trends' relative ranking of Internet interest (2014) of a subset of those five institutions (Figure 12). This gap does not appear to have closed over the last five years.

Some interviewees shared a perception that College should 'shout louder' about its successful projects, particularly since performance in competitive rankings shows that the College is not short of impactful content. However, whilst broad brand awareness has its benefits, it should not in itself be a goal. Clearly the College is a much younger institution than several of its peers, with a narrower scope of disciplines than many. Media and public interest in scientific breakthroughs may not be as prolific as that of politician alumni of Cambridge. Oxford University Press, MIT Technology Review, Harvard Business Review and other similar publications may also afford their respective affiliations a disproportionate advantage.

The question is how to make communication of our successes in societal impact work harder for us. Instead of targeting broad awareness, the key to the force multiplier is to be explicit about what aims the College wants to achieve and to be targeted in its response. To do this it is necessary to have a clear understanding of the stakeholders, networks and communities

that are a priority for the College, how we want to influence them, and with what agenda (aligned with the College Strategy 2015-2020). A distinctive position, in keeping with Imperial's academic principles, would be to practice evidence-based, data-driven communications.

Figure 11: Times Higher Education World Reputation Rankings, 2011-2015
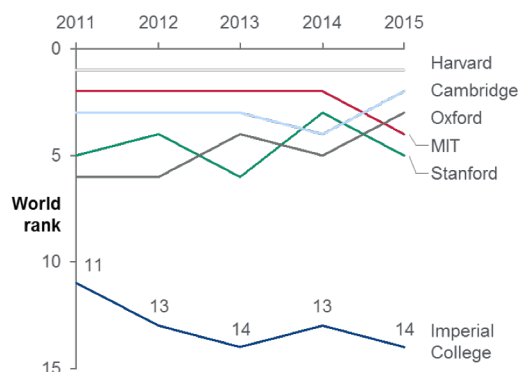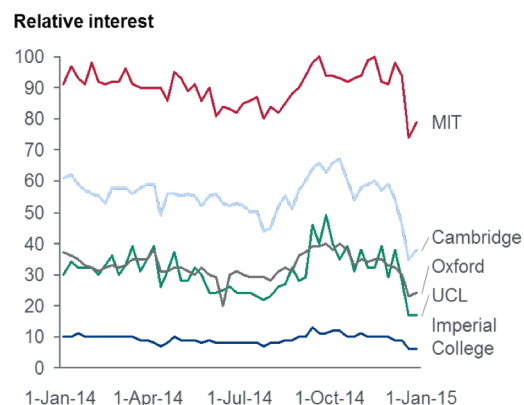[Source: Times Higher Education]

Figure 12: Google Trends relative ranking of Internet interest[1], 2014
1) Numbers represent search interest relative to the highest point on the chart, and do not convey absolute numbers
[Source: Times Higher Education; Google Trends]

Role of alumni and friends

The Imperial alumni community had traditionally been considered as being students, staff and graduates of the College. However, there is merit in extending this concept to a wider range of people working with and interested in the College: alumni and friends. The Education and Student Strategy, and indeed the work of the Advancement Division, is centred on *experience*; if current students have an exceptional experience whilst at the College they are more likely to engage with and give back to the College after graduation. In addition, with the launch of the primary school science outreach programme this has been extended further: prospective students (i.e. some primary school students) are alumni of the future. Imagine if we were to extend this notion further: if current and prospective students, current (academic and professional services) staff including secondees, Visiting Professors and executive education clients and theirl interactions with the College were recognised and valued together. The societal impact of this 'one Imperial community' could be huge.

The College's alumni and friends represent perhaps the means by which Imperial has the greatest direct impact upon society. The College has, educated more than 170,000 people (Figure 13). This number is significantly larger than MIT (119,000) and constitutes approximately 60% of Oxford's alumni base, an institution that has been teaching for more than 900 years. Each and every year, the College graduates 6,000 highly skilled potential future leaders into society.

This is global impact, at scale. More than a third of the alumni are from overseas; this proportion is on a par with Oxford, and significantly higher than UCL, MIT or Harvard. The alumni base is spread across both eastern and western hemispheres; with a particularly large and growing share in East and South East Asia (Figure 14).

Figure 13: Size of Imperial College alumni community, in context
[Source: Imperial College Advancement Division; literature research; team analysis]
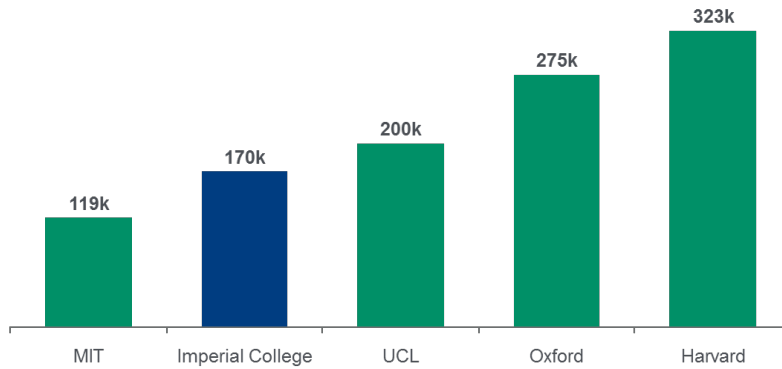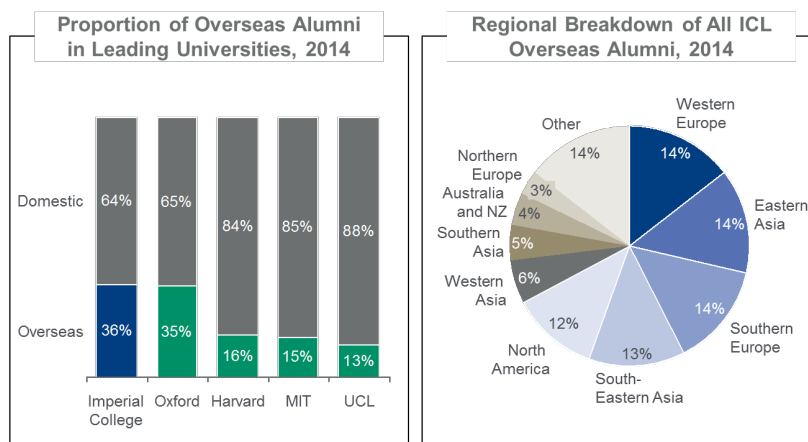

Figure 14: Imperial College London's global alumni network
[Source: Imperial College Advancement Division; literature research; team analysis]

People is one of the three pathways to societal impact and alumni and friends represent an important part of this system. They have the potential to form a direct link with core activities and the external community; providing the 'glue' through which impact can be magnified, for example, through knowledge dissemination, mentoring, 'joining the dots' to their private/public/third/community sector networks, philanthropic giving, being the parents and grandparents themselves of prospective Imperial staff and students, taking up Advisory Board positions, and acting as brand ambassadors.

Historically, the College has had a light-touch approach to managing and engaging with the alumni network. Over recent years there have been substantial efforts to improve on this, increasing support for regional associations and chapters, building receptions into the overseas schedules of the leadership team, and growing the annual Alumni Weekend, which is programmed to coincide with the Imperial Festival. Nevertheless, the College's alumni engagement lags behind other highly ranked HEIs. For example, whilst there is a total alumni population of over 170,000 – 30,000 of which are located in the local vicinity, in London – some 50,000 are non-contactable. Furthermore, approximately 45,000 alumni engage with the College in some capacity; a significant number, but barely a quarter of the potential (Figure 15).

Volunteer-led alumni activity can be considered a proxy for alumni affinity towards the College, including support for the societal impact system. The prevalence of volunteer-led alumni groups shows that the College lags all other HEIs that were examined (UCL, Oxford, MIT and Harvard). Whilst the international footprint of our alumni has the potential to be a clear strength, through established alumni groups we have amongst the lowest coverage of this footprint (Figure 16).

Low engagement ultimately manifests itself in even lower philanthropic return to the College. In 2012-13, just over 5,400 alumni, including friends and staff supported the College through

regular giving, compared with nearly 45,000 for MIT. Proportionally, Oxford and Cambridge sit somewhere between Imperial and MIT, while several US institutions perform above MIT. Advancement has made progress in recent years in building relationships and there is considerable latent potential throughout the rest of the alumni network (Figure 17).

Figure 15: Engagement amongst Imperial College alumni network (absolute number of alumni, 2014)
1) As a proxy, defined as those who have provided business/employment details. This is similar in magnitude to the open rates for monthly email newsletters (20-36%)
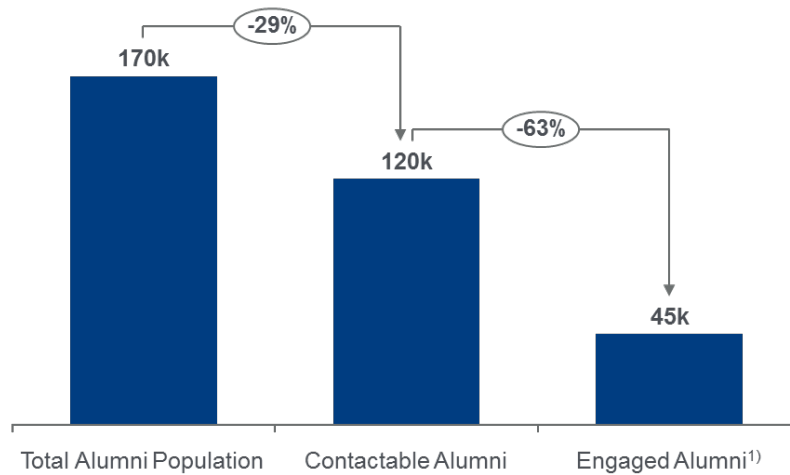[Source: Imperial College Advancement Division; team analysis]

Figure 16: Extent of alumni groups as a proxy for alumni engagement
[Source: Imperial College Advancement Division; literature research; team analysis]
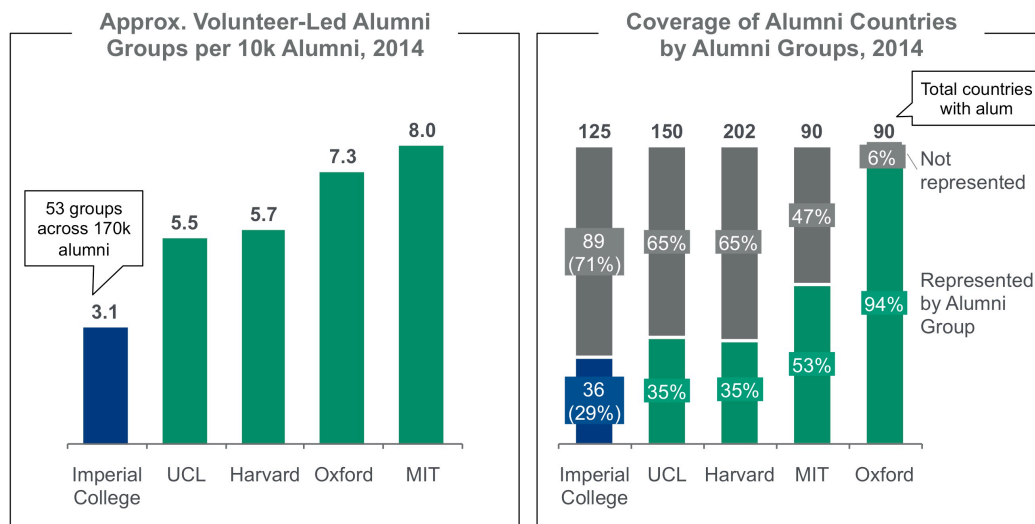
Figure 17: Volume of annual alumni fundraising
1) In the case of MIT, this is fiscal year giving to the MIT Annual Fund. Donors include undergraduate and graduate alumni, friends and family, and matched giving.
2) In 2013-2014, 3,955 alumni gave to Imperial College out of a population of 170,000 (total alumni) or 120,000 (contactable alumni)
[Source: Imperial College Advancement Division; MIT; ROSS-Case study; literature research; team analysis]
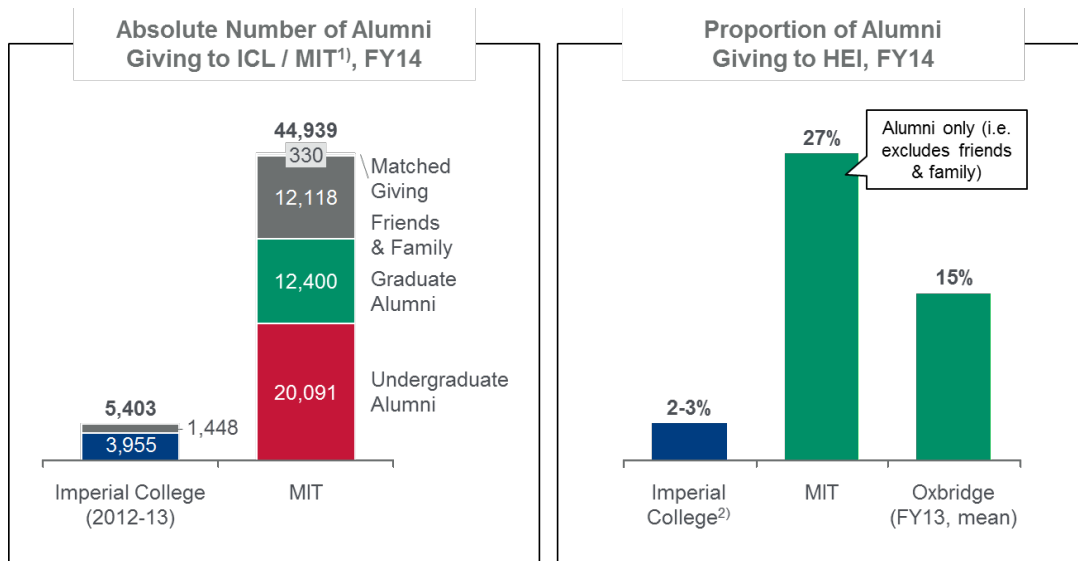
The College's appointment of a Vice President (Advancement), its first senior leader in this area, reflects the importance given to developing the role of philanthropic giving and alumni relations. In the context of this review, one of the goals is to maximise the potential of the alumni base in enhancing the College's societal impact.

Culture, incentives and rewards

There is significant scope to incentivise, grow and recognise the relatively small number of staff responsible for generating the majority of research income, consulting work and high-profile publications. To do this, Imperial needs to raise the profile of 'impact' in its recognition and reward schemes.

