
Royal Academy of Engineering Research Programmes: Evaluation and Career Tracking

**Report by the Careers Research &
Advisory Centre (CRAC)**

September 2020

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Report by the Careers Research & Advisory Centre (CRAC), supported by the
Institute for Employment Studies (IES)

Commissioned by the Royal Academy of Engineering

September 2020

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About CRAC, Vitae and IES

The Careers Research & Advisory Centre (CRAC), registered as a charity in 1964, provides research, expertise and innovation services for all those who support career development, at all ages and across all sectors. CRAC's research and consultancy work focuses on career-related learning, employability development and career transitions, including STEM and researcher careers.

Vitae is a programme which promotes and facilitates the professional, career and personal development of researchers who work in higher education, which is owned and managed by CRAC.

The Institute for Employment Studies (IES) is an independent, international centre of research and consultancy on public employment policy and human resources (HR) issues. It works closely with employers in all sectors, government departments, agencies, professional bodies and associations. IES is a focus of knowledge and practical experience in employment and training policy, the operation of labour markets, and HR planning and development. IES is a not-for-profit organisation with research specialists and consultants from a range of countries, and conducts projects focused on UK, European and International issues.

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1. Executive summary

The Royal Academy of Engineering (RAEng) Research Programmes are designed to promote excellence in UK engineering research and innovation through funding-based support for outstanding researchers at a range of career stages and to enhance partnerships with industry.

Schemes (programmes) within scope of this evaluation were Research Fellowships (for early-career researchers), Industrial Fellowships (secondment to industry for mid-career academics), the Research Chairs and Senior Research Fellowship scheme (jointly sponsored with an industrial partner, targeted at senior researchers), and the recently re-invigorated Chairs in Emerging Technologies (a 10-year award for leading senior researchers with a focus on commercialisation). The key objectives of this evaluation project were to:

- Determine the long-term impact of these programmes in relation to participants' careers and contributions to engineering research and industry;
- Consider whether the programmes remain fit-for-purpose and are operating well, and/or whether improvements are needed;
- Understand more about the career pathways and progression of participants or alumni, including their wider contributions to the sector and/or profession;
- Devise a future engagement and research strategy for alumni and future participants of the schemes, so that the RAEng can undertake career tracking on an ongoing basis.

A multi-strand, mixed-method approach was taken to our evaluation project, in order to gain a variety of perspectives and leverage the range of potential information available:

- Consultation with 11 stakeholders, including RAEng staff and past/current chairs of the schemes, to capture perspectives on the positioning and operation of each main scheme and identify any key issues on which to focus within the primary research;
- Review of grant system information held about awardees, to ascertain certain aspects of profile of awardees and any broad trends in the schemes over time;
- An online survey of current awardees and alumni across the schemes to investigate experiences, career progression and perceptions of impacts, which was targeted to 325 eligible known contacts and generated 182 responses (overall response rate 56%);
- In-depth interviews with a stratified sample of 24 alumni to gain deeper insights into their experiences and with representatives of industrial partners for 8 of these alumni in the Industrial Fellowship and Research Chairs/Senior Research Fellowship schemes.

As almost all results obtained are only meaningful in the context of the scheme in which the awardee participated, the findings are most succinctly summarised here by main scheme. Due to the modest response samples per-scheme, however, all quantitative results should be treated with some caution.

Research Chairs and Senior Research Fellowships

- All relevant stakeholders consulted perceived that the Research Chairs/Senior Research Fellowship (RC/SRF) scheme is amongst the most prestigious fellowship opportunities

available in the UK to support senior engineering researchers and the very direct engagement with an industrial partner makes it distinct from other funding options;

- The profile of awards in terms of host institution shows a high concentration in certain large research-intensive institutions (42% of the 120 known awards have gone to academics at just four institutions, although 31 different institutions have gained at least one award). Stakeholders felt that some institutions were more aware of the scheme than others and more confident in whether and how to apply, particularly given there is also a requirement to secure industrial funding;
- The personal profile of awardees is far from diverse although this partly reflects the (lack of) diversity amongst senior engineering academics in UK research-intensive institutions. The mean length of postdoctoral experience was 18 years for RCs and 11 years for SRFs, but within quite wide ranges, confirming that awards are being made to academics at the career stages intended;
- The overwhelming majority of RC/SRF awardees (current and alumni) reported positive overall experiences (76% very positive and 22% positive);
- Awardees suggested that the intimate relationship with the industrial partner, chance to engage with RAEng, flexibility in funding and especially the time and freedom to focus on their research for a significant duration were the most valued aspects of the scheme;
- The potential opportunities for engagement with peers and others through the RAEng and to undergo mentoring were both viewed as unique and attractive features of the award (along with the possibility of those with an SRF award upgrading to a RC award if they became a Professor at their institution);
- Most respondents (81%) had undertaken mentoring during their award, of whom over three quarters found it very (43%) or quite (34%) valuable. Almost a quarter (23%) did not, perhaps reflecting challenge in finding appropriate mentors for senior awardees and/or that mentoring adds less value at a senior career stage;
- Around 1 in 5 encountered significant difficulties during their award, most frequently relating to issues with the industrial partner such as a change in interest if it was acquired by another organisation or if a key senior staff member left (issues that could be inevitable in a relatively long-duration award);
- There were strong endorsements of the current duration and amount of funding of the award (88% and 85%, respectively, believing this to be sufficient);
- Almost all respondents found the experience of working with their industrial partner positive (64% very positive, 32% quite positive). 95% felt their engagement had enabled them to gain a deep understanding of its business and working culture, which the scheme is designed to foster in order to underpin a sustained research collaboration;
- Of those who had completed their award and were still working, roughly two thirds (63%) were still in contact with their industrial partner when surveyed. Over 80% had engaged in joint research with the industrial partner, having obtained other funding, after the award had ended. These results strongly suggest that many sustained collaborations have resulted from the awards. One third had set up a joint laboratory or research centre with the partner although only very few (4 individuals) had taken up a position in the partner organisation;

- Many awardees described the impact of the award on their career progression as transformational and that it had been key to their success as a senior research leader, enhancing their ability to attract further, often substantial, research funding and improving overall research capacity at their institution;
- There was evidence that over half of RC/SRF awardees had contributed to policy-making at a senior level, while one third of those who had completed an award had been elected to Fellowship of the RAEng.

