Visit our website at . c. /. b to browse our collection of case studies and share any of your own experiences of university-business engagement.

F d

At the Royal Society of Chemistry, we re committed to advancing excellence in the chemical sciences for the benefit of science and humanity.

We do that by connecting people across the chemical sciences and a key part of this is building bridges between academia and industry.

There is plenty of evidence that closer engagement between universities and businesses brings significant benefits from increased support for research and faster commercialisation of new technologies, to better job prospects for students.

In the chemical sciences, universities and companies have traditionally had very strong links. But the precise nature and extent of these relationships has not been documented at the national level.

We wanted to understand what is happening on the ground and to share good practice across

Barriers and opportunities

F a c d a c , ba
a c c ab a b a : d ç d a ;
acc d ; a ab c ac a d IP; a d
acad c .

Our survey and case studies suggest many potential ways of overcoming these barriers, with opportunities for all of the stakeholders across the research and innovation community.

Opportunities for individual researchers and departments:

1. Explore a wider range of routes to finding research partners including using knowledge transfer networks and innovation centres as well as local company and alumni networks.
2. Senior academics facilitate introductions for colleagues at earlier stages in their career.
3. Explore a wider range of funding options for research collaboration with companies and for enterprise activities such as spinouts.
4. Experienced researchers support early career staff in developing successful applications for specific funding schemes.
5. Raise awareness about standardised IP templates such as the Lambert toolkit.
6. Link with institutional, regional and wider mentoring schemes .
7. Explore opportunities to engage alumni in mentoring students and staff

I d c

Collaboration between universities and businesses brings benefits to academics, companies, students and the UK economy. There have been many reviews focussing on different aspects of university business engagement since the Lambert Review in 2003 (1).

From a business perspective, changes in business models and the rate of progress in science and technology have led to an increased emphasis on establishing partnerships with academic researchers. Businesses also increasingly need to engage with universities to fulfil their future skills and technology requirements. In 2015 the Confederation of British Industry reported that 68% of businesses already have some type of links with universities and 35% of businesses are looking to extend their interactions still further (2).

For universities, engaging with companies opens new avenues for research collaboration and funding, as well as opportunities to commercialise academic research. It also gives access to data, equipment, expertise and networks. The value of such knowledge exchange activities to universities was over £4.2bn in 2014 / 15, 6% higher than the previous year (3). In the 2015 Dowling Review academics cited many other advantages to collaborating with companies such as: increasing employability and providing good job prospects; working on challenging, interesting and real-world problems; and seeing the societal value of their research (4).

Universities and individual researchers also increasingly need to demonstrate the economic and societal impact of publicly funded research. In the UK, researchers applying for Research Councils UK funding must include a Pathways to Impact statement in their proposal (5). The Research Excellence Framework (REF) is a system for assessing the quality of research in UK Higher Education iBDClg the quality rameworlcooiD 210(9(omic ato)-10( )]TJ EMApa r)6(esear)6(ch in UK Higher Educa)Councrgas onclude das o inell (5). Th5]TJ

Types of university business engagement

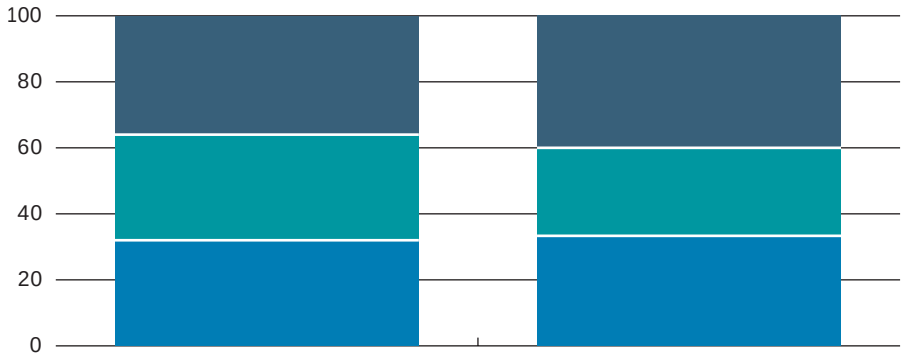
Our survey covered the three academic years from September 2012 to September 2015. We discussed the results at the HCUK 2016 spring conference and clarified some points based on feedback at that workshop.