The culture of the College community is important: it can support or inhibit efforts to move towards a greater emphasis on demonstrable societal impact. A few HEIs have evolved with an 'innovation-driven academic culture', exemplified by entrepreneurial students and alumni, through collaboration, licensing, start-ups: Stanford and MIT are perceived leaders. Others, such as Oxford and Cambridge, are known for their 'traditional academic culture', exemplified by emphasis on celebration of traditionally defined academic brilliance.

Even for these institutions, the idea of a single, general academic culture is a substantial over-simplification. The same is the case at Imperial College where the dominant culture is associated with its position as a leading research institution. Imperial's founding charter emphasises *application* of its work and this legacy continues throughout the College's many activities.

Collaborative research at Imperial has become the norm; in 2014, over 70% of publications were jointly authored with an external co-author, 50% had international co-authors, dispersed across 141 countries, compared with around 20% in 1994. Similarly, the establishment of several multi-disciplinary institutes and a growing focus on thematic Global Challenges is helping to shift the College's culture away from the individual's endeavour to teams. Evidence suggests that these multi-disciplinary institutes balance their focus between research, translation and impact, more so than academics working individually [M. Perkmann, 2014].

The College community balances varied portfolios, operating as researchers, teachers, mentors, entrepreneurs, supervisors, policymakers, managers and public personalities (Figure 18). In several departments there are significant pockets of innovative and entrepreneurial excellence, which perhaps already place an equal emphasis on societal impact as on academic distinction: demonstrating that the two can co-exist. This is led by relatively few individuals: just 10% of staff at Imperial are responsible for 90% of research income, 98% of consulting routed through ICON, and they have the highest profiles in terms of their academic publications [M. Perkmann, 2014].

The College culture is a reflection of the capacity, focus and priorities of its staff and student communities. They already have significant demands placed upon their time, making choices of what activities to pursue and what trade-offs to make. Many people respond to how they are measured, recognised and rewarded – thus the College has a direct pathway to effect change by carefully including societal impact within these priorities, and demonstrably valuing the outcome.

Figure 18: Academic staff undertaking selected impact-related activities (proportion of total academic headcount)
[Source: "Accounting for Impact at Imperial College London", 2014; team analysis]
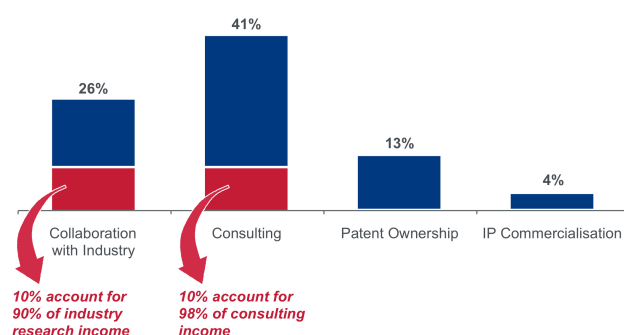
The College's formal appraisal of staff takes place through the annual Personal Review and Development Plan (PRDP) process. This review found some evidence to suggest that the implementation of PRDPs across the College is partial and inconsistent. Only 77% of respondents in the 2014 staff survey received a PRDP annually, and there is anecdotal evidence to suggest that PRDPs are less likely to be completed by postdoctoral researchers.

This review found that more can be done to identify, recognize and integrate the recognition of impact in the procedures used to appoint, appraise and promote staff.

3. Detailed Recommendations

① INTELLECTUAL PROPERTY

The challenge for the College is to maximise the potential for, and benefits from invention, without diminishing our reputation for research collaboration and world-class publications

The College should strive to take greater advantage of the invention potential arising from its research, whilst maintaining its reputation for scholarship. A full review of the relationship with Imperial Innovations will be the subject of a separate study. This review makes the following recommendations:

- Expand the role of TTO grant support and entrepreneurs-in-residence systematically throughout the College
- Improve timelines and systematic approach to disclosures by academics, and work with the UK Intellectual Property Office to explore whether there are conflicts between publishing and patenting
- Work with the TTO to determine how to optimise the cost/benefit trade-off for the intellectual protection of our assets
- Provide a periodic refresher of IP law and Imperial policy to the College faculty and staff
- Explore bold, innovative ideas to maximise the external visibility of and create a market for, our library of IP assets on a continuous basis.

Expand the role of TTO grant support and entrepreneurs-in-residence systematically throughout the College

To unlock the latent potential in invention disclosures from research activity which are not progressed, and from the c.90% of the academic community who are not 'active' in this area, the College must decide where, when and how to support academics in the research cycle (Figure 19).

Figure 19: Two example models of support for commercialisation
[Source: Expert interviews; team analysis]
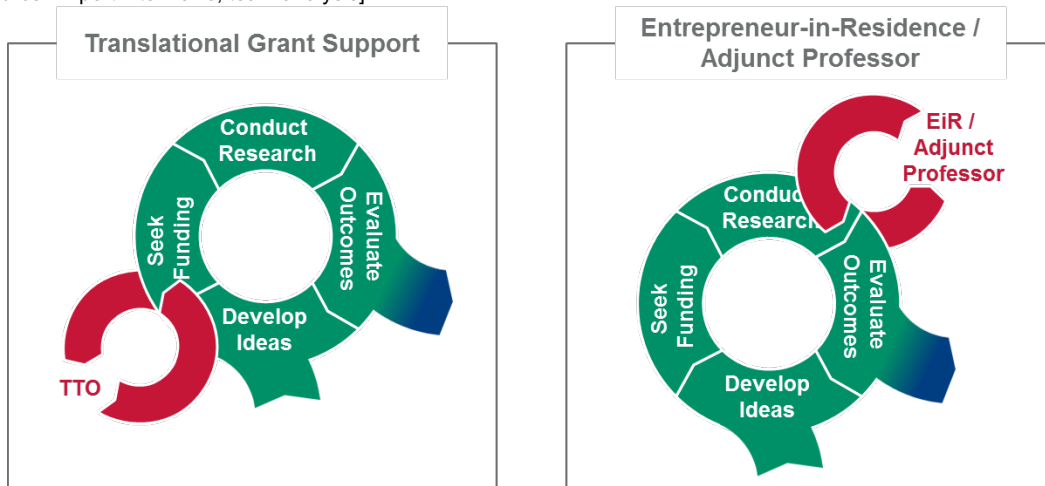
- **Translational Grant Support:** The College selectively operates an approach to promoting inventive potential in translational grant applications, with support provided by Imperial Innovations. In this model, the outsourced TTO provides inputs during the internal College development and review of research applications, providing expertise and challenges to the proposed approach to IP, the commercial strategy, and the reporting framework. The model has been used to support an estimated £50m of grants during the last 3-4 years and has received positive feedback from the grant selection committees. To date, it has been applied predominantly by the Faculty of Medicine and

the European Institute of Innovation and Technology (EIT) Climate KIC, but should be employed more widely (Figure 20).

▪ **Entrepreneurs-in-residence/adjunct or industrial professors**: The role for entrepreneurs-in-residence and adjunct/industrial professors in supporting Imperial's entrepreneurship ecosystem have traditionally focused on *pedagogy* i.e. students learning through Imperial College Business School's educational programmes. More recently, this has been broadened by the TTO to reach across the research community, acting as a catalyst and spurring *practice*-based translational activity i.e. the launching of companies, not necessarily by students. The College has made significant progress in the latter, engaging entrepreneurs-in-residence with student entrepreneurship activities, such as via Imperial Create Lab. This review recommends extending this system where relevant throughout College, reporting on its practices and their outcomes.

These two, equally valid approaches for supporting entrepreneurial activities – pedagogy and practice – provide an opportunity for College to engage alumni and friends with entrepreneurial experience; although there is currently no mechanism for selecting appropriate alumni from the network. In both cases the unpredictable and temporal nature of any return on investment in entrepreneurial activities should be noted, e.g. it may be several decades before the impact of College's investment in some entrepreneurial teaching or activities is realised.

Figure 20: Selected examples of translational grant support provided by TTO
[Source: Imperial Innovations]

Application	Value	Role of TTO
Developing Map4k4 inhibitors to treat heart failure – Wellcome Trust SDDI	£2.7mn	Involved extensive prior art searching for patent and company activity around both the target and competing approaches to treating heart failure. Innovations also assisted in negotiating IP and commercialisation sections of the research agreement governing the specific grant and will play an active role in managing and commercialising the outputs of the project.
Novel Lipase Assay for Pancreatitis – TSB Funding with Mologic	£1mn	Engaged a diagnostics consultant to help triage the application areas for such a diagnostic platform, identifying infectious diseases and pancreatitis as potentials. Innovations was instrumental in the preparation and submission of an application to the Technology Strategy Board for funding the development of a prototype LFD in partnership with Mologic Ltd – a UK SME in diagnostics development.
Flexiplanar Fuel Cell Innovate UK	£1.5mn	Included as a partner in an Innovate UK project which also includes Imperial College, UCL and 6 other industry partners. Imperial Innovations provided input to the grant application and is the lead Exploitation and Dissemination partner for the project. The project will develop the manufacturing process for the Flexiplanar Fuel cell and runs for three years from November 2014 to Oct 2017.
European Climate KIC application	£100mn (consortia)	Provided extensive support across multiple partners to establish one of the first KICs in Europe. With no template to work from Imperial Innovations led the development of an IP framework to underpin this successful bid. We formed and chaired the IP board of the KIC for a number of years post award and the IP framework has been used as a framework for some of the subsequent KICs.

Improve timelines and systematic approach to disclosures by academics, and work with the UK Intellectual Property Office to explore whether there are conflicts between publishing and patenting

Academics face a dilemma. To develop their academic careers they must publish the results of their work promptly, present breakthrough results at international conferences, and comply with Open Access data requirements. This is the dominant pathway, which can be in tension with the potential to manage IP for commercial application of their research, to the benefit of themselves, the College and society at large [A. Dowling, 2015].

Commercial application of research sometimes requires IP protection/management that can take in excess of 12 months from initial disclosure, during which time scientific publication is not usually possible. Understandably, in most cases, publishing takes priority. This review explicitly supports this prioritisation, maintaining the College's position as a leading global

research institution. It also recognises that more can be done to support and encourage a large number of academics to both publish and patent in a timely manner.

This potential conflict is not apparent in all geographies. Many of the world's most innovative societies, including the US and Korea, resolve the conflict with a legal grace period, which allows inventors to have it both ways: disclose the discovery in a technical paper or conference, and then have a further 6-12 months to file a patent application. The US grace period was established nearly 200 years ago, and has since been adopted in many other countries; but no meaningful grace period currently exists in Europe (Figure 21).

The idea of a harmonised grace period has been previously proposed by both the academic and IP communities, and is supported by offices such as the UK Intellectual Property Office (IPO) and the European Patent Office. Discussions with the IPO suggest a willingness to explore creating a grace period. This review recommends that Imperial College, in collaboration with Oxford and Cambridge universities and UCL, works with the IPO to develop and trial a new system across the south east and London cluster.

Figure 21: Selected international examples of IP grace periods
[Source: *A Grace Period for Patents*, Science | Business Innovation Board, 2013; team analysis]

Country	Term	Comments
Europe (inc. UK)	Minimal	No grace period as such. However, disclosure at an International exhibition, or as a result of an evident abuse in relation to the applicant will not be prior art if the application is filed within
Australia	12 months	12-month grace period from date of first disclosure
China	Minimal (6 months)	Chinese Law stipulates three possible exceptions, affording six months' grace, namely : (i) first exhibited at an international exhibition sponsored by Government; (ii) first made public at a prescribed academic meeting; (iii) disclosed without consent of the applicant
Japan	6 months	Six-month grace period available as the "exceptions to lack of the novelty of invention". Was expanded in 2012 to include essentially any form of disclosure by the inventor, including sales
South Korea	12 months	To benefit from the grace period after intentionally publishing the invention, applicant must specifically invoke the grace period and must provide evidence relevant to the publication
US	12 months	12-month grace period from date of first disclosure

Work with the TTO to determine how to optimise the cost/benefit trade-off for the intellectual protection of our assets

College has a strong flow of invention disclosures compared with other UK and US universities. However, downstream of this, it has one of the lowest rates of patent filings amongst UK universities (39%, Figure 22), substantially below the cross-institution average for UK HEIs (53%), as well as US peers (49-54%). The proportion of patents granted is also low when compared to peers.

Figure 22: Patents filed and granted as a proportion of invention disclosures, 2009-2012 average
[Source: HE-BCI survey; literature research; team analysis]
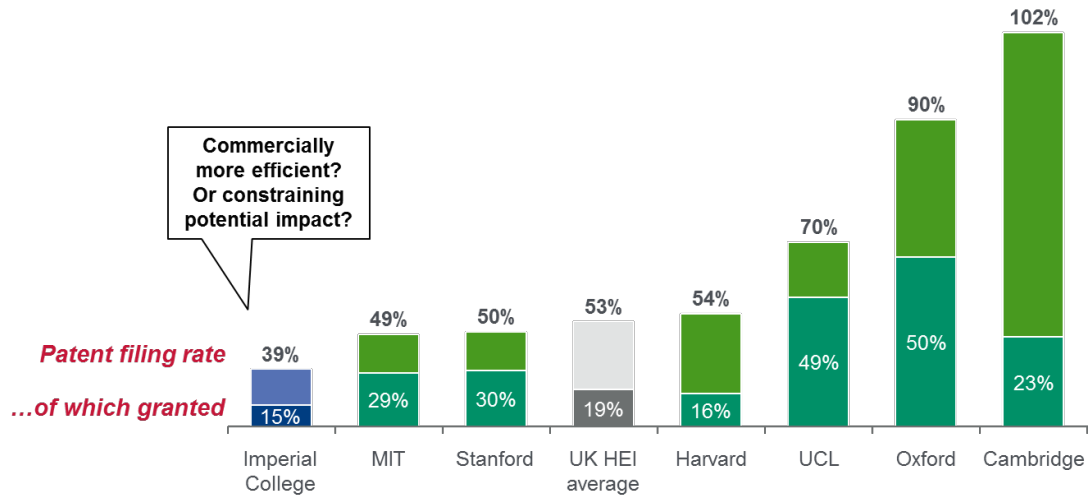
This disparity could be driven by one of two factors:

1. Imperial's academics may be making *too many invention disclosures*, such that there is a significantly higher proportion than in other universities that are premature, non-commercial or otherwise not valid for patent protection.
2. Imperial's TTO may be *more stringent* when deciding what does and does not warrant the investment of IP protection costs, for example, by having a higher commercial potential than that of other HEIs.

Since early disclosure is essential in an environment with no grace period, it is likely that a significant proportion of disclosures are promising but premature; a belief which has previously been shared by Imperial Innovations.