Research Fellowships

- Despite its similarity to several other early-career awards from other funders, the Research Fellowships (RF) scheme was uniformly perceived by the stakeholders we consulted as a critical opportunity specifically for engineering researchers seeking to make the transition to independent research leadership. It was viewed as a prestigious award which should facilitate progression to a permanent academic post, enabling the the RAEng to bring the next generation of research leaders into its community;
- As for the RC/SRF scheme, RF awards have been quite heavily concentrated at certain research-intensive institutions, particularly in London and the south east of England. 43% of all awards have gone to four institutions within the 'Golden Triangle', while 30 institutions in total have hosted an RF awardee;
- Although the profile of awardees is probably only slightly narrower than (rather than representative of) the eligible population, several stakeholders were concerned about a limited diversity of applicants and awardees, which raises the question of whether a more thorough review of the inclusiveness of the application and award process could be timely, given the key stage of progression at which the scheme is positioned. RF awardees responding to the survey had an average of 3 years of postdoctoral experience prior to starting their award, as would be expected from the eligibility criteria;
- The overwhelming majority of respondents (both RF alumni and current participants) felt that their overall experience of the scheme had been positive (82% very positive and 17% positive), with only a single individual perceiving a somewhat negative experience;
- The prestige of the scheme and duration of the funding were the most attractive features of the scheme, driving applications, followed by the prestige of the RAEng as a funder, while the extent of funding and flexibility in its use were also seen as valuable. Some stakeholders felt that the RAEng should do more to encourage awardees to make more of the opportunities for networking within the RAEng community and to benefit more from being a member of this valued cohort within the research pipeline;
- 4 in 5 respondents (81%) had received mentoring during their award and, of these, three quarters had found it valuable (27% very valuable and 49% quite valuable). The value of mentoring was felt particularly appreciated in relation to supporting individuals' career progression, helping to develop the direction of research and to maintain progress;
- Around 1 in 5 respondents indicated that they had encountered major difficulties during their fellowship. Most of these stemmed from perceived shortcomings in the support provided by their host institution – while many of these cases appeared to relate to an individual personality clash or specific issue with facilities, several respondents reported a lack of support in relation to progression as they approached completion of their award;

- The vast majority felt that the duration of the scheme was about right for their needs, with only two respondents feeling that it should have been longer. Perhaps surprisingly in the context of some competitor schemes being better funded, and stakeholders' concerns, 88% of awardees felt the extent of funding was sufficient (only 5 respondents said it was not generous enough);
- Respondents were very clear in perceiving that the RF had enabled them to progress in their academic career, with over 95% believing it had made a significant difference to their career path (82% agreeing strongly that this was the case) and a similar proportion feeling it had made or would make it easier obtain their first permanent position;
- The opportunity the fellowship afforded to establish genuine independence in research was rated as a highly valuable aspect of the scheme by almost all respondents, with many believing it enabled them to establish an international reputation and the chance to explore novel directions in their research;
- Over half believed that the fellowship had been very valuable in improving their self-confidence, with high proportions believing that they had gained valuable new skills in addition to expert knowledge;
- Survey responses included many highly positive endorsements of the value and perceived impact of the scheme, many respondents reporting that they felt they might not have their current job and positive career without the RF. Overwhelmingly they would encourage others to apply for a similar award (and had done so).

Industrial Fellowships

- The aims of the Industrial Fellowship (IF, formerly Industrial Secondment) scheme are to immerse academics in a contemporary industrial environment, experience of which should enhance their teaching but also assist in developing collaborations. The scheme was viewed by stakeholders as valuable in providing a low-risk test of a relationship between an academic and industry, which could be a springboard to sustained collaborative research. Recent changes to IF duration and funding/flexibility should increase its attractiveness to potential participants;
- The profile of institutions hosting IF awards is much more diverse compared with those hosting RC/SRF or RF awardees, being much less concentrated with a greater balance both in geography and institutional type. 47 different institutions had hosted the 85 awards in the sample. Notably, the four large institutions which hosted 41% of RC/SRFs had only hosted 8% of IF awards. Interestingly, 77 different industrial partners were involved in these 85 awards, suggesting that repeat business was rare at least since 2011 (the period of IF awards that was studied);
- All the IF respondents were either very positive (80%) or positive (20%) about their overall award experience, and all of them would recommend it to others. They were attracted not only by the chance to undertake work within an industrial setting, but by the prestige of the scheme and of the RAEng that was behind it. Despite this positivity, almost a third suggested that the RAEng could have done more to make it even better, by providing more support to them to work more effectively with the partner, such as through mentoring;
- Although few (n=6) respondents reported they had experienced significant difficulties during their fellowship, these included practical issues like the time taken to get fully set

up at the industrial partner or difficulties getting access to its senior staff, issues which potentially could be resolved by a longer-duration secondment. 71% felt that the duration of their award had been about right while 27% felt it was not long enough (these respondents having dominantly experienced only a six-month award). There was only one case of a protracted intellectual property dispute involving their host university;

- Just over two thirds (68%) believed that the level of funding had been sufficient but 27% thought otherwise, and several commented that they were limited in what they could achieve because of a lack of ability to access funds to cover research costs;
- The large majority (83%) of respondents found the experience of working with their industrial partner to be positive (the remaining 17% quite positive) and almost three quarters felt that the secondment had enabled them to understand its business and working culture to a great extent;
- 88% of those who had completed their award were still in contact with their industrial partner and over 80% had engaged in subsequent joint research with them (most of whom had successfully applied jointly for funding for that work), indicating that most of the awards had led to sustained collaboration, so the secondment had had the desired effect in underpinning such a development;
- Despite the relatively short duration of the IF, almost all respondents felt that the award had impacted positively on the level of seniority they had reached in their academic career (almost 60% agreeing strongly that this was the case). Around three quarters felt it had made or would make some positive difference to their career path, accelerating their career progression and enhancing how they were perceived by senior colleagues. Many recent awardees were mid-career and either currently seeking progression to a professorial role or had recently achieved one (and believed the award was seen as a positive contributory factor);
- On the key objective of improving their teaching practice, nearly 72% of IF respondents reported that they had enhanced their teaching through use of new practical examples they had observed with their industrial partner;
- Perhaps more surprising was the impact on their research – although not an overt objective of the scheme, a high proportion of respondents indicated that they had pursued a new line of research as a result of the secondment (linked with successful applications for other grant funding) and some felt that the experience had been quite transformational in their attitude to research.

Recommendations

1. The first, high-level, recommendation is that all the main current research support programmes should be continued since, on the basis of the evidence obtained in this evaluative study, most awardees are achieving the intended objectives.
2. We do not recommend major changes to any of these schemes as they appear to remain largely fit-for-purpose and appropriate in terms of positioning in the research funding landscape for engineering in the UK.
3. We do not recommend substantial changes to the operation of the schemes as in the main they appear to be functioning effectively and the experiences of almost all awardees are reported as positive.