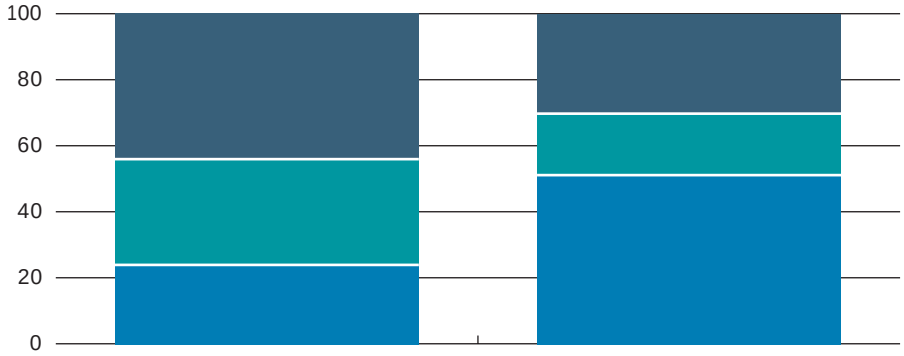
Our survey had three sections reflecting the main types of activity chemistry departments engage with businesses to support:

a) R a c : Types of companies involved in collaborative research, mechanisms for sourcing partners and funding, outputs and barriers.

b) E : Spinouts, funding mechanisms, and enterprise and business awareness training for staff and students.

c) E ab : Contributions by industrial partners to staff development, teaching and student employability skills.





U b a ac

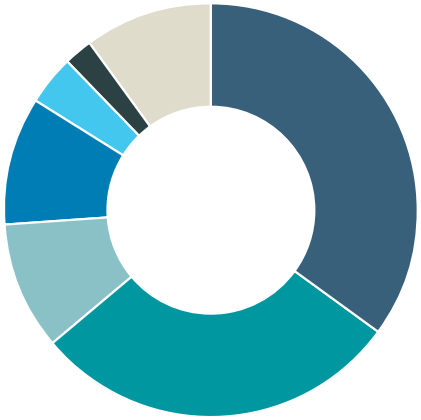
Relationships based on trust and understanding underpin successful research collaboration between universities and businesses (4; 8; 9; 10; 11). Developing such relationships takes time and it is also a challenge to initiate them in the first place. According to the Dowling Review one of the top 10 barriers to collaboration with universities from a business perspective is that it is difficult to identify academic partners or where academic capability lies. From a university perspective, one study across all faculties identified that the single biggest challenge to engagement with industry on research was the difficulty in finding suitable collaboration partners (12).

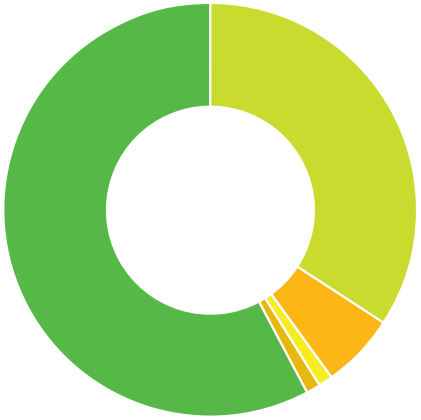
Mobility in both directions across the academia-industry boundary is one way of fostering open and trusting relationships between people. This mobility is important at all levels in universities from students to professors but lack of incentives, a perception that collaboration with industry is damaging to an academic career path, and low awareness of schemes can all act as barriers to mobility.

There are also people and organisations that act to broker new relationships and develop networks across disciplines and sectors. Well-networked individuals, or discipline hoppers (4), can be very effective at building links across the interfaces between academia and industry. Knowledge Transfer Partnerships and Local Enterprise Partnerships also provide frameworks for creating links.

University Technology Transfer Offices (TTOs) and Research Collaboration Offices (RCOs) play a role in facilitating agreements and developing connections between universities and businesses (13). Intellectual Property (IP) arrangements are still cited as a barrier to developing research partnerships and in negotiations related to commercialisation of research outputs, although standard intellectual property (IP) templates such as the Lambert Toolkit can be useful. The Dowling Review also highlighted the importance of IP awareness and broader business training for PhD students (4).

Collaborative research projects between business and universities range from fundamental curiosity-driven research to applied programmes addressing a specific challenge. Applied research can sometimes fall into the gap between the remits of Research Councils and Innovate UK. However, there is a range of funding to support collaborative research, including Innovate UK s Higher Education Innovation Funding (HEIF), Research Councils UK (RCUK) Impact Acceleration Accounts and RCUK CASE studentships.