Potentially valid and applicable ideas deemed premature may not progress through the disclosure pipeline if they require development work to answer critical questions, with an associated cost exceeding, for example, an initial £20k investment covered by existing research grants. However, once disclosed, or successful in receiving further translational grant funding, the potential to leverage additional investment may be considerable. Some evidence from the TTO suggests that early-stage proof of concept or 'accelerator funding' could be valuable when preparing ideas for proposals to other, significant translational funders such as the Wellcome Trust or Innovate UK. The College systems should be updated in order to collate and analyse the historic data on commercialisation projects funded via the (former) Technology Strategy Board, and similarly for Innovate UK where more recent but partial data is available. UCL operates a model in the healthcare space that may be worthy of further analysis: ucl.ac.uk/translational-research/about-trg.

The College and its TTO already deploys a number of funds to support related activities, including Imperial Create Lab for students and recent alumni, with limited project funding of £25k. The Advanced HackSpace initiative plans to provide support for 'makethons' and those wishing to build concepts. Helix (in collaboration with the Royal College of Art) provides some support for those with ideas for low-cost medical devices but lacks project funding. Similarly, SymbiCITE provides mentoring and advice for those developing ideas in synthetic biology but lacks project funding. The Faculties of Engineering and Natural Sciences operate small 'pathways to impact' schemes, but these lack commercial input and the level of external review and support that might result in greater success. Faculty of Medicine runs a 'concept in confidence' programme. The EIT Climate KIC operates a Cleantech proof of concept process, which is relatively well funded with support available of up to £100k in stages. Of these, only the Climate KIC provides the full spectrum of resources to develop a project, including mentors, staged project funding, training, competitions and help with access to management and investors.

This review recommends that College finds mechanisms to fund, accommodate and accelerate early-stage ideas whilst not necessarily expecting this stream of funding to generate a return and learning lessons from approaches such as the University of California's quantitative biosciences research, education and commercialisation catalyst, QB3. College may consider establishing its own Imperial seed fund, (to re-invest IP income) in the same way that Stanford University and MIT have already done so, including that received through successfully won translational grants. The fund may also be populated by a combination of sources, including from further HEIF funding (although this may be unlikely in the current funding environment), block awards from Innovate UK, and from Foundations. An Imperial seed fund would provide essential relevant expertise and proof of concept funding, tackling a frequent barrier to disclosure of IP: access to supplementary, independently controlled and flexible resource.

Alternatively, Imperial's TTO may employ more stringent criteria when deciding what does and does not warrant the investment of IP protection costs. This could be negatively perceived by the Imperial community but could also be considered a positive reflection of a more financially efficient, professional TTO than that of other universities. Nevertheless, the gap appears to be widening (Figure 23).

Analysis by the TTO of its 'due diligence and evaluation process', the stage-gate that covers initial invention review for protectable IP and commercial viability, shows that around 18% fall into a holding pattern. These disclosures require further work to substantiate the ideas for commercialisation and additional funding to resolve critical questions. This would allow the filing of robust IP, and ultimately their progression out of the holding pattern.

Some have also questioned whether ideas are tainted when they are managed by a 'tied fund': if the tied fund says 'yes' to developing IP it may be difficult to obtain a good price; if on the other hand the tied fund says 'no', others may be discouraged from investing; even if spin-out is not the most appropriate mechanism for commercialisation, opportunities may be pushed towards this in order to feed the pipeline [Tom Hockaday – CEO, Oxford's ISIS fund – presentation, Global Corporate Venturing conference, London]. In this scenario, the fund managers are unlikely to be successful and so they, along with the investors, may blame the university.

Figure 23: Comparison of patents granted after disclosure for Imperial vs other TTOs (2008-2013, % conversion)
[Source: HE-BCI Survey; Imperial Innovations Investor Relations; team analysis]
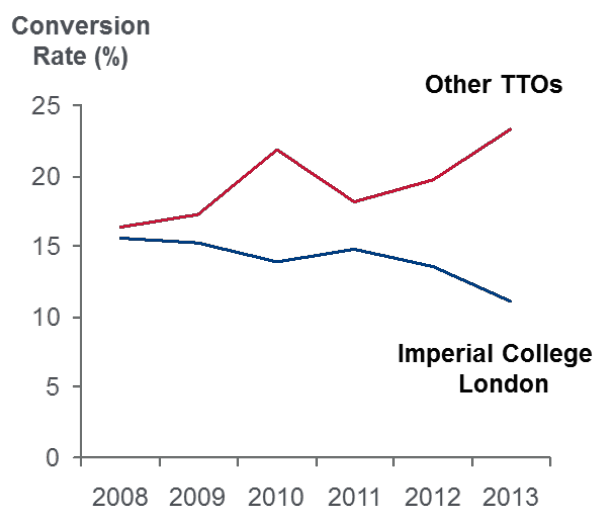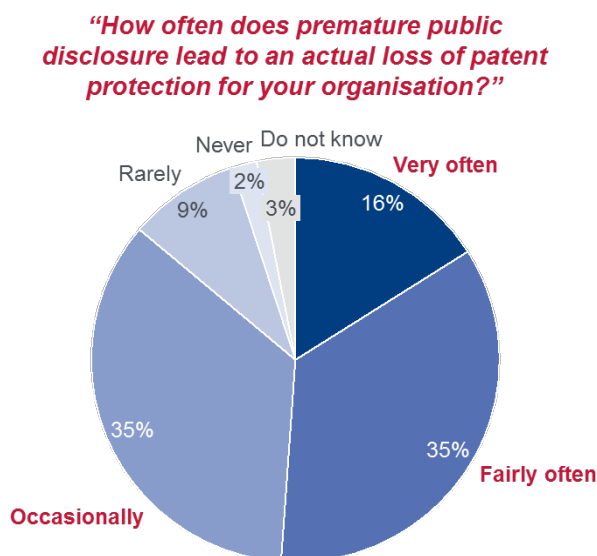

The net result for College, which has a reputation as a leader in foreseeing the potential application and impact of its research, is that it sits mid-table in terms of creating IP assets. The goal is to be confident that College's TTO is not being too selective in choosing which ideas to disclose, thereby creating a potential barrier to impact. College also needs to ensure

that it is providing adequate support and 'after care', such as helping to identify other routes of exploitation, to those whose ideas are not pursued by the TTO.

Provide a periodic refresher of IP law and Imperial policy to the College faculty and staff

The picture is further complicated by an often limited understanding of the complexities of patent law amongst the academic community: 86% of surveyed European HEIs (n=147) felt that premature public disclosure often or occasionally led to an actual loss of patent protection (Figure 24; [Science | Business Innovation Board, 2013]). There is an opportunity to improve knowledge of the patent process and law across Imperial's academic community; this review recommends an internal education and communications exercise.

Figure 24: Impact of premature disclosure on patent protection
[Source: "A Grace Period for Patents", Science | Business Innovation Board, 2013; team analysis]

"How often does premature public disclosure lead to an actual loss of patent protection for your organisation?"

Explore bold, innovative ideas to maximise the external visibility of, and create a market for, the library of our IP assets on a continuous basis

College's TTO is thorough in assessing the commercial potential of an invention prior to protection. Nevertheless, it is often challenging to accurately foresee market demand for IP assets and commercial exploitation may take several years, particularly if the strategy is to seek licensing agreements as opposed to directly forming spin-out companies. This is exemplified by the fact that, over the period 2012-2014 (inclusive) Imperial's TTO filed patents for a total of 170 unique disclosures and entered into income-generating agreements for 89 unique disclosures (not including multiple agreements for the same disclosure). Seventy-eight of these 89 were licences; others included investment agreements, purchase agreements and R&D agreements. Assuming that this three-year period was broadly representative of College activity, this implies a ratio of patents to income generating agreements of roughly 2:1 (Figure 25). College's patent portfolio continues to grow (for example, from 1,476 in 2009-09 to 1,676 in 2012-13). This implies that a significant body of IP is of no direct commercial value to the College, having unrealised impact upon society.

Similarly, with other HEIs: research commissioned by the Kauffman Foundation found that, on average, 65% of invention disclosures in US research institutions remained unlicensed and unused over the period 2002-09 (n=145) [S. Arbesman, 2013].

College might activate the latent potential in its growing patent portfolio through new pathways. For example:

- Non-practicing entities acquire IP in bulk, providing financial recompense to the patent holder. Whilst ethical questions have been raised around these 'patent trolls', which often use their patent stockpile to sue other companies for infringement, many HEIs have explored this. More than 45 universities around the world, including members of the UK's Russell Group, have licensed or sold patents to Intellectual Ventures shell companies (Figure 26).
- Several universities have explored the use of EasyAccess IP, an agreement to provide free access to new technologies if licensees are able to demonstrate a viable use. However, this is broadly and anecdotally considered a 'failed experiment' within the academic community.
- Other web-based third-party providers have recently emerged, offering match-making services to provide visibility of IP, for example, Leading Edge Only: leadingedgeonly.com.

Figure 25: Three-year level of commercial activity for Imperial's TTO – count of unique inventions; 2012-2014 total[2]

1) Total number of disclosures and patents may vary slightly with other sources due to difference between reporting periods (FY / CY) and sources
2) Income generating agreements include the following categories from the Wellspring database (based on input from the Research Office): Collaborations, Development Contract, Investment Agreement, Licence, Material Supply Agreement, Purchase Agreement, Research & Development, Service.
[Source: Imperial College Research Office / Wellspring database; team analysis]
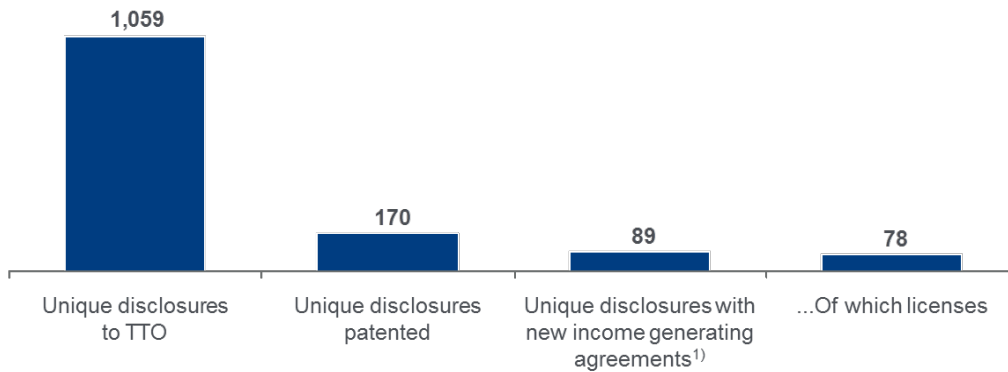
Note – numbers refer to total level of activity in the period 2012-2014. They are not outcomes for the individual disclosures from that period (since patenting and commercial agreements can take many years to achieve)

Figure 26: Selected mechanisms to exploit unused IP
[Source: literature search; team analysis]

If College is to unlock the latent potential in its growing IP portfolio, provision of enhanced visibility and creation of a physical or virtual marketplace for this library is key. Even if this does not lead to direct financial benefit, it may well create significant indirect benefits, for example with showcasing Imperial's talent to prospective recruiters, as marketing collateral when pursuing private sector partners, and generating interest in the emerging cluster of co-located companies at Imperial's White City campus. Given there is no dominant, successful model for HEIs in place today, there is an opportunity for College to create a bold new approach.

Next steps

This review proposes that College develops a roadmap for better exploitation of the College's latent IP. This should be done in consultation with representatives from Imperial's inventor community, key external opinion leaders and where possible, input from other leading HEIs.

② PRIVATE SECTOR PARTNERS

The challenge for the College is to develop partnerships with a strategic portfolio
of international private sector companies

The College should strive to take greater advantage of its world-class status as a research institution through its collaborations. A target portfolio of international private sector companies should be strategic in design but also dynamic in nature, recognising that it will evolve in response to both industry and academic shifts. To do this, the review makes the following recommendations:

- Articulate a strategic portfolio of size and shape that will deliver a step-change in industry research income in 2015-2020 (*volume* i.e. number of partners and scale of income, and *frequency/depth and mode of engagement*)
- Prioritise development of collaborations in industry sectors where we are under-represented (*composition*)
- Establish broader, more extensive UK-industry ties and pursue strategic international partners (*geography*)
- Engage more broadly and proactively with our current and target industry partners, beyond the Imperial Business Partners programme (*frequency/depth and mode of engagement*)
- Set out a clear roadmap for transition to deliver the strategic portfolio, with milestones and financial targets.

Articulate a strategic portfolio of size and shape that will deliver a step-change in industry research income in 2015-2020

Whilst there has been a gradual decline in the absolute number of partners engaging with the College from 2009 to 2013 (Figure 27), the average income per partner has increased significantly: £75million of research funding has been secured by Corporate Partnerships over FY2010-FY2014, excluding IBP membership. This implies that the partner portfolio is becoming more concentrated.

Segmentation of the College's portfolio based on value of research income supports this. For example, in 2012-13, 16 partners invested over $1million, and 106 invested $100k-1million (Figure 28). The remaining 158 partners each invested <$100k. Given the cost-to-serve of each individual partner, this 'pear' shape has benefits in a resource-constrained environment. Imperial College usually recovers full economic costs for its industrially sponsored research.

However, this model also poses challenges for the College. From the perspective of societal impact, an emphasis on a smaller number of higher-value partnerships makes it harder to drive awareness of research and education activities widely across the private sector. As expected, collaborations with long-term, multi-year partners are significantly higher in value than one-off collaborations. Furthermore, growth in the value of the partnership portfolio requires extra care to nurture and develop existing relationships, as the impact of any lost collaboration could be significant.

As a comparator, MIT appears to take a different approach to their partnerships portfolio (Figure 30). The breadth of their portfolio is much larger, with 700 collaborations in 2012-13. Furthermore, MIT's portfolio shape, although similar, is distinctly exaggerated, with a broad base of 'transactional' relationships (<$100k) that comprises 67% of their portfolio by number and yet a maximum of 3.5% by value. Whilst there is again an inherent cost-to-serve for this group, it is most likely treated as a 'feeder' pipeline for the higher value portfolio. Other intangible benefits may also be enjoyed by having a wider range of relationships, such as broadening the reputation of work at MIT.