4. Given these high-level recommendations, the following lower-level issues emerge which should be considered as recommendations for possible enhancements or adjustments to specific schemes:
 - There would be benefit in further clarity in requirements for industrial partners within the IF and RC schemes, as some respondents report issues in relation to differences between their expectations and lived experiences of support from those partners;
 - In parallel, while most respondents report positive experiences, there is scope for revised guidance or greater clarity in the requirements of host HE institutions in relation to the support they offer RF and RC/SRF awardees (around release from teaching and administration loads and potentially more support as awardees progress at completion of the fellowship);
 - The extent to which RC/SRF and CiET awardees can access funding to cover research costs, including support for additional posts, should be reviewed to ascertain whether this could materially accelerate the progress made in early years of these awards (this also applies to IF awards in relation to modest additional research cost funding);
 - The total extent of funding of the RF award should be reviewed to ensure that costs of buying out time from the institution are fully covered and the scheme remains competitive within the range of early-career fellowships available;
 - Given the current levels of competition for awards and the quality of applications, could consideration also be given to increasing the number of RF awards made?
 - There would be benefit in greater outreach and/or application support being offered in order to widen the range of institutions at which RC/SRF and RF awards are made (based on a review of applications);
 - We recommend consideration of undertaking a review of the inclusiveness of the application and award-making processes in relation to diversity, for the RF scheme in particular given its pivotal position in the research pipeline;
 - Additional promotion of success stories within the IF scheme, to industry in particular, could be beneficial as evidence suggests that few industrial partners are repeating their participation (contingent on review of applications);
 - The offer of mentoring is a clear success in most cases so further effort should be made to ensure all awardees in all the main schemes can benefit from this support;
 - In parallel with other early-career fellowship schemes, consideration should be given to ways in which the RAEng and host institutions could support RF awardees approaching the end of their fellowship who have not yet secured progression to permanent employment;
 - Given the positive reported experiences of awardees' engagement with the RAEng, including their peers and other scheme awardees, exploration of potential additional opportunities to facilitate networking and cohort benefits would be valuable.
5. Finally, we recommend that further career tracking of scheme participants and alumni, together with periodic evaluation work, are undertaken on a planned and systematic basis, to build upon this initial study (for which we have provided some specific recommendations and guidance).

2. Introduction, context and aims

2.1. Introduction and background

The Careers Research & Advisory Centre (CRAC), supported by the Institute for Employment Studies (IES), was commissioned in 2019 by the Royal Academy of Engineering (RAEng) to undertake an evaluation of a number of its Research Programmes.

The RAEng Research Programmes are positioned to promote excellence in engineering research and innovation, supporting strategies to develop outstanding researchers into future research leaders in engineering and enable partnerships with industry (so there is sustained exceptional research on themes that matter to industry). The following programmes were agreed to be within the scope of this project:

Research Chairs and Senior Research Fellowships: launched in 1986, grants for strategic partnerships to strengthen academia/industry links, supporting exceptional established academics in UK higher education (HE) at Professor or Reader/Senior Lecturer level, respectively, to initiate or enhance sustainable, world-leading engineering research on 'use-inspired' themes that meet the needs of industrial partner/s (c.£2 million/year investment).

Research Fellowships: 5-year grants (first launched in 2001) to support early-career (postdoctoral) researchers to develop independent and successful research careers in the UK, each of c.£500k value.

Industrial Fellowships: providing academics the opportunity to undertake a 6-month collaborative research project in an industrial environment, to catalyse links between their university and industry, develop strategic relationships, gain industrial experience and enhance their teaching (launched in 2001).

Chairs in Emerging Technologies: long-term support (10 years) to global research visionaries to work on an emerging technology which will ultimately be commercialised, recently expanded with Government support.

More detail on each scheme is given in subsequent chapters as context to the results and findings obtained, which are reported for each scheme in turn (as this is the most meaningful presentation). It was agreed to extend the research to cover a small number of individuals who had participated in Clean Technology Fellowships and Chairs in Innovative Manufacturing, programmes which are broadly similar to the current schemes but no longer in operation, but the number of participants in these was too small to merit separate analysis.

2.2. Context

The academic research environment is becoming more competitive. The numbers of early-career researchers (ECRs) in the UK and other developed countries have increased considerably over the last 15 years, partly fuelled by rising numbers undertaking doctoral research programmes. Most postdoctoral ECRs aspire to an academic career but there are insufficient opportunities for the majority to achieve one. Progression from postdoctoral research to independent research leader is a critical career step and one of the hardest to achieve, but within the research system is key to building sustainable research capacity.

Progression for ECRs (particularly into long-term academic roles) is dependent on publishing highly-cited papers in high-impact journals and successful applications for research funding. However, the way research is conducted is changing. Researchers are expected to: work

collaboratively, interdisciplinarily, intersectorally and internationally; share their research, data and publications more openly; demonstrate impact of their research to the economy and society; attend to research integrity, ethics and reproducibility; and support creation of a more diverse and equitable research environment. The current reward and recognition system runs counter to many of these over-arching policy messages. ECRs need to navigate a difficult path through these competing challenges. This potentially career-defining stage may also coincide with personal aspirations by some to establish a family.

The economic backdrop is recognition that the UK needs to drive productivity and growth by leveraging our world-class research base and helping businesses to develop and realise the potential of new ideas generated. The current Industrial Strategy aspires to greater national investment in research and development (R&D) and a larger workforce undertaking research and/or deriving impact from it, partly to address major global challenges. Building sustainable research capacity, and absorptive capacity in industry to innovate and utilise new knowledge/technologies, is crucial for the UK and increasingly will be through international and intersectoral collaborations.

2.3. Project aims and scope

The RAEng sought research into these programmes through the lens of current participants and especially alumni. The key objectives of the research project were to:

- Determine the long-term impact of these programmes in relation to participants' careers and contributions to engineering research and industry;
- Consider whether the programmes remain fit-for-purpose and are operating well, and/or whether improvements are needed;
- Understand more about the career pathways and progression of participants or alumni, including their wider contributions to the sector and/or profession;
- Devise a future engagement and research strategy for alumni and future participants of the schemes, so that the RAEng can undertake career tracking on an ongoing basis.

The project aimed to explore the impact of these schemes upon awardees' careers, research activity, leadership development and contributions to engineering and science. It was not designed as a formal impact study, partly because of the wide range of schemes and the relatively modest scale of each but also practically due to the challenge of defining and engaging an appropriate control group against which outcomes could be compared. It was hoped the study would also add to the growing base of evidence about the career progression and development of those who undertake engineering research and researchers' careers more generally. From CRAC's point of view, the project adds to a growing range of evaluative studies we have undertaken for research funders about early-career research support and funding.

3. Methodology and samples achieved

3.1. Approach and methodologies used

The mixed-methods approach we selected for this investigation comprised a series of linked activities (Figure 3.1), utilising a range of types of and sources of information:

- Consultation with a range of key informants and stakeholders to capture perspectives about the schemes, their positioning and operation, which also contributed to development of an evaluation framework upon which the primary research instruments were designed;
- Review of scheme management information (MI) data available from the RAEng's grant management systems about awards made in the schemes;
- An online survey of current awardees and alumni to investigate their experiences of the schemes, career progression and perceptions of emerging impacts. Such quantitative data could also be used in some cases to explore any key differences in results for certain major participant groups/types;
- In-depth interviews were undertaken with a sample of alumni to gain deeper insights into their experiences, outcomes and progression, cross-referenced where possible to interviews with representatives of their employer partner so that case studies could be generated;
- Synthesis of these strands of information and data analysis, culminating in this research report and recommendations.