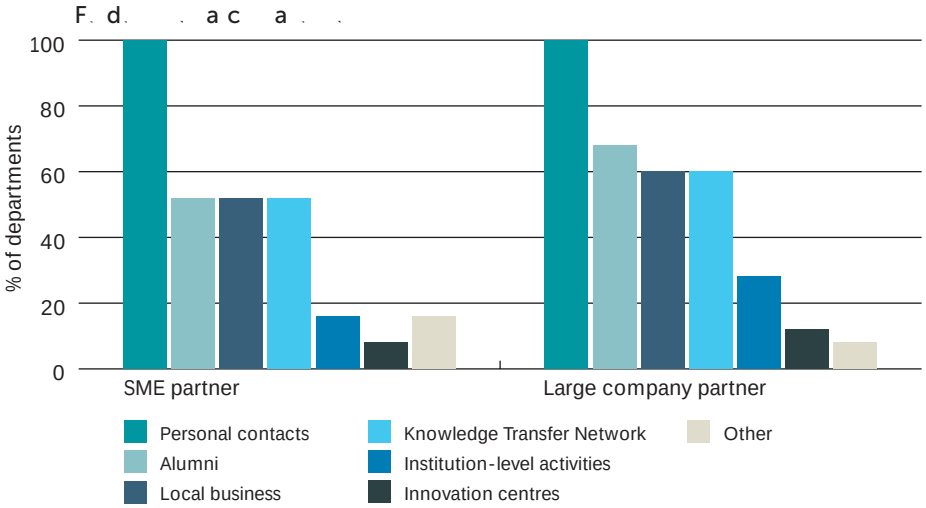


Figure 4: Mechanisms used by chemistry departments in our survey to find new collaborative partners in SMEs and large companies.

Barriers to and opportunities for successful university business research collaboration

Participating departments identified the four top barriers to university business research collaborations in chemistry from a university chemistry department perspective:

i. Difficulty in finding suitable partners
ii. Lack of funding
iii. Intellectual property and contract negotiations
iv. Pressures on academic time

Barriers ii) iv) were among the 10 obstacles to successful university to business research collaboration identified from a university perspective in the Dowling Review (4).

Finding suitable partners in industry

Individuals and departments use a variety of mechanisms to identify and develop partnerships with businesses. Personal contacts are a key way of finding new partners. Participants in the HCUK workshop reinforced the view that personal contacts are the most effective way of developing collaborations. They also said that expanding personal networks of contacts in industry networks is challenging. See Figure 4.

RECOMMENDATIONS AND OPPORTUNITIES FINDING PARTNERS IN INDUSTRY

For departments and individual researchers:

E a c a a ab d c ac d a

Case studies on the Knowledge Centre for Materials Chemistry (c. / b -ca -17) and the Organic Materials Innovation Centre (c. / b -ca -3) give examples of how knowledge transfer centres can be used to find industry partners.

A case study on the University of Nottingham s Chemistry Innovation Laboratory describes how they build links with SMEs in particular (c. / b -ca -16).

A case study on how Aston University partners with consortia is available at c. / b -ca -18. Researchers could also explore online brokerage tools such as Innovate UK s _connect (26) and the National Centre for Universities and Business s (NCUB) Konfer (27) as well as opportunities provided by events such as the RSC Emerging Technologies Competition (28) or more indirect connections through student placements in companies.

S a c ac b d a ; a a c a a c acad c ca c a a a ca d c c c a

For innovation supporters:

Ra a a d c a a ab d d a a d a acc

RECOMMENDATIONS AND OPPORTUNITIES
IP ARRANGEMENTS

For departments and individual researchers:

Ra a a . . . . a da d. d IP ! a . a d a . . . . d ac c a . . . a c a d . a c . . . a .

For institutions:

R ! . . . . a IP a a ! . . a d . . TTO . . . . . a c c ab a . . . . d . . d c . . c . ca b a ba . c ab a . . a . a ba a c . . . . a . . . .

Research engagement score and the Research Excellence Framework

The Dowling Review (4) found that some universities perceive collaborating with industry partners as damaging to an academic career path. We had heard similar concerns from chemistry academics that this negative association would mean their departments would not submit the work of academics that collaborate with industry to the Research Excellence Framework (REF).

We created a research engagement score as one potential measure to explore the relationship between the extent to which a department collaborates with industry and its 2014 REF ranking by Grade Point Average (GPA) (16). See Figure 8.

We found that departments engaged in a larger number of research collaborations, as measured by this research engagement score, tended to have a higher ranking by GPA in the 2014 REF exercise [2].