Figure 27: Absolute number of companies funding collaborations with Imperial
[Source: Imperial College London Corporate Partnerships / Sales Force data; Finance / Oracle data; team analysis]
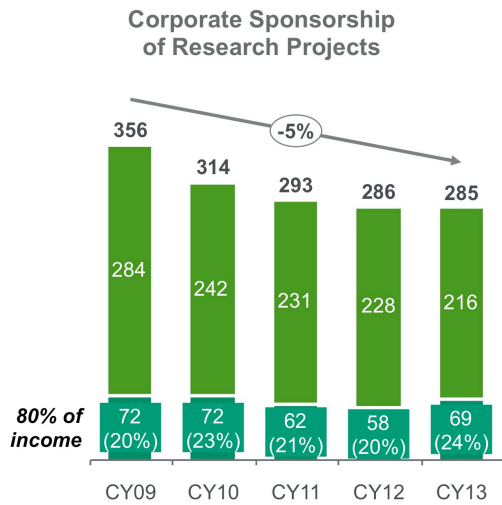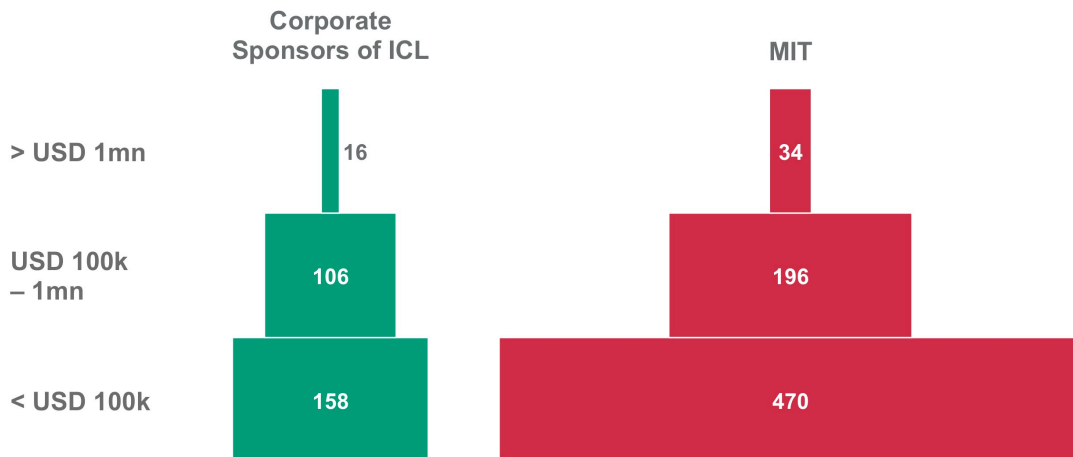
**Corporate Sponsorship
of Research Projects**

Figure 28: Breakdown of companies by value of collaboration[1] – Imperial vs MIT (absolute number of companies, FY 1 April – 31 March 2013)
1) Based on an exchange rate of 1.59 USD = 1 GBP
[Source: Imperial College Corporate Partnerships / Sales Force data; Finance / Oracle data; MIT; team analysis]


In addition to volume, the College also needs to consider the optimal value of the private sector partnerships portfolio. There are ambitions to grow the value substantially and there appears to be the potential amongst industry to do this. We recommend a target of at least £3m per year, year-on-year. However, there is also the perception that much of the existing relevant academic 'capacity' is accounted for, implying the need to either increase the value of existing collaborations, and/or consider recruiting particular academics and adding new domains to the research base. Furthermore, there is latent potential amongst our internal academic community, which should be mobilised. There is scope to be more strategic in identifying new academic leads or champions; those who are prepared to engage externally and who value partnership opportunities.

It is important that Imperial maintains its focus on high quality fundamental research as it expands its collaboration with industry. It recognises that industrial support for long-term academic research is best leavened with short as well as long-term industrial gain, without forcing the College into a position of providing short-term technical assistance. The latter can be provided through consulting services. Successful collaboration occurs when each partner has complementary assets to contribute and combine. Imperial's assets are firmly based in

the quality of its research. This implies focusing new relationships on an industry-university collaboration sweet spot (Figure 29). To inform future strategy, it would be useful to map Imperial's current partnerships to specific zones in/outside this sweet spot.

Figure 29: Industry-university collaboration sweet spot (shaded domain)
[Source: team analysis]
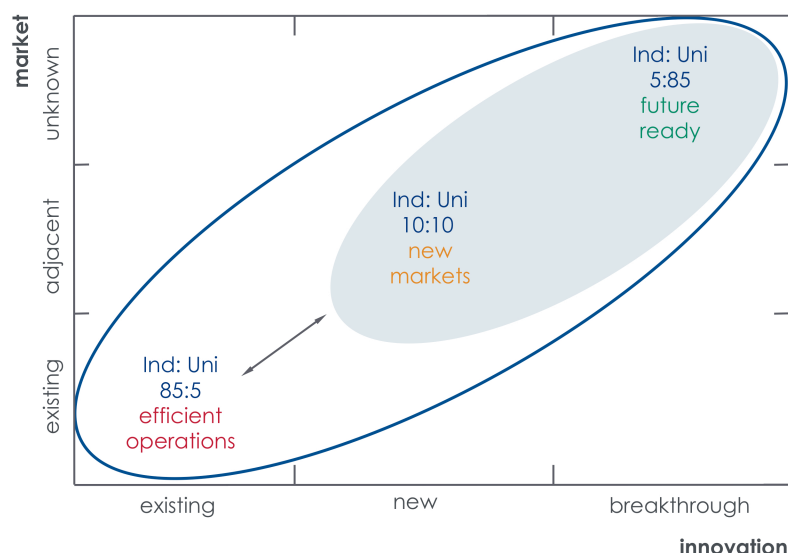
There is a difference between starting new partnerships and maintaining existing ones. The College's Corporate Partnerships team already provide a valuable service: they are often instrumental in bringing new partners on-board, with recent examples such as Intel, Dyson, Petronas and China Southern Railways. They provide high-quality due diligence assessment of mutual compatibility, and a professional relationship management service for maintaining existing relationships. New partners should be chosen for their fit within three overlapping principles for collaboration, with the aim to:

- Provide clear mutual benefit
- Bring together partners who can work well together
- Be distinctive, such that similar outcomes would be difficult to achieve between other partners.

In addition, insight from the Corporate Partnerships team on the development of industrial joint ventures show that success depends upon *clarity* of joint objectives, *transparency* in the terms of the relationship, ownership of the relationship at a senior level in both organisations, including *champions* on both sides, and a process for *dispute resolution* described at the beginning of the partnership, rather than when a dispute occurs. Although these operating principles have been actively applied for some time, this review recommends that the College embeds these principles more deeply and widely.

Prioritise development of collaborations in industry sectors where we are under-represented

Imperial College's private sector partnerships portfolio is heavily concentrated in two sectors: oil and gas (43%) and pharmaceuticals (20%) (Figure 30). These are areas of strength for the College, particularly oil and gas, with broad long-standing relationships that cover substantial research activity, as well as other societal impact pathways such as recruitment, internships, and consulting. Despite the recent fall in oil price, Imperial has not witnessed a drop-off in oil and gas projects and programmes; indeed sizeable research contracts continue to be signed. This reflects our excellence in oil and gas related technical subjects. The College should maintain and grow these partnerships, exploiting its strength in this area to the full.

Figure 30: Sector breakdown of Imperial industrial research funding (GBP mn; 2009-2013 total)
[Source: Imperial College Corporate Partnerships / Sales Force data; team analysis]
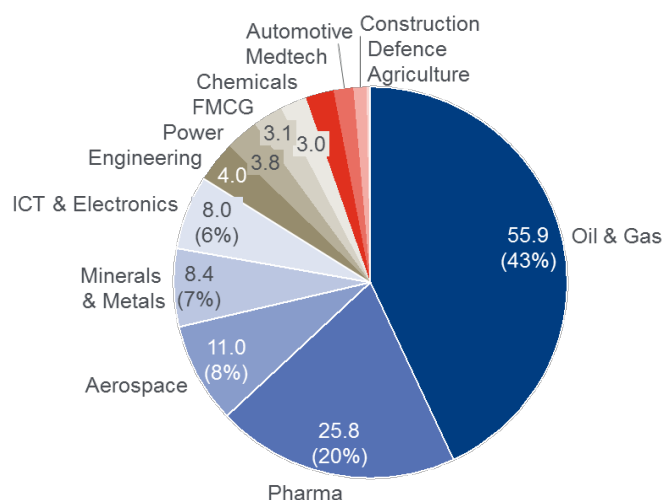
At the same time, this heavily focused portfolio also leaves the College vulnerable. Income from pharmaceuticals has been in decline in recent years. Income from oil and gas (and a small number of players within this) is susceptible to industry-wide decline in investment, which may have a real, albeit delayed, effect on project and programme flow to the College. This illustrates the need for the College to be strategic yet also responsive when reviewing and defining the portfolio; any 'optimal' portfolio will be dynamic, evolving in nature in response to internal and external conditions.

It is noteworthy that Imperial College has not historically been seen as a strong performer in terms of areas of life sciences relevant to the pharmaceutical industry (such as dentistry and veterinary) in comparison to UK peers (Oxford, Cambridge, UCL, and Kings). With the growth of Faculty of Medicine at Imperial and the development of the 'health and wellbeing quarter' at White City, there may be opportunities to find new areas that would differentiate the College's future position in working with pharmaceutical and healthcare companies, for example by signalling expertise in stratified medicine, translational medicine and genomics research.

The corporate partnership portfolio does not currently reflect the balance of research activity that takes place within the College, the College's four Global Challenges, or the value of R&D spending within global industries. In total, College's reliance upon Energy and Chemicals accounts for more than half of private sector research income, yet just 7% of global R&D spend among the top 1000 industrial investors. For Healthcare, including the College's pharmaceuticals and MedTech incomes, investments are on par with global spend. For other major R&D-driven industries, such as Computing and Electronics (28% of global spend), and Automotive (16%), the College is significantly under-represented (Figure 31).

However, as previously discussed, only a small proportion of the top 1000 technology firms' total R&D spend ($643bn, 2014) may be dedicated to research, as opposed to development, and this is likely to vary by sector. In order to more accurately inform College's partnership strategy, we should focus on understanding the component of *research* spend, within industry's R&D spend. The Corporate Partnerships team collected data on global, publicly announced industry-funded university research grants by sector from 2011 to 2013 (Figure 32). During this period, the four sectors spending the most on research were IT, Healthcare, Electronics, and Oil and Gas. This data directly informed the decision by Corporate Partnerships to explore new opportunities in IT and Electronics. Since then, new relationships have been built and research funding secured with Vodafone, Intel, Cisco, NEC and Huawei.

Figure 31: Imperial industrial research funding vs. global R&D spend by sector (% of total, based on Top 1000 Global Spenders on R&D)
[Source: Imperial College Corporate Partnerships / Sales Force data; Strategy& 2014 Global Innovation 1000; team analysis]
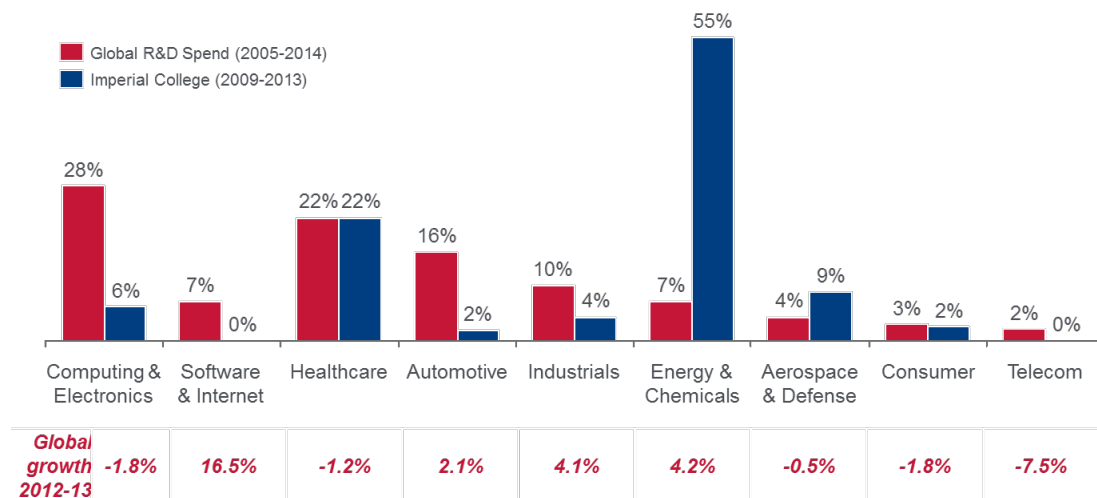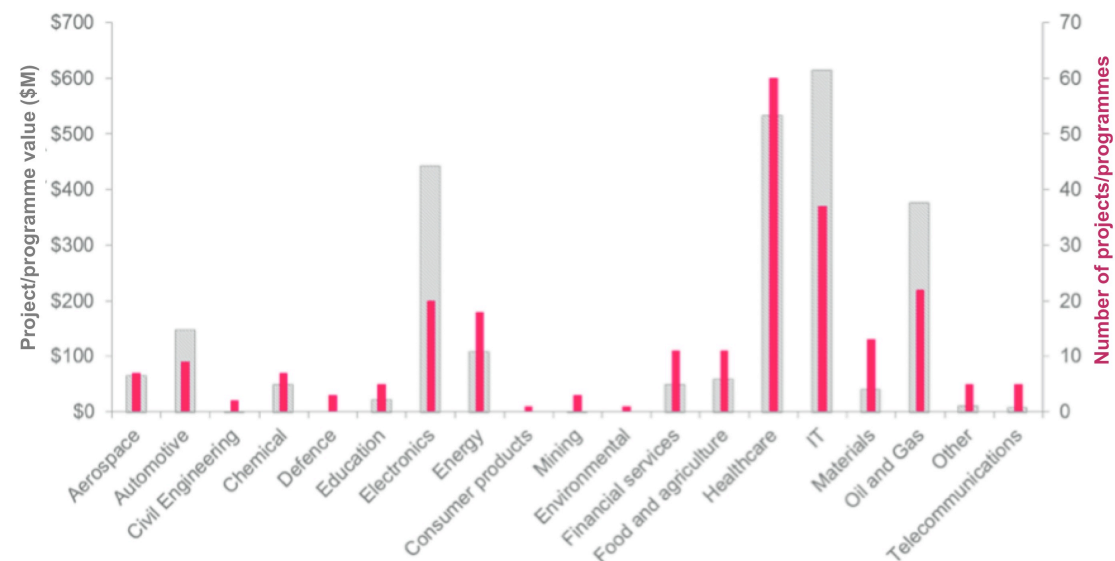

	Computing & Electronics	Software & Internet	Healthcare	Automotive	Industrials	Energy & Chemicals	Aerospace & Defense	Consumer	Telecom
Global growth 2012-13	-1.8%	16.5%	-1.2%	2.1%	4.1%	4.2%	-0.5%	-1.8%	-7.5%

Figure 32: Global university industry-funded research grants by industry sector (2011-2013)
[Source: Imperial College Corporate Partnerships; team analysis]

In addition to the R&D-intensive industries, there are other areas in which enhanced partnerships could be beneficial for Imperial's societal impact agenda: for example, the formation of partnerships with innovative, fast-growing 'scale-up' companies, particularly in the growing digital and Internet-of-Things industries, or in design. This could support the reputation of the College as a unique, leading-edge research environment. For example, the transport app Uber recently initiated a substantial collaboration with Carnegie Mellon University to conduct research into autonomous vehicles. Similarly, better links with London's investment community, for example angel investors, VCs etc, could help drive greater impact of the College's technology through enhanced level of commercial activity. Imperial Innovations, through its Co.Create initiative, is already growing its community of angel investors, and looking to improve coordination within and across these networks.