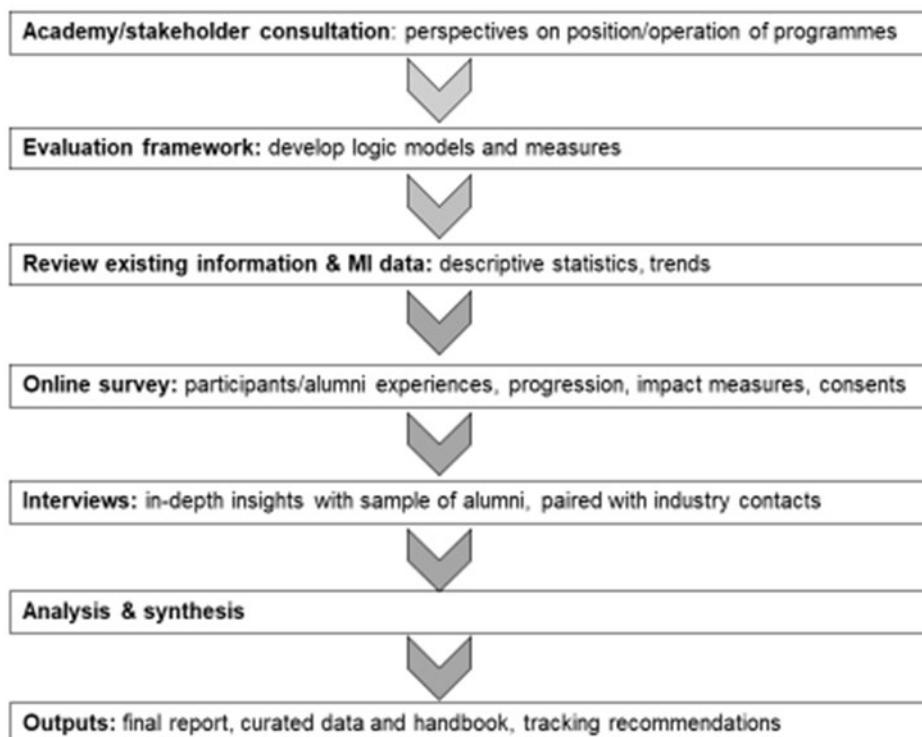


Figure 3.1 Diagrammatic overview of research stages

Together the research approaches aimed to address, for the schemes, their:

- **Relevance:** where programmes fit in the research funding landscape; their relevance and unique impact; whether they appear to be targeted optimally and are attracting appropriate participants;
- **Outcomes and impacts:** have the programme objectives been met and have desired participant impacts and research outcomes been achieved?
- **Administration and delivery:** have appropriate ranges of candidates been selected; have programmes been delivered effectively; should changes be made to the awards, processes or operations?

3.1.1. Stakeholder dialogues

Telephone interviews were conducted with 11 individuals, comprising three RAEng staff with responsibility for the programmes and a range of current and previous members of RAEng committees or groups directly related to the schemes. These interviews were designed to obtain perceptions on the positioning and current functioning of the active schemes, together with experiences of applications and the selection process. They were also used to identify potential issues which could be investigated within the survey and participant interviews, and generally to understand better the context in which to consider the results obtained and situate the findings in this report.

3.1.2. Analysis of existing data

A limited range of data from the RAEng grant management systems relating to these schemes was available, in addition to the name and last-known contact details for participants. These data included award start and end dates, host institutions and industrial partners (where relevant). This information was used partly to support desk research we undertook to seek current contact details where these were missing or out-of-date, and also for analysis of the profile of awards made.

The survey process was designed on the basis that response data obtained from each respondent would be combined with any pre-existing data about that respondent, from the grant system, prior to analysis. This was a deliberate approach which sought to reduce the burden on respondents, i.e. trying to avoid re-collecting through the survey any data that was already available (other than to validate responses) thereby enabling the construction of a slightly shorter questionnaire.

3.1.3. Survey of scheme alumni and participants

An online survey was designed to investigate the profile, current circumstances, career progression, leadership development and scientific contributions of current award-holders (i.e. current participants in the schemes) and those who had completed an award within the range of schemes investigated ('alumni'). It also sought their experiences of their scheme and perceptions of its impact. Themes within the survey were developed based on previous surveys CRAC has implemented with other early-career researcher support schemes, steered by inputs from the stakeholder interviews. The questionnaire was designed using logic to route respondents to appropriate questions according to their responses to certain key questions. Despite the range of schemes to be investigated, a single questionnaire was deployed, with different sections being answered by different groups and some sections by all. While the

majority of questions were closed, to enable quantitative analysis, some open-ended questions were included to allow respondents to express views in more detail. The survey also invited volunteers for potential in-depth interviews and obtained consents for participation and re-contact where necessary.

The survey was targeted at alumni across the lifetime of the schemes, who were contactable by email, and more established current award-holders. Specifically, in agreement with the RAEng, the following groups were targeted:

- Research Fellowship (RF) alumni and current award-holders starting prior to 2018;
- Research Chair & Senior Research Fellowship (RC/SRF) alumni and current award-holders starting prior to 2018;
- Industrial Fellowship (IF) alumni for awards made since 2011;
- Chairs in Emerging Technology (CET) alumni and current award-holders other than those starting in 2019;
- Alumni of the Chairs in Innovative Technology and Clean Technology Fellowships schemes.

The platform used by IES to implement the online survey on our behalf utilised access control, so that personalised reminders could be sent to those who had not responded or had started a response but not completed it. The survey was launched in early January 2020 and open for a period of 4 weeks, closing on 7 February 2020.

3.1.4. In-depth interviews

Drawing upon a pool of volunteers identified in the survey, invitations were sent to a range of respondents to participate in a telephone interview to explore experiences and perceptions in more depth. The individuals were purposively selected to reflect a range of key sub-groups within the survey respondent sample, deliberately attempting to include the main scheme types, men and women, those in different research areas and, where possible, a range of experiences (i.e. not exclusively those who were the most positive).

Where appropriate, survey respondents were asked to identify an individual from their industrial partner that we might contact, on the basis of which we were able to select 8 pairs (i.e. interviewing the participant and the industrial partner, separately), which could be used as the basis for potential case studies. The total interview sample was agreed with RAEng, consisting of 6 interviews with RFs, 6 with IFs and 12 with SRF/RCs. In total, 24 participants and 8 industrial partner representatives were interviewed in this way during February 2020. The information gained was used to augment and illustrate findings from the survey and to construct case studies demonstrating the impact of the funding on the industrial partner company as well as on the individual.

3.1.5. Data analysis

Response data from the survey was downloaded from the online survey platform into an excel file for combination with the pre-existing grant system data, prior to uploading this combined dataset into SPSS for quantitative analysis. Frequency tables for the overall response sample, and for each key scheme, were generated to develop descriptive statistics and quantitative results to closed questions. A number of cross-tabulations were performed on each of these

response datasets in order to explore differences in the responses of key sub-groups. Responses to open-ended questions were coded and grouped to provide additional insights and some were selected for inclusion in this report to illustrate certain findings.