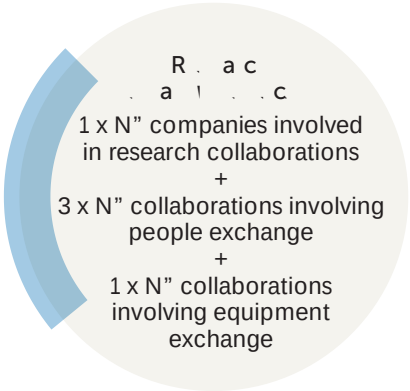


Figure 8: Definition of research engagement score. We gave projects involving people exchange a higher weighting based on the perception at the HCUK workshop that this type of collaboration is most significant in terms of its investment and value.

50
40
30
20
10
0

U b a ac , a a d ab

Businesses contribute in many ways to university teaching, training and employability activities. Various reports have highlighted the value to students in all STEM disciplines of work placement programmes (8; 17; 18; 19). They are also a key mechanism that businesses across sectors use to address their skills requirements. Nearly two in three of all employers look for graduates with relevant work experience and over a third of all companies that engage with universities offer some form of work placement (2). Work-based learning schemes range from work tasters through to summer internships and one year sandwich placements (20).

One in four employers across all sectors is involved in developing higher education courses. This can include curriculum design and technical teaching as well as providing general advice on course content and delivery and is particularly prevalent in biological and physical sciences (21). The Wakeham Review suggests that more could be done to align student skills development in universities with the expectations and needs of employers (22).

Enterprise skills and business awareness

23 departments completed survey questions about contributions by industrial partners to the development of skills in enterprise and business awareness:

75% of departments worked with companies to enhance the enterprise skills of their students and / or staff. Figure 10 gives the breakdown of activities by type and level. Case studies on the Soft Matter and Functional Interfaces Centre for Doctoral Training at the University of Durham (. c. / b -ca -5) and the Medici Enterprise Training Programme at the University of Birmingham (. c. / b -ca -6) give examples of enterprise training for postdoctoral researchers and academic staff.

43% of departments worked with companies to deliver training courses, workshops or events for their academic staff.

17% of departments worked with industry experts to provide mentoring to their academic staff. Participants in the HCUK workshop said this type of mentorship was the most effective way of developing these skills for this group.

Chemistry departments used several routes to find partner companies to support enterprise and business awareness skills development. See Figure 11.

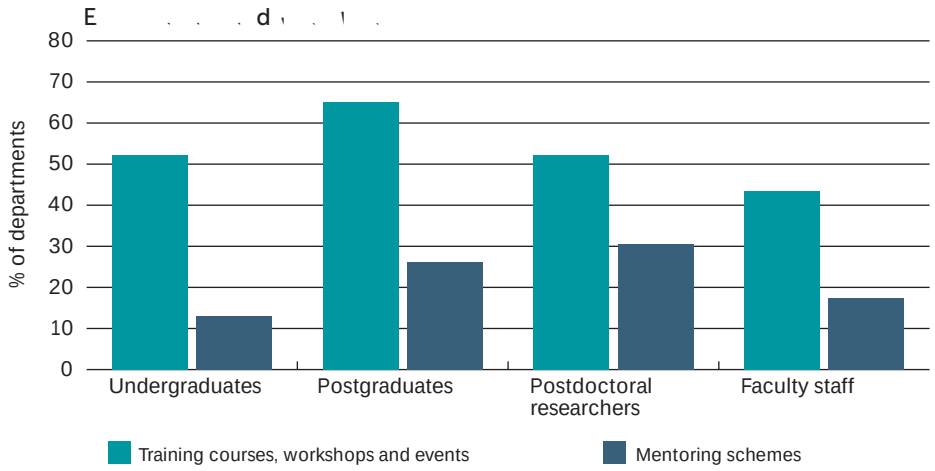


Figure 10: Percentage of chemistry departments that involve companies in enhancing enterprise skills development.