There are other opportunities. The challenge is to define a cross-sector, multi-stage ('established', 'emerging' and 'new key players') and ethically-balanced portfolio that both

reflects the availability of research capital and is also bold and innovative. The Enterprise Division has already started to work on some of these opportunities.

Establish broader, more extensive UK-industry ties and pursue strategic international partners

Traditionally the College's industry partnerships portfolio has been focused towards UK-based STEM companies. Over the last five years, growth has come from non-EU countries, whilst income from UK and EU partners has declined (Figure 33). As a result, whilst research income in 2012-13 was similar in value to 2008-09, the geographical make-up of the portfolio is now substantially different, as is the global market. Today's portfolio is similar to that of UCL and Cambridge, although notably different to Oxford due to the clinical trial with Merck, which is categorised as 'non-EU' (Figure 34).

Figure 33: Change in Imperial's industry, commerce and public sector research income (2008-2009 vs 2012-2013; GBP mn; as submitted to REF 2014)
[Source: REF 2014 submissions (only including assessment units – i.e. departments - #1, 2, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 19); team analysis]
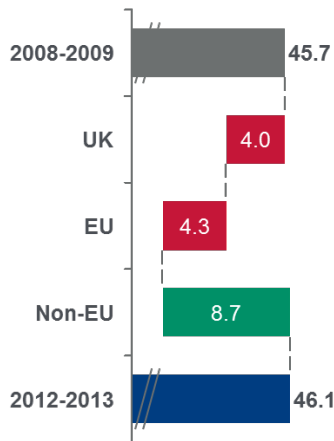
Figure 34: Regional breakdown of industry, commerce and public corporate research income (2012-2013; GBP mn; as submitted to REF2014)
[Source: REF 2014 submissions (only including assessment units – i.e. departments - #1, 2, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 19); team analysis]
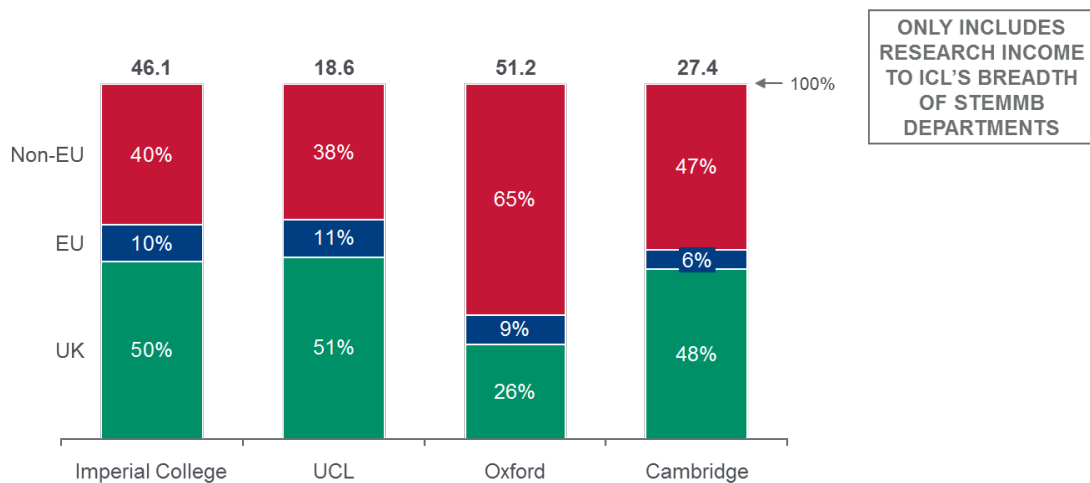
Expansion in overseas research income is a positive trend that reflects the growing global reputation of Imperial. However, this demands intelligence gathering 'on the ground' to understand emerging markets, and needs to be balanced against the potential of UK-based partnerships. Imperial College is fortunate to be located in London, a global hub of corporate

activity, thinking and ideas. Comparing the breadth of research collaborations of Imperial College with FTSE100 (i.e. UK) and S&P100 (US) companies, versus those in place for MIT, suggests that Imperial only has a similar penetration in top UK companies as MIT (Figure 35). The latter has a much stronger penetration in its own 'domestic' market. For Imperial, this is significant: the median value of a FTSE100 collaboration for 2009-13 (total) was £951k, whilst for a S&P100 collaboration it was just £207k.

Nevertheless, the bulk of R&D spend, i.e. the 'addressable market', remains outside the UK (Figure 36). Furthermore, to remain a leader on a global stage, international collaborations will become more significant as a source of intangible benefits in addition to research income. College needs to consider the value in pursuing stronger, long-term collaborations in the College's domestic market, and/or those in other western markets, and/or establishing a presence in fast growing economies.

Figure 35: Regional collaborations of Imperial College London vs MIT
Note: Defined as the largest private UK and US companies by market cap on 12th Feb 2015 (i.e. FTSE100 and S&P100)
[Source: FTSE; S&P; Imperial College London Corporate Partnerships team; MIT Industrial Liaison Program; literature research; team analysis]
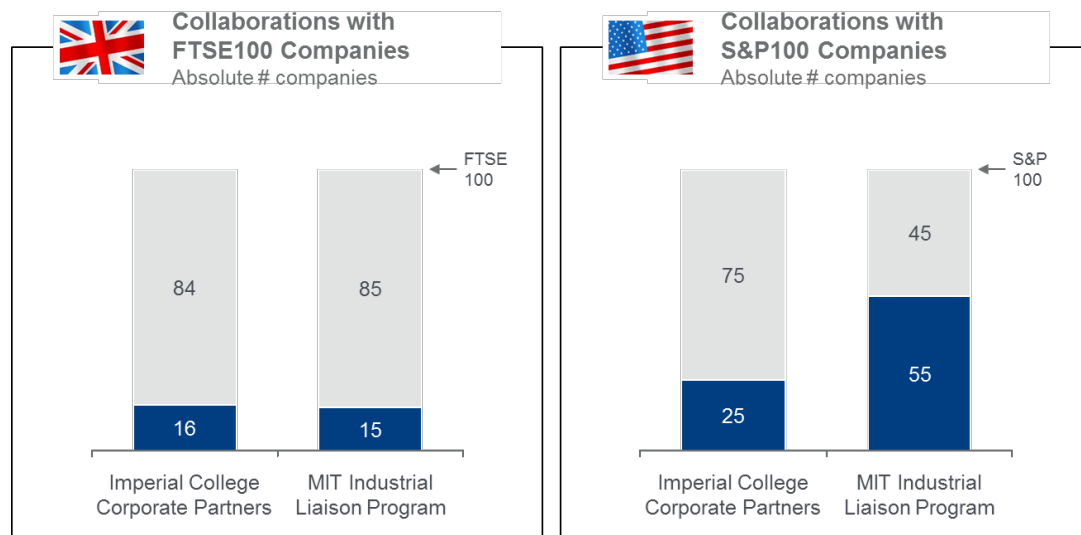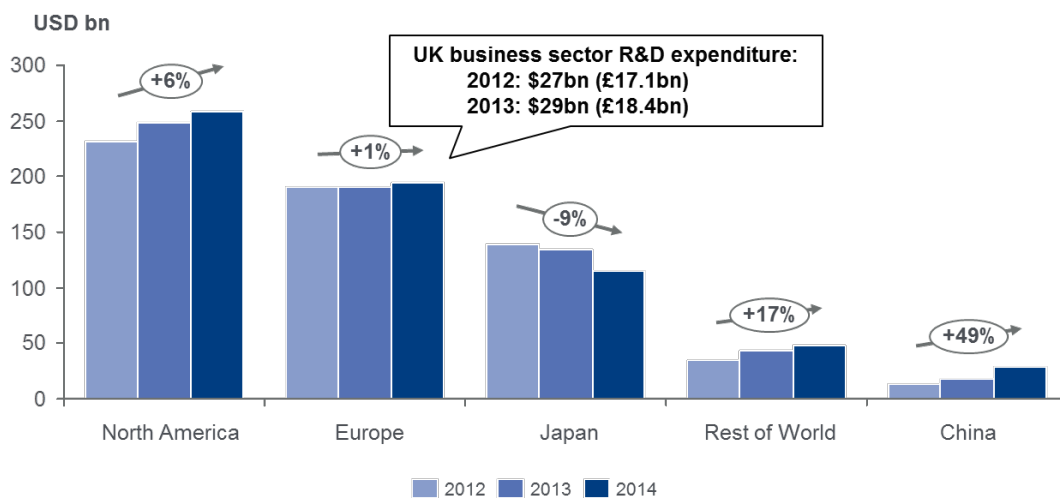

Figure 36: Global R&D spend by geography (USD bn; based on top 1000 global spenders on R&D)
[Source: Strategy& 2014 Global Innovation 1000; UK Office for National Statistics; team analysis]

Engage more broadly and proactively with our current and target industry partners, beyond the Imperial Business Partners programme

Active engagement with collaborators is crucial both to maintain and build long-term relationships and also as a means to generate awareness of Imperial's broader research and education activities. The most concentrated, centrally coordinated management of private sector engagement at Imperial is conducted by the Corporate Partnerships (10 FTE) and IBP programme (1 FTE) teams: they manage relationships throughout the collaboration lifecycle. The remainder of the Enterprise Division (34 FTE total staff) is comprised of the Foresight Practice (3 FTE), Programme Management Office (10 FTE), Enterprise Ventures (3 FTE), Student Enterprise (3 FTE), and Central Support (4 FTE) teams.

The Enterprise Division is primarily focused on academic support for Imperial's research community (80%); for example through developing industry funding for research projects with a clear academic lead, or 'opening doors' to external partners for the academic community. Continuing support for external collaborators constitutes the minority of activity (20%).

The College's main external-facing industry programme is IBP, which brings together board-level executives and senior management in member companies to discuss key industry themes through exclusive events, including the annual Tech Foresight conference and dinners. Such events are 'high touch' for individual member companies, in part through their exclusivity. However, this also limits the exposure of the private sector partner base to the College's core activities – and perhaps rightly so, as IBP currently seeks to be representative of the College's interests rather than map directly to the top global R&D spenders. IBP has 14 member companies, approximately 200-300 eligible employees in total, and members account for 11% of the College's private sector funding. Only one of the largest global R&D spenders and most innovative companies is a member (Figure 37).

Figure 37: IBP membership amongst (i) top 20 R&D spenders 2014 and (ii) top 5 innovative companies 2014
[Source: Strategy& 2014 Global Innovation 1000; team analysis]
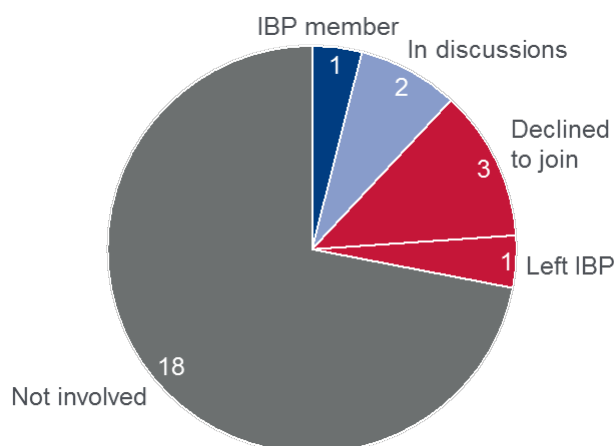
In contrast, MIT employs a different approach. The MIT Industrial Liaison Program focuses on broad engagement, with more than 200 member companies accounting for 53% of MIT's private sector funding and any employee thereof eligible to participate – i.e. a potential base upwards of 100,000 employees. The focus of the programme is geared more towards broad engagement, for example through communication of research, hosted conferences, and making new connections across MIT. In contrast to Imperial's 11 FTE resource focused on corporate relationship management through Corporate Partnerships and IBP, approximately 40 FTE staff support MIT's Industrial Liaison Program.

In the current resource-constrained environment, the College needs to make choices between engaging with key partners on a continuing basis, versus investing time and resource in horizon scanning, and in proactively developing new relationships.

The College should also explore how best to strengthen and progress research partnerships through coordination with other private sector activities, such as recruitment programmes, internships, and corporate outreach, and with other College entities, such as the other members of the Imperial Industry Touchpoints network. Today this cross-College coordination occurs primarily for major collaborators such as Shell. For some partners, multi-disciplinary account teams that also include senior academic champions, cross-faculty representation, and a 'pyramid' of junior academics, may be beneficial.

The Foresight Practice team provides valuable in-house expertise in supporting the academic community in defining future subject areas of scientific research, and devises and delivers content to inform high-profile policy organisations such as the World Economic Forum. Foresighting content is conducted in close collaboration with corporate partners, responding to emerging industry needs and inspirational visions of the future. There is an opportunity for the College to learn from this foresight methodology, employing it to dynamic partner foresighting (i.e. promoting tools for futures thinking to regularly identify new collaborators in the dynamic corporate landscape) and for College to lead and define new areas of science. At present, these are not fully realised.

Set out a clear roadmap for transition to deliver the strategic portfolio, with milestones and financial targets

Imperial College is a leader within the UK in terms of partnering with the private sector and the societal impact this produces. Proactively articulating a future target portfolio and starting the journey towards this, should allow a transition from a position of strength. This transition will take time to effect, and should be carefully managed over an agreed timescale with clear milestone targets without being too prescriptive. This should help to ensure that the portfolio continues to grow in value and in impact, in a managed way.

A greater understanding of partners' needs will be important for sustaining the existing portfolio and developing the target portfolio. For example, the College should review and update the current partnership targets. This should be informed by understanding a potential partner's strategy, research needs, existing academic partnerships, emerging competitors and threats, international strategy, the wider market conditions and sectoral opportunities, internal buy-in and academic appetite to deliver, and alignment with the College's Global Challenges. High-level targets will enable us to allocate internal resource appropriately, and qualify where new opportunities sit within the industry-university collaboration sweet spot. Ultimately, this would allow us to pursue collaboration with the companies we want to work with more effectively.

Next steps

This review proposes that the College's Enterprise Division develops the recommendations above.

The team should set out a clear roadmap to strategically broaden and deepen private sector collaborations. This should be done in consultation with academic leaders, faculties, departments, institutes, and key industry opinion leaders.