Information obtained in each interview was summarised from the interviewers' notes, drawing selected verbatim quotations from audio recordings. These summaries were used to provide detailed insights on concepts and themes identified in the survey.

The results and findings presented in this report are based on quantitative results from analysis of the survey response data, augmented by the deeper understanding provided by the interviews and open-ended responses. Verbatim quotations included within the report are drawn either from interviews or open-ended responses but maintaining the respondent anonymity that was assured during data collection. Participants who were the subject of the case studies have given express permission to be identified and approved the content written about them.

3.2. Survey samples achieved

A total of 391 grant system records relating to the Research Programmes in the periods agreed were provided to us by RAEng. These data were cleaned and de-duplicated (as some individuals had taken part in more than one scheme). Where email contact details were absent or an alert email sent by the RAEng in December 2019 resulted in a 'bounceback', we undertook web research to identify current contact details where possible. Following this contacts data cleaning and enhancement exercise, 325 useable awardee contacts were available and survey invitations were issued to these individuals.

Table 3.1 summarises the numbers of responses obtained and response rates. In total, 181 eligible responses were obtained to the survey from the total of 325 eligible contacts, an overall response rate of 56%. As Table 3.1 shows, the numbers of responses from the three largest programmes were sufficient for quantitative analysis of those results to be undertaken, and these are reported in the next chapters in this report, by scheme.

Scheme	Useable contacts	Survey responses	Response rate %	No. of alumni	No. of current
Research Chairs / Senior Research Fellowships	104	59	57%	44	15
Research Fellowships	110	66	60%	54	12
Industrial Fellowships	85	41	48%	41	0
Chairs in Emerging Technologies	13	11	85%	0	11
Chairs in Innovative Manufacturing	5	1	20%	1	0
Clean Technology Fellowships	8	3	38%	3	0
Total	325	181	56%	143	38

Table 3.1 Responses obtained to survey of Research Programme alumni and participants

An overall response rate of 56% gives a reasonably high level of confidence that the results reported by respondents are likely to be representative of the views of the overall populations targeted. However, analysis of these responses as a single aggregated response sample has little meaning given that they are drawn from participants in widely differing schemes. For this reason, almost all results in this report are given at scheme level. The response sample sizes of 59, 66 and 41, respectively, for the key schemes (Research Chairs/Senior Research Fellowships, Research Fellowships, Industrial Fellowships) are, however, each very modest. For this reason, a strong caveat is needed in relation to the limited statistical robustness of quantitative analysis of results within each scheme. This is unavoidable given the scale of operation of the schemes.

4. Research Chairs and Senior Research Fellowships

4.1. Strategic relevance and awardee profile

The RAEng Research Chairs and Senior Research Fellowships scheme aims to strengthen the links between industry and academia through providing a jointly sponsored award. Though there are two different levels at which the award can be made, administratively the Research Chair and Senior Research Fellowship awards are run together as a single scheme. Awards are made depending on the level of seniority of the applicant. If a Senior Research Fellowship award-holder is promoted to the professoriate at their institution, their award is automatically upgraded by RAEng to become a Research Chair.

Launched in 1986, the 5-year duration (if undertaken on a full-time basis) scheme aims to establish or develop a strategic partnership between universities and industrial partners. Award-holders undertake 'use-inspired' research that meets the needs of the industrial partners, and are expected to establish or enhance a world-leading engineering research group, deliver research that meets the needs of their industrial partners and become a self-sustaining research group by the end of the award (through securing substantial grant income), as well as publish their research in high-quality peer-reviewed journals. Successful applicants are allocated a senior mentor and have access to a media training course run by RAEng.

The scheme is open for applications twice a year, with applicants for both levels of the award (Research Chair and Senior Research Fellowship) being involved in the same application round. Prior to 2015/16, applications were accepted on an ad-hoc basis rather than scheduled application rounds. The application process was also changed for the 2015/16 round and subsequent rounds in that prior to this the host university had to recruit an individual to a Chair position as part of the award, whereas since 2015/16 the university must now have an existing Chair position in order to apply for an award (meaning that more recently appointed Research Chairs are likely to be experienced Professors). This is likely to result in the focus being on consolidating a research group rather than establishing a new group. For Senior Research Fellowships, applicants should already have a Reader or Lecturer post or equivalent.

As the scheme encourages industrial engagement, applicants must have agreement that their industrial sponsor will contribute at least £250,000 (with the option for this to be in kind, rather than cash) over the 5-year period, in order to be eligible to apply. RAEng then contributes an additional £250,000 over five years. The proposed research must be directly relevant to, and have impact on, industry. The award enables the individual to develop their programme of research through close engagement with a particular industrial partner company, allowing the award-holder to be released from university teaching and other academic duties. Historically, the success rate has been around 50%.

The analysis of the profile of participants that follows is based on either the MI data shared by RAEng (for 90 Research Chairs and 30 Senior Research Fellows, i.e. n=120) or survey responses (n=59).

4.1.1. Host institutions

Analysis of the institutions at which Research Chairs and Senior Research Fellowships have been funded was undertaken using grant system records, whereas all other aspects of award or awardee profile were obtained via survey responses. Of the 120 known awards since launch of the scheme(s), 85% have been made to English institutions and 10% to Scottish (Table 4.1). In terms of type of institution, 75% were Russell Group member institutions and only 3% to

post-92 institutions. Regionally, of the awards made to English institutions, just under half (47%) were institutions in London and the South East, 22% essentially 'northern' and 19% in the Midlands (the remainder being Eastern and South-West England). Around 40% of awards were made to institutions that we would consider to be within the 'Golden Triangle' (i.e. comprising London, Oxford and Cambridge).

Host institution		Awards	Awards %
Country / region			
	England	102	85%
	Eastern	10	10%
	East Midlands	12	12%
	London	29	28%
	North East	2	2%
	North West	9	9%
	South East	19	19%
	South West	3	3%
	West Midlands	7	7%
	Yorks & Humber	11	11%
	N Ireland	4	3%
	Scotland	12	10%
	Wales	2	2%
Broad type			
	Russell Gp	90	75%
	Other	26	22%
	Post-92	4	3%
Total		120	

Table 4.1 Institutions obtaining RC/SRF awards, based on grant system records (n=120). Percentages for English regions are of awards made to institutions in England

Closer examination shows that Imperial College (21), Oxford and Loughborough (10 each) and Cambridge (9) were the most 'successful' institutions in terms of numbers of awards in these schemes, with these four institutions securing a total of 50 (or 42% of all) awards. In total, 31 different institutions had secured at least one award at the time of analysis.

From the perspective of stakeholders, it was felt generally that some institutions (such as Imperial) were more aware of the scheme than others and thus more likely to apply for the funding. RAEng has acknowledged this and recently begun advertising the scheme via social media and within industrial publications, which it is hoped may raise the profile of the scheme at more universities and thus widen the range of institutions that apply.