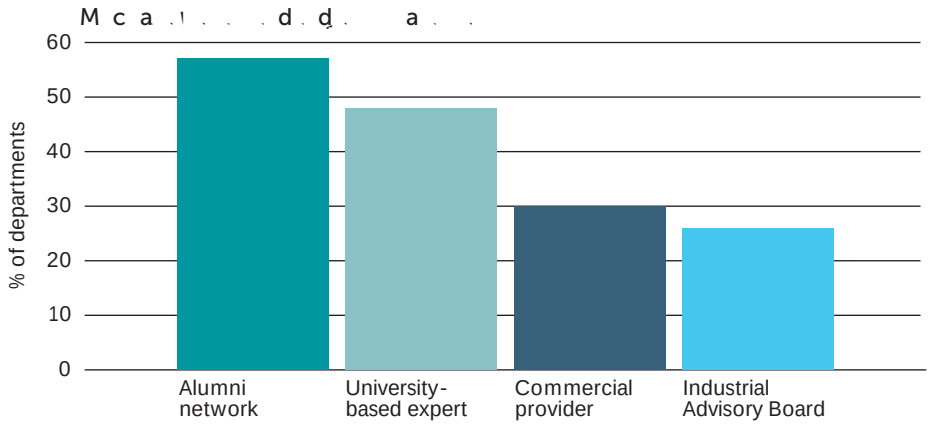
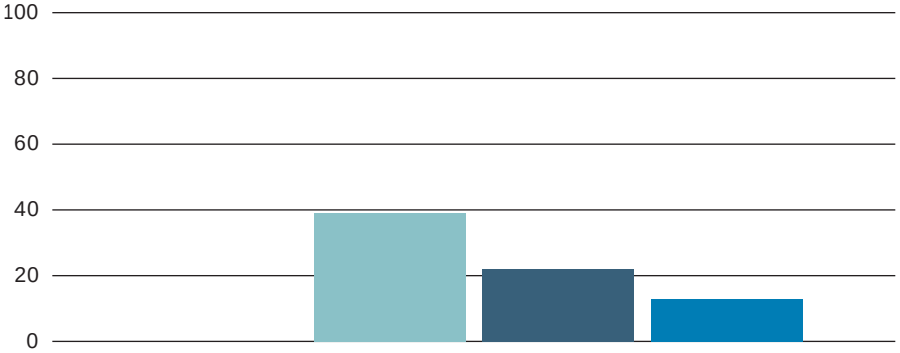


Figure 11: Mechanisms used by chemistry departments to identify partners to support enterprise skills development.

University business engagement in teaching, training and employability


100
80
60
40
20
0

Chemists benefit from having a way of recording skills they have developed, which they can present to future employers. Mechanisms already exist for this, such as the Royal Society of Chemistry s Undergraduate Skills Record (25). If a student does not do an industrial placement they can, with support from their supervisors, use the skills record to identify gaps in their experience and seek alternative opportunities to develop skills for a role in industry or elsewhere.

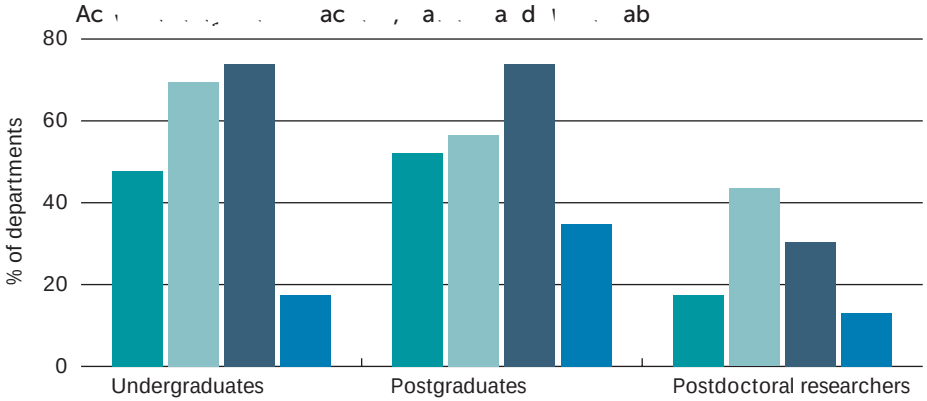


Figure 14: Activities undertaken with companies to support teaching, training and employability for undergraduates, postgraduates and postdoctoral researchers.

RECOMMENDATIONS AND OPPORTUNITIES

For departments and individual researchers:

D a a d a c d d a c a d ad a d . There is the option of adopting or adapting existing skills frameworks such as that used for awarding Registered Scientist (RSci) status (. c. / . c), or those in the case studies at . c. / b -ca -8 and . c. / b -ca -9.

T . a a d ac c d . a ac

For universities, companies and funders:

T . a c a b . a ac d ad a a d P D. d . . There are different factors that limit availability of industrial placements, including availability of funding and capacity of companies to host industrial placement students. It is also a challenge for chemistry departments and for companies to connect with one another in order to explore industrial placement opportunities.

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Ac d

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Heads of Chemistry UK (HCUK) is the body which represents the interests of departments engaged in chemical education, scholarship and research in universities and similar institutions throughout the United Kingdom and Ireland.

We would like to thank the wider group of individuals that contributed to the case studies for providing more detailed information about their experiences of engaging with businesses. We are grateful to Prof Mike Ashfold FRS, Chair of our Science Education and Industry Board, for commenting on drafts of this report.

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For further information, please email . c . c @ . c.