The College should explore the benefits of centrally pursuing strategic public and third sector partners, and should strive to define a new approach to identifying and coordinating this portfolio. To do this, the review makes the following recommendations:

- Establish a database of existing collaborations and relationships across the College
- Define clear financial and non-financial objectives for these partnerships and the ways in which collaboration will achieve these
- Create a strategic portfolio of potential collaborators across public, third and community sectors
- Establish central responsibility for coordinating and managing College-wide collaboration with key partners.

Establish a database of existing collaborations and relationships across the College

Data on funding the College has received from public and third sector partners is available centrally, for instance, via the Oracle Business Intelligence website (Imperial College Analytics). However, there is currently very limited central visibility of the breadth and depth of collaborations that the College undertakes with its not-for-profit sector partners. This baseline intelligence is required to leverage our existing networks and inform future strategy.

Before defining a strategic partnership portfolio, existing collaborations should be mapped. In addition, long-term relationships with senior members of the College community should be captured and clear College-wide relationship leads formally identified. Gaps in existing academic capability, relationships or coordination resource may have previously hindered the progression of new opportunities in this space but this should not remain the case. Defining these upfront is critical when establishing a new, complementary approach for proactive and managed pursuit of opportunities, whilst not losing the ability to be reactive in some cases.

Define clear financial and non-financial objectives for these partnerships and the ways in which collaboration will achieve these

The criteria by which the College identifies its strategic partners should be driven by the College's broader strategy for its collaborations, and aligned with the academic mission. For example, a refreshed International Strategy being developed by the Associate Provost – Academic Partnerships in consultation with the Vice President – Advancement may result in prioritisation of strategic partnerships with other academic institutions such as MIT; research ambitions might influence prioritisation of AIDS Healthcare Foundation versus WWF; policy ambitions might influence a prioritisation of Greater London Authority and the European Commission versus the Qatar Foundation.

There are other significant factors that should define the criteria by which the College identifies its strategic public and third partners: consideration of, and respect, for the relationships, research passions and academic freedom of individuals.

The primary driver for partnership may not be research income. Instead, the focus might include:

- Conducting activities which we could not otherwise do alone (capacity building)
- Building the College's reputation in particular geographical domains/regions (brand awareness)
- Establishing access to third parties (strengthening contacts and networks)
- Securing philanthropic funding (donations)
- Achieving the public support of senior leaders (political, advocacy)

- Facilitating/leading networks of stakeholders to shift global focus onto specific challenges
- Identifying emerging trends or defining new sciences (convening)
- Informing the College's research agenda and helping shape curricula, in the same way that two-way interactions with private sector collaborators do (engagement and strategy).

There are already exciting examples of active public or third sector partnerships at Imperial. One 'engagement' example is the College's Reach Out CPD programme, a free online science Continuing Professional Development resource for UK primary school teachers. It has been developed by Imperial in partnership with science teaching resource Twig, TigTag. It offers imaginative classroom ideas to support primary school science teaching, and is accessible to all 200,000 primary teachers in the UK.

Create a strategic portfolio of potential collaborators across public, third and community sectors

There is opportunity to expand the College's engagement with not-for-profit partners in areas such as healthcare, environment and the public realm, such as education or security. Collaboration with public and third sector partners could lead to new sources of funding and improve possibilities to gain impact. There is potential to expand College income from Foundations and Trusts to at least an additional estimated £15m per annum within 5 years.

As with private sector partners, a portfolio of strategic public and third sector sponsors should be developed, aligned with the College's Global Challenges and strengths, particularly in health and wellbeing, energy and environment, education, and outreach. This should be built from a select number of long-term candidates, enabling the College to invest time and resource in establishing, growing and stewarding the relationships. This is timely as the College implements its strategy 2015-2020 Strategy, placing an even greater emphasis on collaboration. Questions and choices should also be considered around *scale* (profile, absolute number and geographical reach of partners and their networks) and *composition* (sectoral and discipline representation of partners, and public/third/community mix).

Establish central responsibility for coordinating and managing College-wide collaboration with key partners

There is benefit to central, 'light touch' coordination of public and third sector partnerships, ensuring that we maximise the potential for long-term collaborative relationships, and generate more opportunities for societal impact and sharing the wonder. However, this would be a new step for the College: there is no equivalent Corporate Partnerships team dedicated to securing and managing public and third sector sponsored research/translational funding, and currently there is no clear institutional 'owner'.

Consideration should be given as to how these relationships will be managed at an operational level – including decisions as to whether they should be managed through the Advancement stakeholder management database (Raiser's Edge), the Corporate Partnerships stakeholder database (Salesforce), or an alternative. Whichever system(s) is chosen, there needs to be a high level of integration given the overlapping networks of many trusts and foundations with that of corporates and philanthropists, and the personal and often sensitive nature of the information captured.

In a 2011 report on unlocking the College's advancement potential, Dr John Cash (Marts & Lundy) made a recommendation to appoint a dedicated Trusts and Foundations team within the new advancement structure. The recommendation was included in the Development Investment Plan approved by Council in 2012, but not subsequently implemented due to internal reorganisation. It is suggested that this material be used as a starting point to re-open discussions.

In addition to a coordinating function, the College may wish to consider putting support for mentoring and incentives for staff in place, similar to that suggested for industrial

collaboration. This would develop a new cadre of academics with the skills and interests to lead such collaborative partnerships.

Next steps

This review proposes that the Vice Provost, Research and/or Associate Provost, Academic Partnerships with the Vice-President – Advancement should develop the recommendations above, with a roadmap for establishing a strategic partner portfolio for the not-for-profit sector. This does not prescribe that the same internal stakeholders are responsible for implementing these recommendations thereafter: for instance, in the long term this may be best placed to sit within the Advancement Division.

This development work should involve representatives from Corporate Partnerships Advancement, Strategic Planning, the International Relations Office, and the Research Office, in consultation with relevant faculties, departments and institutes.

④ a. FORCE MULTIPLIER: COORDINATION,
MEASUREMENT + COMMUNICATION

The challenge for the College is to enable visibility and coordination of its impact on society and
the economy, without introducing unnecessary workload or bureaucracy

The College should introduce new mechanisms for coordination to strategically manage, measure and communicate its impact, without centralising activities or adding unnecessary bureaucracy or overhead. To do this, the review makes the following recommendations:

- Define what we mean by societal impact and set out our goals, providing internal coherence and external thought-leadership
- Position societal impact as a central strategic activity across the College community
- Lead the HE sector in defining and capturing performance measures of impact
- Establish a systematic mechanism to capture impact from research projects and education programmes, providing an evidence-based, data-driven approach to coordination and communication
- Implement central light-touch coordination of the societal impact agenda whilst the recommendations herein are delivered
- Deploy a communications strategy to increase awareness of the College's impact.

Define what we mean by societal impact and set out our goals, providing internal coherence and external thought-leadership

Imperial's ambition to increase societal impact is a somewhat intangible objective without clarity of definition. College should seek to define objectives at the next level of granularity, i.e. at the level of the individual components of the societal impact system. For example, we could agree goals for the growth of the industry partnership portfolio (in the context of impact, not just research income); a specific global challenge theme; or patient experience and outcomes in translational medicine work. Ideally, a first step towards achieving objectives on a specific global challenge theme, progressing a philanthropic project, or preparing for the next REF exercise in 2020, would be to map evidence of impact in previous and/or related work. The recent launch of the Antimicrobial Research Collaborative ('ARC@Imperial') is a good example.

Position societal impact as a central strategic activity across the College community

Societal impact begins at home. Measurement and communication of Imperial's impact on society must be a collective effort; academic and professional services staff, students, alumni, donors, advisers, friends and the senior leadership team should be considered mutually responsible for this.

Coordination is the key to success. The Imperial community is large, multi-generational, with diverse experiences and personal affinities. It is local to London and it is global. Imagine the brand and reputational benefits that could be achieved if the community were equipped with up-to-date information and briefings, engaged and mobilized.

Academic staff are not the sole 'public face', nor are they always the first point of contact for those visiting or engaging with the College. In many cases this may be a personal assistant, or a member of Industry Touchpoints, the College's cross-faculty network of professional services staff who engage with corporate partners. To deliver operational, educational and academic excellence, and to share the wonder of what Imperial does, *all* members of the College community can take ownership and become involved.

Lead the HE sector in defining and capturing performance measures of impact

The College should consider tracking outputs and/or outcomes relating to societal impact on a periodic basis, sufficient to create an evidence base. Many private and public sector institutions are attempting to measure their impact and there is an opportunity for Imperial to take the lead.

Outputs and outcomes should be assessed through both qualitative and quantitative measures. However, quantifying outcomes in a consistent manner is challenging. The REF assessment sought to address this by focusing primarily on qualitative assessment of research impact through case studies, standardising these through a panel-based ranking of 1 to 4. This is a time-consuming process and aside from the UK government assessment, a ranking of 1 to 4 does little to convey the real impact of a case study.

Quantitative assessments are, in most HEIs, limited to output measures in technology transfer pathways such as number of patents, licences, spin-outs, etc. By defining key performance indicators (KPIs) for each of the pathways output measures could be extended. Some have gone a step further to propose a 'composite indicator' built from these (Figure 38). The emphasis remains, however, on outputs rather than outcomes.

Figure 38: A composite indicator for knowledge transfer
[Source: European Commission's expert group on knowledge transfer indicators]
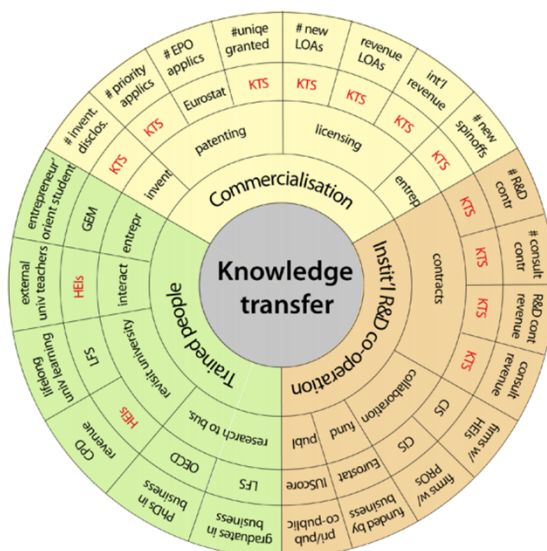
The most pragmatic approach for the College is to report a combination of selected high-profile impact case studies, along with a limited number of outcome-based headline metrics, likely to be discipline or institute specific. This review recommends that each department, institute and/or multi-disciplinary theme sets its own small number of high-level impact goals. These could potentially form the basis of individual performance metrics as part of a revised appraisal process (see recommendation 5: Culture, Incentives and Rewards).

Establish a systematic mechanism to capture impact from research projects and education programmes, providing an evidence-based, data-driven approach to coordination and communication

The largest body of information on Imperial's impact was collated as part of the recent REF exercise. This has given the College a strong starting point, a baseline, and an understanding of processes that worked well, or less so. For instance, Faculty of Medicine established an external and senior impact committee with user groups, which proved successful. Conversely, the Faculty of Medicine initially employed mock writers to draft the case studies, which was less successful; they reported the importance of the lead academic writing (at least) the first iteration. However, the resource-intensive nature of the REF exercise should also be noted:

review interviewees who were involved in the REF 2014 recognised that "it was a major undertaking that the College should learn from".

A separate study, *Accounting for Impact at Imperial College London* [M. Perkmann, 2014] gathered a range of output data on the impact of individual academics through a one-off staff survey. This is one approach by which we could track impact on a regular basis. It was not exhaustive, the study received 60-70% survey returns, and more likely to be completed by those whose activities have a significant impact.

Alternatively, this information could be gathered through individuals' PRDP submissions, however this may raise the question of how this data would be used in the review process itself.

Ultimately, the College should consider ways to gather case studies and metrics in a standardised, routine format. For example, the Research Office working with Communications might introduce internal pre- and/or post-grant assessments of societal impact across the academic community, to systematically capture anticipated and realised impact of research projects.

Implement central light-touch coordination of the societal impact agenda whilst the recommendations herein are delivered

There is a clear argument for some degree of coordination of the College's societal impact agenda, to bring together activity and ensure coherence across each of the different pathways. However, it is not clear how best to do this. An organisational construct may not be appropriate since the *technology*, *people* and *knowledge* pathways touch on most parts of the College's organisation. A governance structure could be an alternative, incorporating key stakeholders from each of the pathways, and with terms of reference to explicitly focus on coordinating and optimising societal impact. However, this risks becoming a hybrid of the Provost's Board, the Technology Transfer Working Group, and various other existing internal governance bodies.

One option for the College is to begin with utilising existing project teams or working groups for each of the areas of recommendation contained within this report, plus a central, coordinating resource – a College Impact Officer – together with executive leadership. This in itself will start to bring the various pathways together on an interim basis. A more permanent solution could then be defined that builds on the lessons from this project structure.

Deploy a communications strategy to increase awareness of the College's impact

A strategic approach to communications should be taken aligning – and thereby amplifying the impact of – particular stories and case studies with known future events and announcements by government and other institutions. For example, news coverage of specific impact funded by the Wellcome Trust could be timed to coincide with the publication of Wellcome's annual report. The College successfully produced news on collaborations with Chinese organisations timed to coincide with President Xi's 2015 visit.

Next steps

This review proposes that the Vice President – Development and Innovation, in collaboration with College's Strategic Planning team, should be charged with further developing the recommendations above. Should College agree to regularly track its societal impact, this group should consider working with academic staff from Imperial College Business School to identify the most appropriate methods and metrics.

④ b. FORCE MULTIPLIER: STAKEHOLDERS, NETWORKS + COMMUNITIES

The challenge for the College is to make more of its successful projects in a targeted and systematic approach to stakeholder engagement

The College should strive to leverage its successes in societal impact further, sharing this and its world-leading research systematically. To do this, the review makes the following recommendations:

- Identify and prioritise influential stakeholders who might assist the College's mission
- Establish a systematic approach to engagement for each of the stakeholders, incorporating new activity such as 'road shows' and coordination of communications
- Lead the HE sector in providing evidence to support external engagement
- Define a mechanism by which to measure and monitor influence, such as an impact tracker.

Identify and prioritise influential stakeholders who might assist the College's mission

The College has the potential to influence a broad range of both internal and external stakeholders, networks and communities through the impact and successes of its activities. The challenge is to define clearly the segments that are a priority and the objective for each of these groups. There is a trade-off to be made here: the larger the groups, the more efficiently we can share the College's impact, whilst the smaller the groups, the more effective and targeted we can be in influencing them. For example, IBP members are a distinct subset of private sector partners who are managed with the objective of developing senior relationships that ultimately lead to greater corporate research income and longer-term collaborations. There are good examples of individuals managing complex networks of relationships and making more of our successes, particularly amongst senior faculty members and the College leadership. In general, however, there is a belief that the College is not systematic in identifying and engaging with key groups.