4.1.2. Profile of awardees

In this section, the statistics presented are only on the basis of results from our survey, not grant records. Table 4.2 summarises the information available about the nationality, gender

and ethnicity of awardees who responded to the survey. From this it can be seen that awardees were overwhelmingly from the UK, male and white, although this presumably reflects the profile of relatively senior engineering academics in the UK academic sector.

Awardee characteristics		Number	Proportion
Nationality			
	UK	52	91%
	Other EU	1	2%
	RoW	4	7%
Gender			
	Women	5	9%
	Men	52	88%
	Prefer not to say	2	3%
Ethnicity (of UK nationals)			
	Asian	4	8%
	Black	0	0%
	Mixed	1	2%
	Other	1	2%
	White	43	83%
	Prefer not to say	3	6%
Total		59	

Table 4.2 Personal characteristics of RC/SRF survey respondents (n=59)

Comparison of the year in which respondents indicated they had obtained their PhD and the year in which their award started, enabled some insight to be gained into the career stage at which awardees were undertaking these schemes. For RC alumni and participants, the length of experience prior to starting their award ranged from 10 to 40 years, with a mean of 18 years of post-doctoral experience. In contrast, the relatively few respondents (8) who had undertaken an SRF started it 5-20 years after their doctoral qualification (mean = 11 years).

From the RAEng perspective, whilst there are no clear trends as to which types of applications tend to be funded over others, there has been an increase in the total number of applications in the most recent round of funding, with twice as many applications as in previous rounds. There has also been a rise in the number of applicants at the Senior Research Fellowship level of the scheme in particular. This may well be due to increased promotion of the scheme recently, and which aimed to address perceptions that the SRF was less of a priority than the RC side of the scheme.

Some stakeholders considered that the requirement to secure industrial funding may be a barrier for potential applicants and expressed the feeling that the awards are not quite as competitive as they would hope them to be. In contrast, one stakeholder felt that the requirement on industry was actually too low, and that (for large companies at least) a higher budget and contribution would make them take such an award more strategically.

4.2. Experiences of scheme participation

4.2.1. Positioning and rationale for applications

The RC/SRF scheme is positioned specifically to strengthen links between industry and academia through a 5-year co-funded strategic research partnership. It was no surprise, therefore, that in the survey responses the opportunity to work with industry was rated as one of the most attractive aspects of the scheme when respondents had applied to it. Figure 4.1 illustrates the most commonly cited facets of the scheme that applicants had found attractive, showing that over half had been attracted by the scheme's prestige, the prestige of the RAEng as funder, and its significant duration as well as the inherent opportunity to work with industry.

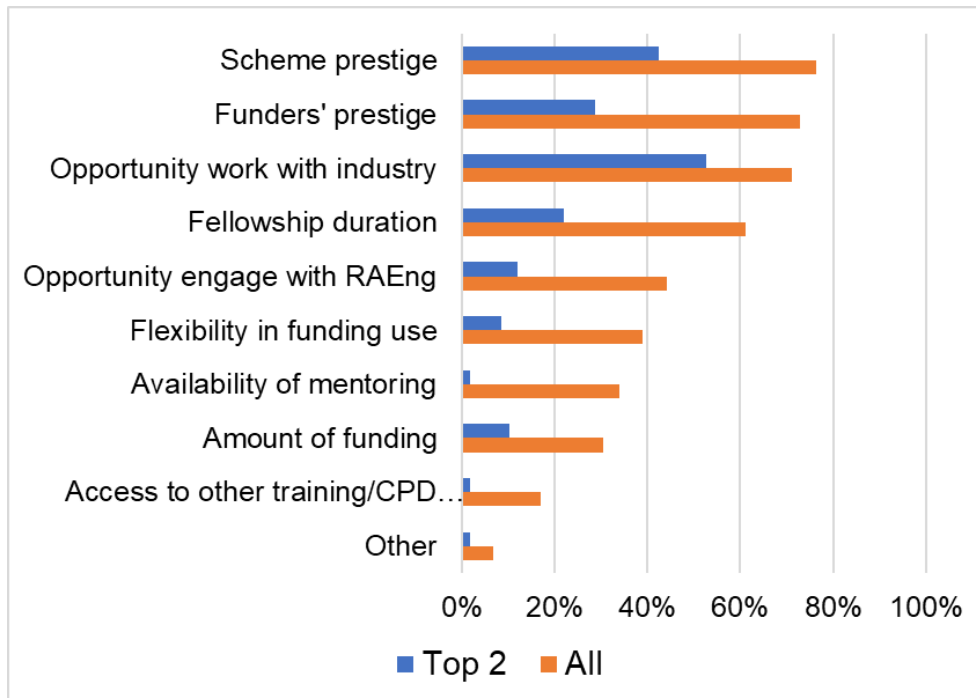


Figure 4.1 Aspects of the RC/SRF scheme that had attracted respondents to apply (n=59)

Significant minorities found the potential opportunities for engagement with the RAEng and for mentoring to be attractive, as well as the relatively significant extent and flexibility of its funding. When invited to identify the two most attractive aspects, the most commonly identified were the opportunity of working with industry and the prestige of the scheme itself.

This corresponds with the views of stakeholders who were consulted on the position of the scheme within the broader funding landscape. All stakeholders interviewed were involved in the scheme in some way and uniformly perceived that the RC/SRF scheme is amongst the most prestigious fellowship opportunities available in the UK to support researchers in these fields at this career stage. The scheme is perceived as distinct from other funding options at this level because of the industrial relevance and direct engagement required of the partner. Further, the added value of the prestige of the RAEng itself, within both industry and academia, and the kudos associated with the award, were also perceived as significant attractions of the scheme for candidates. However, a possible downside of this established prestige could be reflected in the comments of a couple of stakeholders who expressed some concerns around whether the scheme was effective in supporting riskier and/or more interdisciplinary research approaches or projects.

A key factor considered by stakeholders to be appealing to potential applicants for the SRF level of the scheme was the possibility to upgrade the award to a Research Chair once the award-holder becomes a Professor at their institution. Records suggest that almost all those appointed at SRF level are promoted to the professoriate before they reach the end of the 5-year award. The RAEng staff with knowledge of the scheme perceive that the prestige of the award is used, and effective, as leverage for such promotion.

In terms of the application process, 78% of respondents indicated (based on their personal recollection) that they had found the process straightforward, while 14% felt it was easy and only 9% difficult. Only three respondents felt that there was something that they would preferred to have been different, one of whom made the interesting comment that they would have appreciated an opportunity for an interview or discussion with the RAEng itself in addition to the interview with the host institution, as this would have helped judge the opportunities that the RAEng could facilitate as part of the award. Only five respondents (i.e. fewer than 1 in 10) had been applying for other similar types of award or opportunity when they applied, perhaps illustrating the very specific nature of the scheme.

4.2.2. Scheme benefits and experiences

The overwhelming majority of respondents (both alumni and current participants) believed that, overall, their experience of the scheme had been positive (76% very positive and 22% positive), with only a single individual feeling that it had been a somewhat negative experience.