Establish a systematic approach to engagement for each of the stakeholders, incorporating new activity such as 'road shows' and coordination of communications

College needs to have a strong base of systematic touch-points with the external community and to find opportunities to 'show and tell' the breadth and impact from its research and education. There are many examples through which this is done successfully today. For example, the Imperial Festival, 'shares the wonder' of the College's research with more than 15,000 visitors each year from across the broader community, as well as specific groups within private, public and third sectors. This is but one approach. More are required and the Fringe activities are beginning to periodically engage with different London communities. Another example is the College's Tech Foresight practice focusing on future trends and their impact on society, through an annual one-day conference for IBP industry partners, delivered with academics.

The most frequently perceived barrier to academic engagement, industry collaboration, consulting etc amongst Imperial academic staff is the difficulty in identifying appropriate partners for collaboration. This suggests that intervention efforts could focus on 'match making': bringing academic staff together with potential industrial and other collaborators. One option for the College to increase these interactions could be to implement a regular series of 'road shows' or 'market forums' to networking the College with other parts of its societal impact system. This idea received strong support during the consultation process for this review, in many different forms. The general principle that was consistently proposed was to find an opportunity to bring together a multi-disciplinary group of academics, students, alumni, corporates, public sector stakeholders and wider society around a specific science or

technology challenge; i.e. a facilitated collision of ideas and perspectives. This showcase and 'match making' proactive approach would be markedly different to the current approach to events: the College would demonstrate what it can offer in the context of what it understands potential partners may be interested in. Examples could be formal events at South Kensington or another campus, and in-situ immersive events such as a 'tour' in a care home in White City to focus on the challenges of dementia. Several inputs into this review emphasised the benefits of making these multi-disciplinary and representative of a cross-section of the College community, perhaps selected through an innovative application and pre-screening process as opposed to being automatically based on tenure or academic reputation.

Lead the HE sector in providing evidence to support external engagement

The College typically communicates impact and success stories through two different routes. The College's *internal* community is served primarily through a standard set of publications including a College bulletin, Staff Briefing, a student newspaper and an alumni magazine. In addition, *external* audiences are targeted through press releases and online news. This is consistent with the approach used by most other HEIs. However, there is a gap in how Imperial communicates its broader research and impact with key stakeholders, networks and communities: there is a perception that this is often plugged by responding to requests for customised marketing materials.

Some HEIs supplement this internal and external communication with different approaches. For example, Cambridge established its *Research Horizon* publication, specifically to communicate its research activity to a broader audience that includes academics and corporate partners. MIT and Harvard have their own branded publications focusing on industry news that, whilst not focused on academic activity, provides a strong platform to communicate relevant stories to a broad audience. The *MIT Technology Review* has a print circulation of over 169,000 and more than 1.5 million unique monthly online visitors. Leading academics from MIT and Stanford are also regularly showcased in TED talks. New opportunities through similar global platforms are emerging for Imperial, for example, as we strengthen our links with the World Economic Forum.

The College needs to ensure that it has readily accessible, professional and up-to-date marketing collateral, particularly as it broadens its interactions with external parties. For example, the Department of Chemistry is preparing a prospectus to showcase their research, education and translation activities, which will be housed in the new Molecular Sciences Research Hub at Imperial's White City campus. High-quality digital material and calling cards such as brochures and briefings are essential to spark interest from other world-leading institutions, potential industry partners and philanthropic donors. If all members of the Imperial community were able to access a dynamic suite of such collateral, capturing activities on the Global Challenges, major capital investments, and key institutes, the College would, at all times, be equipped and 'on message.' Additionally, the College could establish a centralised catalogue of impact case studies (building from REF 2014 submissions), summaries of research, and success stories of students, alumni and staff. This could form a periodic 'Impact' publication in its totality, but more importantly it could form the basis for a quick and easily accessible 'mix and match' resource when engaging with and influencing key groups.

A broader interpretation of 'collateral' may encompass *people, knowledge* and *technology*. With respect to *knowledge*, this could be as simple as a 'repackaging' exercise to re-think and apply current activities in new ways: there may be many things College intuitively does, without considering it societal impact. In terms of *people*, in the long-term College could deliver more impact through establishing ways to identify the College's future (academic and professional services) leaders, putting mechanisms in place to nurture them; establishing internal networks and buddying schemes e.g. a quarterly lunch for College's most active entrepreneurs to engage with and mentor fellow staff or students.

Define a mechanism by which to measure and monitor influence, such as an impact tracker

The benefit of a systematic approach towards stakeholder engagement and communications may take time to observe. In some groups, traction may be visible relatively near-term – for example, progress in influencing specific stakeholders, or early-stage discussions with potential new partners. In other areas, changes may only be visible over the long-term – for example, the perception of key local community groups around White City. Furthermore, direct and indirect financial benefits will also take time to accrue, and may be difficult to associate with specific communications action.

The College's ability to measure and understand the effect of actions on these groups forms an important part of being able to review and refine Imperial's approach to societal impact. The first, essential step is to establish a baseline understanding of the College's current level of brand awareness, reputation, and reach. An innovative 'impact tracker' digital tool, similar to the London DataStore's dashboard, could be developed to sample opinion systematically, analyse and draw insight from responses and attitudes, visualise these in meaningful ways, and tailor a College response – all in near real-time. This review recommends that the College deploys its own capabilities in digital technologies, data analysis and visualisation to develop such a system.

Next steps

This review proposes that senior College and Faculty management, in consultation with the wider College community, identify Imperial's key audience groups, stakeholders, networks and communities. The areas of recommendation above should be considered as part of the Outreach Strategy development, led by the Associate Provost (Academic Partnerships) and Communications Division.

④   c.   FORCE MULTIPLIER: ROLE OF ALUMNI

The challenge for the College is to define and implement activities to involve alumni
in increasing the College's impact, as part of a broader advancement strategy

The College should maximise the potential of the alumni base in enhancing its societal impact. To do this, the review makes the following recommendations:

- *Modes:* create greater alumni involvement in the College's 'people pathways', such as with mentoring for entrepreneurs
- *Introductions:* cultivate Imperial alumni, employed by existing and targeted industry collaborators to support research and education activities
- *Networks*: explore innovative social media models through which alumni can help 'share the wonder' of *our* societal impact; extend these models to the College sharing the wonder of our *alumni's* societal impact.

Create greater alumni involvement in the College's 'people pathways', such as with mentoring for entrepreneurs

There are direct ways to involve alumni in the College's impact system. Currently, approximately 700 alumni (0.4%) volunteer each year to support the College, by contributing to mentoring schemes, outreach programmes and College governance as well as representing Imperial at student recruitment fairs and events around the world. Stanford, by comparison, has over 11,000 alumni (5.5%) who volunteer each year.

The *people* pathways could be further supported by the College's alumni community, both as inflows and outflows, and in many different facets. For example, 'mentoring' could include: the mentoring of secondary school science students seeking to apply to Imperial College; continuous pastoral care during students' time at the College; and mentoring in a specific technical or professional capacity such as involvement with Imperial Create Lab.

Cultivate Imperial alumni, employed by existing and targeted industry collaborators, to support research and education activities

Alumni, if engaged and positive about their time at the College, should represent one of the most direct links into third parties, i.e. their employers (Figure 39). Only a relatively small proportion will be in senior, decision-making positions, able to influence potential or existing collaborations directly. Current experience of engagement with these leaders is mixed.

The majority of the College's alumni provide an opportunity to increase visibility of the College's activities. The question is how to engage and excite them, and provide them with appropriate up-to-date information about our activities. For example, the College has a deep alumni presence within companies such as Shell, Petronas, IBM, KPMG and Citigroup, who provide significant corporate sponsorship for research. The issue is whether these alumni have knowledge of current research activities of benefit to both their firm and their alma mater.

The greatest challenge for the College in leveraging the full potential of the alumni base is the lack of data to inform strategic engagement: including where alumni are employed and how this maps on to our existing and target partners. Increased, tailored communication with our alumni would help to disseminate Imperial's work and improve our reputation. In addition, this could lead to new opportunities, such as research collaborations and consulting contracts.

Figure 39: Top private sector employers of Imperial College alumni (headcount, as at March 2015, based on LinkedIn data[1])
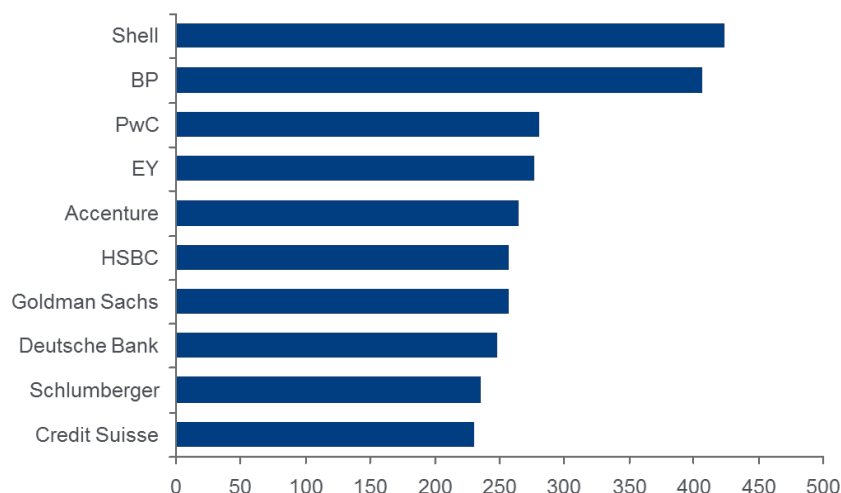
Explore innovative social media models through which alumni can help 'share the wonder' of *our* societal impact; extend these models to the College sharing the wonder of our *alumni's* societal impact

The College uses a combination of print, digital and social media to communicate with alumni, as well as special events. Even where content resonates with alumni, it is often not quick and easy for them to share further, cascading through their networks. College should consider how to augment existing traditional alumni publications to better communicate in a more tailored, data-driven and personal way, providing profiles of research and impact.

One option is to increase the role of social media in alumni engagement. Despite being commonplace in society – for example, there are more than 78,000 Imperial College alumni with profiles on LinkedIn – many HEIs still appear to focus resource on print publications and digital equivalents. The College is already moderately active with social media, for example with almost 35,000 followers on Twitter. Yet, in common with major UK universities, this number is notably lower compared with the overall number of alumni (Figure 40). Many universities in the US have been supporting social media interactions with their alumni for some time; for example, Cornell's Alumni Affairs office has, since 2010, had a senior director of social media strategy with a specific mandate to implement tools to better engage alumni. In the same vein, in 2014 Cambridge developed an institutional strategy for alumni engagement through LinkedIn.

Figure 40: Social media as a means to engage our alumni base
[Source: Imperial College Advancement Division; literature research; Twitter; LinkedIn; team analysis]
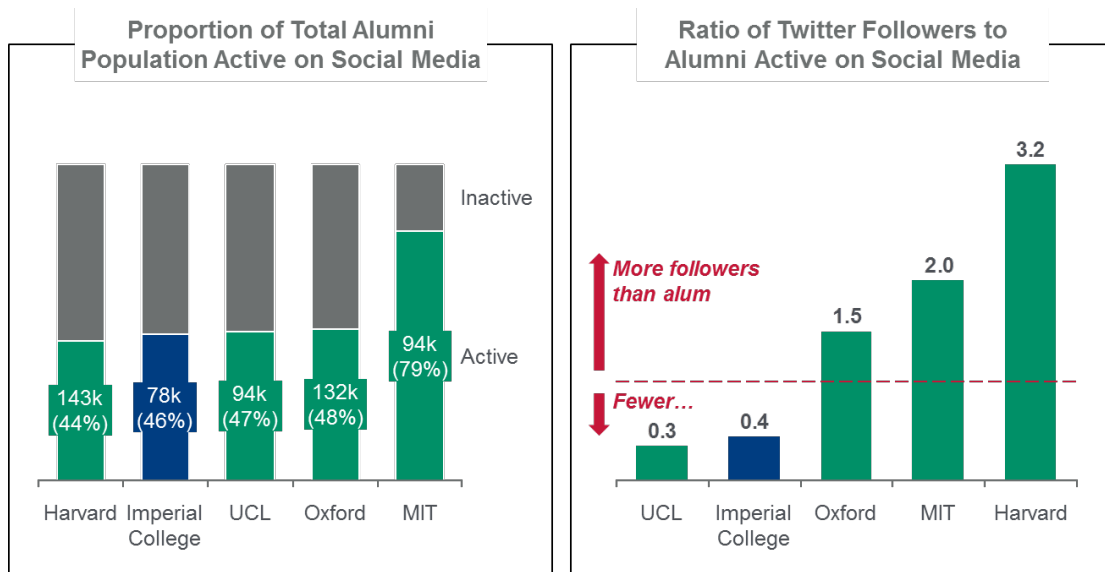
Social media provides opportunities to mobilise networks and to collect valuable data about different interests within these networks, further informing our engagement strategy. Activating this data can provide value to different interest groups. Part of the College's role in society, and in generating impact, is to facilitate the impact of others. Clearly Imperial cannot be all things to all of its 170,000 alumni. There are a number of mechanisms, however, by which College could start to help alumni to achieve greater impact themselves and to celebrate their achievements, creating an 'impact ripple effect'. This could include highlighting the achievements of high-profile alumni, particularly when they have a direct relationship with current research at the College.

On a day-to-day basis, increasing the role of social media in the alumni relations strategy would also allow Imperial to be more active in listening to alumni and sharing *their* successes with a broader audience. On a regular but less frequent basis, the College might also consider using more alumni-generated content in communications and digital media.

Next steps

Links between, and opportunities for, Imperial's alumni and the impact agenda should be considered as the Vice President – Advancement defines the strategy for developing alumni relations.

This review assumes the College wishes to increase its emphasis on societal impact, while maintaining its strength in research and education, and the health of disciplines. This can be achieved through revising formal promotion and appraisal criteria, greater recognition and celebration with prizes, and growing the disproportionately small staff community currently leading the majority of Imperial's impact. To do this, the review makes the following recommendations:

- Introduce formal and consistent recognition of societal impact in promotion and PRDP criteria for all staff
- Introduce high-profile 'Impact Awards' to publicly celebrate our leaders in impact
- Explore mechanisms to provide greater time flexibility to all staff so that they can pursue societal impact
- Continue to build, support and celebrate a culture of student entrepreneurship.