Asked to identify the aspects of their experiences that had been most positive, through open-ended comments, respondents most commonly cited the 'real' industry access that had been possible through the scheme, with over one third of them commenting on this aspect. Other commonly held views were: that their engagement with the RAEng had been very valuable; that they had had the time and freedom to focus exclusively on their research for a significant time duration; and that the flexibility of the award had enabled them to focus on research that was distinct from what other academic funders typically supported. This was echoed in several of the interviews undertaken with award-holders, including:

"The package was really attractive – funding plus industrial support and the opportunity to focus on research without any teaching was very attractive indeed." (SRF, early-mid 1990s)

In parallel, a closed survey question was used to identify the extent to which certain particular benefits had been valuable (Figure 4.2). The large proportions reporting that they had found the close work with the industrial partner, the prestige of the scheme and the engagement with experts (potentially through engagement with the RAEng or the partner) valuable closely reflect what had attracted them to the scheme. This is reflected in comments made by interviewees:

"What was particularly satisfying was to have a direct access to an industrial sponsor who was interested in what I was doing and was able to make use of the research and then it also enabled me to develop other industrial contacts for my research" (SRF, mid-late 1990s)

A more mixed picture emerged from their perceptions of the mentoring they undertook, with respondents about evenly split between those thinking it valuable and not so. Equally, the opportunity to commercialise work or to access specific types of equipment or facilities through

their industrial partner had been very valuable to certain individuals but these made up smaller proportions of the respondent sample.

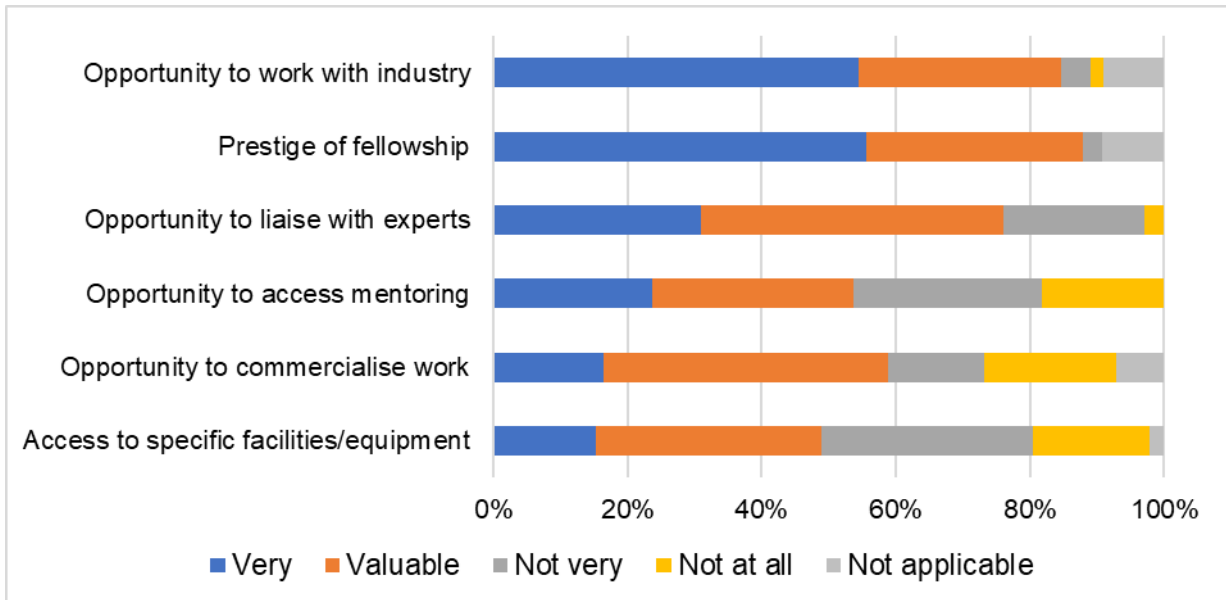


Figure 4.2 Respondents' perceptions of the extent of value of certain benefits of the fellowship (RC/SRF survey, n=58)

Considering the views of stakeholders, the possibility for awardees to become involved more closely in RAEng activities and events was also perceived as a significant positive aspect of the scheme. Opportunities such as becoming involved in policy work, both in the UK and internationally through the RAEng networks, were viewed as beneficial career development opportunities offered to awardees. The chance to be invited onto panels and symposia, and thus expand professional networks, particularly having access to those with FREng status, was also deemed to be a benefit to the profile of awardees. However, it was acknowledged that these opportunities varied considerably depending on the research field of the awardee, with those working in areas such AI being more likely to be asked to be involved in policy work.

4.2.3. Support and mentoring

In their open-ended comments, around 1 in 5 of respondents commented on the value of their engagement with the RAEng. In some cases they reported that this was through the networks that had opened up to them but some also specifically mentioned that the support they had received from RAEng staff had been a highlight, while a few others praised the relative lack of bureaucracy and hands-off attitude of the RAEng as a funder. However, within discussions with interviewees, it appeared that some Chairs in less common sub-disciplines felt that RAEng could do more to support and understand their area of research:

“If the Academy are going to fund chairs that are innovative or in pioneering or outlying areas they need to explicitly realise and overtly acknowledge that they are doing this and they need to adapt in the same way the person they are supporting needs to adapt. They have either got to say ‘we are funding you but we don’t understand what you are doing’ or there has got to be some conscious work on both sides.” (RC, late 1990s-early 2000s)

“I still think that the RA[Eng] sees it as an obscure niche area. It’s very frustrating. They are still very much stuck in their disciplinary structure – the committees reflect this. If you are CE, there will be another 500 CEs in the Academy but if you are in any of the new or peripheral areas, the Academy has very little capacity to embrace where you can contribute. No matter how lip service is paid to multi-disciplinarity – [in] the processes like peer review – multidisciplinary doesn’t work. If you move into a space that is multidisciplinary, you are going to have a miserable time because you are going have to fight constantly to keep your presence.” (RC, mid-late 2000s)

More specifically on mentoring, 81% of respondents indicated that they had undertaken mentoring during their award. Of these 47 individuals, just over three quarters found it very (43%) or quite (34%) valuable, but 23% did not. The comments made by survey respondents about the value of mentoring revealed a variety of impacts and support during the award, but that it also supported their subsequent career progression:

“I hugely respected the person who was recommended by the RAEng to mentor me. He gave valuable, insightful help and support, which has proven to be of long-term help in enabling me to flourish in my on-going chair appointment” (RC, mid-late 2000s)

“Meetings were a valuable opportunity to test and develop research strategy. The achievements of the Fellowship have accelerated my career development - I now serve on two Government advisory boards, one of which is a senior BEIS funded co-appointment” (RC, early-mid 2010s)

“My mentors gave significant advice on career strategy, research centre development and support with developing my research ideas and industrial partnerships” (RC, mid-late 2010s)

The relatively small number (11) of respondents who had not undertaken mentoring were in three categories: some current awardees who had yet to start it, some SRFs for whom they believed it was not offered, and a few others for whom it had not been offered, or it had not transpired, or they had not taken up the offer.