Introduce formal and consistent recognition of societal impact in promotion and PRDP criteria for all staff

There are currently tensions between expectations on staff to have demonstrable impact and incentives for staff members in terms of promotion, career advancement and reward and their host Departments.

- There are some opportunities for *personal* benefit – for example, the monetary benefit to the individual of licensing, or the personal satisfaction and public profiling from involvement in outreach – but these are, in general, small reward for the extra time and effort that is required to pursue these activities. It should also be noted that an individual's motivation to participate in impact-generating activities would likely vary over the course of their career. For instance, early-stage career researchers may look to supplement their income via consulting, whereas later-stage researchers may focus more on publications.

- There are questions to explore further regarding how the College incentivises Departments to support and reward their staff's impact. This should be considered a long-term investment by Departments, with potential benefits such as return via philanthropic giving realised in the very long term. Departments currently receive little or no direct benefit from a host inventor's impact. For example, under Imperial's 'Rewards to Inventors' scheme, 0% of the first £50k of cumulative College revenue generated by the successful commercialisation of IP is directed to the respective department, with 100% attributable to the inventor. Above £50k, the contribution to the department is stepped up to 20% (with 80% attributable to the inventor).

This tension point is likely to become more acute as the College expects more from its staff. We recommend that this be dealt with by building the concept of impact into revised and new HR processes, wherever sensible, and balancing criteria used in promotion and appraisals. At least 25 of the top 200 US HEIs have already started down this path, by recognising innovation and entrepreneurialism as formal promotion considerations.

For the College to recognise broader societal impact in promotion and appraisal criteria, it would most likely make it a leader in the UK, if not globally, and would send a clear message to the external community about the College's priorities and culture. This change could have a significant impact on behaviours. The challenge for the College will be in implementation; to determine how to balance this against other existing criteria, and the distinction between minimum requirements and nice-to-have. It may also be important to understand how changes to promotion and appraisal criteria would be perceived by other HEIs, so as not to inhibit the progress of staff who might wish to transfer to another HEI later on in their career.

Introduce high-profile 'Impact Awards' to publicly celebrate leaders in impact

We recommend the College celebrates its biggest success stories in a visible way, for example through a series of annual "impact awards" or high-profile positions, publicly announced at Commemoration Day ceremonies or dedicated events. Impact awards would generate an institutional confidence, further community building, and help and facilitate a sense of belonging. Other universities have employed similar approaches. For example:

- MIT: Lemelson-MIT Prize awarded to academic from any US HEI for "outstanding mid-career inventors, who have developed a patented product or process of significant value to society";
- Cornell University: biennial Ezra Technology Innovator award to "recognise an outstanding Cornell innovator whose inventions have significant impact on society";

Imperial College's existing portfolio of awards recognises excellence in research and in teaching, but less so in impact on society. Work needs to be done on collating the existing prizes and awards across College (such as President's Awards for Excellence in Education, Research or Safety, Imperial College Medal, Awards for Excellence in Animal Research, and Julia Higgins Medal and Awards) and analysing and developing the portfolio. Only 58% of respondents in the College's 2014 staff survey were satisfied with the recognition they receive for their achievements.

Introducing a range of impact awards could be of benefit to the broader College, as well as to prize winners. For example, by making prizes significant both in kudos and in financial value, potentially supported by corporate sponsorship or philanthropy, a clear signal would be sent to staff of the importance that the College places on societal impact. Furthermore, such an approach would provide a high-profile opportunity to showcase the best of Imperial College to a broad external audience involving key stakeholders. There may also be opportunities for these stakeholders to sponsor awards, lending their financial support and affiliation.

Impact awards may also act as a useful tool in helping to identify and nurture the College's future academic and professional services leaders. When combined with other inputs, they could signal high-performing early-stage career staff, informing a talent development pool, ultimately feeding a pipeline of Imperial's next-generation Principal Investigators and senior leadership team. There is an opportunity for the College to learn from the methodology employed by the Foresight Practice team when identifying and cultivating rising stars. This futures thinking approach could shape the impact award nomination, selection and development process.

Further attention is needed to the question of secondments and the movement of staff in both directions between industry and academia. Impact awards could also provide explicit recognition for staff who have succeeded having moved between industry and academia.

Explore mechanisms to provide greater time flexibility to all staff so that they can pursue societal impact

Imperial staff are already stretched for time. The 2014 staff survey highlighted that the single greatest cause of "unreasonable levels of pressure" is that the workload is too great (Figure 41). Furthermore, 57% of respondents were satisfied with the volume of work they have to undertake, and 63% satisfied with the time they have to complete it. Building in additional expectations around societal impact has the potential to exacerbate this.

Figure 41: Imperial College staff survey results on workload pressures (2014; answered by 77% of staff)
[Source: Imperial College London annual staff survey, 2014]

"What would you say was the cause of the unreasonable levels of pressure at work you have experienced?"
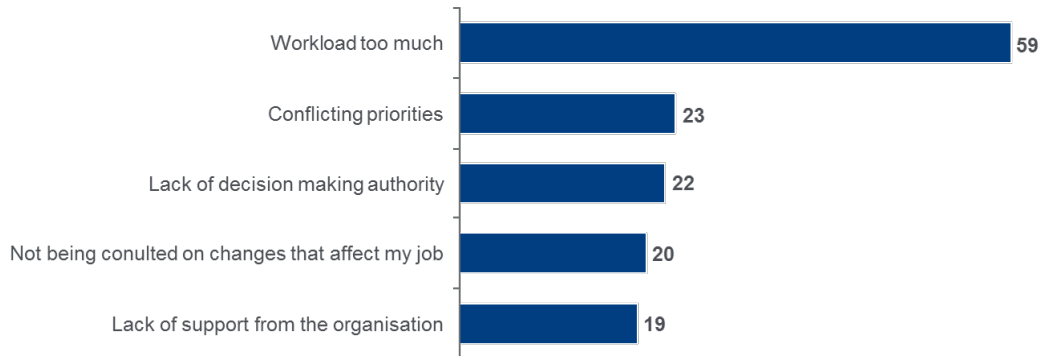
Revising formal promotion and appraisal criteria would provide benefit to those who choose to undertake societal impact activities. It will require leadership and a balanced approach to management. In addition, it is important to identify what flexibility around time commitments support or inhibit these activities. Possible levers for academic staff include: (i) greater clarity and flexibility around the 20% that an Imperial College academic is entitled to spend consulting or on outreach; (ii) more creative ways of scheduling and bundling teaching commitments; (iii) greater support for academics on sabbatical. For example: a significant proportion of US HEIs allow time for academics to pursue enterprise activities (Figure 42), as does Imperial College, but we may wish to review how this is communicated, utilised and perceived.

Figure 42: Institutional flexibility for academic entrepreneurs
[Source: Literature research; team analysis]
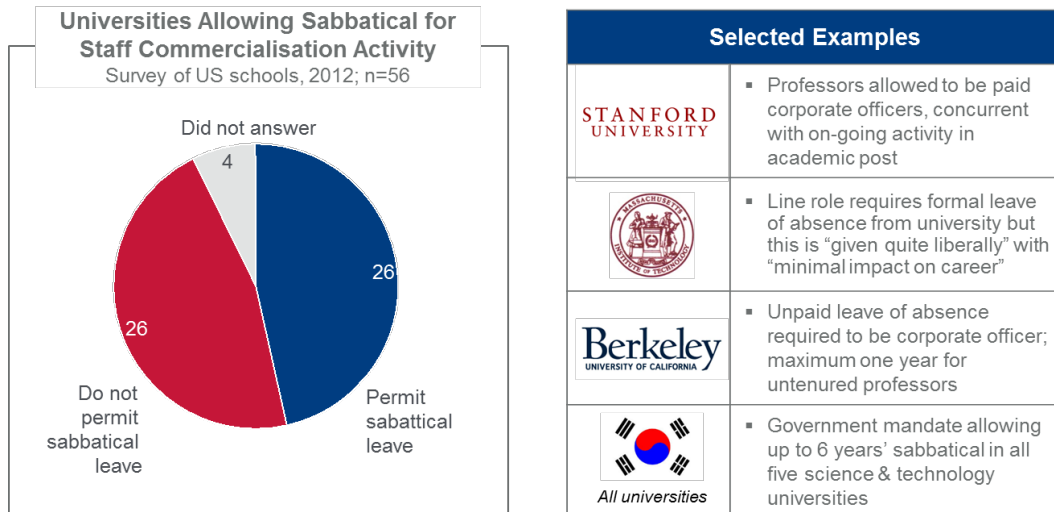
There may also be a disparity between academic and professional services staff. The College should consider the value in increasing the level of flexibility allocated to the pursuit of impact-generating activities for professional services members – such as influencing policy, building/sustaining networks etc – and if deemed beneficial, how this may be achieved.

Any introduction of institutional flexibility has to be balanced against the knock-on effect that it has on the rest of the Department. For example, if an academic takes a sabbatical, how the remaining staff might absorb the extra teaching commitments would need to be considered.

The College is in a position of strength because there appears to be capacity to improve and do more. A disproportionately small staff community is currently leading the majority of Imperial's impact. With an enthusiastic core of individuals securing research income and engaging in consultancy, there is an opportunity for the College to build on this to deliver more impact. Whilst recognising that not all academic staff may wish to focus on activities beyond conducting their excellent research and protecting this, the enthusiastic core could be harnessed to grow the network further: leveraging these leaders to inspire and mentor the remaining community.

Continue to build, support and celebrate a culture of student entrepreneurship

The College recently conducted a study of student entrepreneurship led by the Dean of the Business School, under a mandate from the Provost's Board. This review does not intend to duplicate that study. However, similar questions can be asked of the College's education provision as for research activities, i.e. how to teach, encourage and support students to have greater and wider impact in what they do.

Next steps

Culture, incentives and rewards encompass many areas of the College, including research, education, Enterprise, HR and Office of the Associate Provost (Institutional Affairs).

Two internal reviews have recently been conducted, linking to the first 3 recommendations and the final recommendation, respectively: an HR review of the appraisal process and criteria; a review of the role of student entrepreneurship, led by the Dean, Imperial College Business School. In addition, a group convened by Office of the Associate Provost (Institutional Affairs) is exploring potential academic performance metrics. These working groups, in consultation with the Deans, could be charged with responding to the recommendations specifically in the context of societal impact.

4. Appendices

Method statement

The review involved an assessment of recent literature on technology transfer, translation and university impact. It included the collection and use of a wide range of web-based material from a number of leading universities.

The review has drawn on diverse perspectives. More than fifty interviews were conducted across Imperial College and with selected external opinion leaders from a range of external organisations.

In addition, the following Imperial staff members have provided access to internal data: Amy Austin, Laura Bailey, Liz Choonara, Dario Colombo, Elena Dieckmann, Dominic Falcao, Audrey Fraser, Christopher Green, Tony Lawrence, Josie Lewis-Gibbs, James McSean, Greg Robinson, Ewa Szynkowska, Liang Yew-Booth, and Ros Whiteley.

Imperial College London interviewees	
Jess Adams	Alumni Engagement Officer
Anand Anandalingam	Dean of the Business School
John Anderson	Director of Financial Strategy
Erkko Autio	Chair in Technology Transfer and Entrepreneurship
David Begg	Emeritus Professor of Economics
Donal Bradley	(former) Vice Provost (Research)
Anthony Bull	Head of Department of Bioengineering
Oscar Ces	Academic Lead, Imperial College Advanced HackSpace
Peter Childs	Head of the School of Design Engineering
Dario Colombo	IP Executive
Bruno Cotta	Director of Enterprise Strategy
Lynne Cox	Director of the Research Office
Maggie Dallman	Associate Provost (Academic Partnerships)
David Gann	Vice Provost (Development & Innovation)
Tim Green	Director of the Energy Futures Laboratory
Yike Guo	Director of the Data Science Institute
Chris Hankin	Director of the Institute for Security Science and Technology
Jonathan Haskel	Chair in Economics
Simon Hepworth	Director, Enterprise
Tony Hickson	MD of Technology Transfer, Imperial Innovations
Mimi Hii	Coordinator, Pharmacat Consortium
Carole Hobden	Senior Strategic Planning Officer
Debra Humphris	Vice Provost (Education)
Nick Jones	Academic Lead, Advanced HackSpace proposal
Dermot Kelleher	Dean of the Faculty of Medicine
Kelly Kent	Head of Development: Provostial and University-wide initiatives
Louise Lindsay	Director of HR
Jeff Magee	Dean of the Faculty of Engineering
Charles Mallo	Director of Enterprise Projects and Imperial Business Partners
Tom Miller	Director of Communications and Public Affairs
Tom Pearson	Head of Special Projects (Academic Partnerships)
Sarah Perkins	Programme Director: Research & Head of Research Strategy, Faculty of Medicine
Markus Perkmann	Associate Professor of Technology and Innovation Management
Nelson Phillips	Chair in Strategy and Organisational Behaviour
Nik Pishavadia	Director, Corporate Partnerships

John Polak	Head of the Centre for Transport Studies
Stephen Richardson	Associate Provost (Institutional Affairs)
Eulian Roberts	CEO, Imperial College ThinkSpace
Muir Sanderson	Chief Financial Officer
Martin Siegert	Co-Director of the Grantham Institute
James Stirling	Provost
Alireza Tahmasebzadeh	Co-Founder at Blocks Wearables (Undergraduate Student)
Emma Toumi	Licence and Patent Management Executive
Jonathan Weber	Vice Dean of the Faculty of Medicine
Tom Welton	Dean of the Faculty of Natural Sciences
Eric Yeatman	Deputy Head of Dept. of Electrical and Electronic Engineering
Julia Zanghieri	Imperial Business Partners Programme Manager

External interviewees	
John Alty	CEO, Intellectual Property Office
Gregg Bayes-Brown	Editor, Global University Venturing
Steve Caddick	Former head of Enterprise, UCL
Mick Cardew-Hall	VP Innovation, ANU
Mark Dodgson	Director of Tech. & Innovation Mgmt. Centre, Uni. of Queensland
Christine Doel	SQW Group
Chris Green	CEO, SQW Group
Alan Hughes	Professor Emeritus of Enterprise Studies, University of Oxford
Peter Madden	CEO, Future Cities Catapult
Sir Keith O'Nions	Chairman, Cambridge Enterprises
John Pickering	Head of Triple P Innovation Precinct, University of Queensland
Graham Richards	Former head of Chemistry, Oxford University
David Simpson	KPMG, External Advisor, Imperial College
Ian Smith	Chairman, Four Seasons Healthcare
Rolf Stahel	Advisory Board of the Business School
Sir Richard Sykes	Chairman, Imperial College Healthcare
Irving Wladawsky-Berger	Adjunct Professor, Innovation and Entrepreneurship Group

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