When many of the respondents had undertaken their RC or SRF, little training or support other than mentoring was being offered by the RAEng within the award package, although this offer has been stronger and more consistent in recent years. Nonetheless, comments from a few respondents indicated that they had taken part and valued the media training facilitated by the RAEng in particular, while others mentioned the value of presenting at the RAEng Forum.

Generally, stakeholders’ views of the support provided by mentors to awardees were that if the right mentors were allocated, then mentoring could be highly beneficial. For some participants who are already established and experienced Professors, mentors may be less valuable, but many others felt they could still benefit from guidance and especially if they were assigned proactive mentors. In these cases, there could be considerable value in having an external viewpoint on their work. Some stakeholders perceived that the involvement of the industrial partner could be a useful aspect of the mentoring relationship, though others viewed it as a more individual relationship which should focus on supporting their personal career development as an academic.

4.2.4. Challenges

Respondents were invited to indicate whether they had had any major difficulties during their award. 12 of them (so around 1 in 5) felt that they had done so. From their comments, around

half of these respondents had experienced difficulties due to issues with the industrial partner – including loss of interest in the collaborative research as the partner had been privatised or acquired by another organisation or due to departure of a key staff member. This theme was also present among comments made by interviewees:

“The big challenge of working with industry is that you build up a relationship over 2-3 years but then if they leave you have to build that up again with someone else, so you have to go through the whole thing again and understand what the university does in terms of research and what a Chair really means, it can be quite tough for them- once people get it and realise the value of it, they really support it but sometimes they think well why are we spending this money because you don’t notice it, if you turn it off you don’t notice it immediately...but ultimately you lose out.” (RC, early-mid 2000s)

From survey responses, difficulties relating to intellectual property arose in one case and in two cases there was delay or persistent difficulty due to the university and partner expectations being divergent. In two cases it was felt that the host university had not lived up to its responsibilities (in terms of support and allowing freedom from teaching). It was also notable in these, admittedly few, instances of difficulties that the respondent’s mentor was more than once cited as being very valuable during some of these challenges.

Some of the challenges that stakeholders perceived for award-holders related to the differences in the nature of research in industry compared to in universities. Stakeholders perceived some potential difficulties relating to the length of time that it might take awardees to have an impact on the company, given the long-term nature of academic research. Further, the balance between exploratory research which may not translate into application, and research which has a direct influence on commercial processes and products, was also seen to be a potential challenge.

4.2.5. Other reflections

Asked about their perceptions of the duration and financial value of their award, respondents were very positive. 88% felt that the duration had been appropriate (with only 9% thinking it insufficient, the remaining 3% unsure). In relation to the amount of funding, 85% believed that it was sufficient and, again, only 9% (5 respondents) believed that it was not enough. The latter commented either that the amount of funding was insufficient to fully cover the way their university calculated their salary cost (so that they were not fully bought out of teaching duties) and/or that they would have appreciated some explicit funding for research costs. It should also be noted that these respondents were not the same as the five individuals who felt the duration was too short.

On balance, these would seem to be strong endorsements of these physical parameters of the award and lead us to suggest that there is no requirement for substantial change. A further and overwhelmingly positive endorsement for the scheme is that on the basis of their experiences, all but one respondent would recommend others to apply for the scheme.

In response to a question about whether or how the programme could be made better, only half of the respondents provided any comments (and many of the others suggested that there was no need for any change because the scheme was already so good). Many of the suggestions that were made related to somewhat individual or circumstantial issues but the following more structural suggestions were also raised (although none of these was raised by more than two respondents):

- A more substantial offer of training/professional opportunities provided by the RAEng;
- An overt research budget to enable hiring of a PhD student or post-doctoral researcher;
- A clearer pathway for progression through and after the award (including towards Fellowship of the RAEng) and potentially follow-up support;
- Greater clarity and/or expectations of the mentoring process;
- Earlier definitive agreement (of responsibilities) between the industrial partner and the RAEng;
- A potential research fund so that RCs could collaborate on projects.

4.3. Collaboration with the industrial partner

4.3.1. Collaboration experiences

For 96% of RC/SRF respondents, the experience of working with their industrial partner had been positive (64% very positive, 32% quite positive). Only two respondents differed in their view – one because of a major disagreement around intellectual property and another where the partner company had changed its focus.

One of the aims of the scheme is for participants to obtain a genuine and deep understanding of the business and working culture of the industrial partner, in order to enable a sustained and mutually beneficial collaboration on research that really matters to the partner. One interviewee gave insight into how this might be achieved at an early stage:

“I visited different sites of the industrial partner and spoke to many colleagues which I found immensely helpful. The industrial partner also highlighted areas of research that would be beneficial to them.” (SRF, early-mid 1990s)

Further, 95% of respondents felt that their engagement with the industrial partner had enabled them to gain this deeper level of understanding (68% to a great extent, 27% to some extent). Open-ended comments provided by respondents attest strongly to the benefits that they had gained through their close engagement with the partner, and suggest that this aim was achieved in many (but not all) cases:

“I was brought into strategy at all levels at various times within the company. Was able to directly contribute to real products that now have on-going impact” (RC, mid-late 2000s)

“I feel very much a part of [partner]. They have been excellent in sharing very sensitive data with me and this has been at a very high level within the company. This has been crucial in understanding their business challenges and how my research will help them overcome some of these” (RC, late 2010s-present)

“Academics (in my opinion) are often very naive with regards to the commercial operations of their industrial sponsors. Obtaining a better understanding of this has helped me to channel my research into areas which are needed while still being fundamental to deliver academic impact” (RC, late 2010s-present)

“I was thoroughly integrated into the company with interactions all the way up to the Chief Technology Officer. There were many collaborations with several parts of the

company in the UK and across Europe, with many extended secondments for me and the researchers. The company funded additional projects too. Several researchers have proceeded into good careers with the sponsoring company” (RC, mid 2000s-early 2010s)

As we had not anticipated that so many of these responses would be so positive, we had included a question in the survey about whether respondents felt that the RAEng could have done more to support them to work effectively with their industrial partner. Unsurprisingly, most (48 respondents) did not think it could have done more but 10 felt that more support could have been beneficial. One of these responses directly related to an IP dispute, while the remaining 9 respondents’ comments were essentially on one of two themes. The most common was a desire for greater engagement between all the parties, conceivably through an annual meeting between them including the participant, to consolidate progress but also partly to showcase the company’s support and benefit and make it feel more part of the award. Perhaps related to this, the other issue raised by a few respondents was that they felt more could have been done to ensure the partner understood the academic expectations of the scheme.

4.3.2. Sustaining the collaboration

A key issue in evaluating the RC/SRF scheme is the extent to which an award resulted in a sustained research collaboration, i.e. beyond the duration of the award itself. Of the 32 respondents who had completed their award and were not now retired, 20 (62%) were still in contact with their industrial partner, while the remaining 12 (38%) were not. In addition, all but three of those who were still undertaking the award when surveyed expected that they would continue to work with the industrial partner after completion of the award period.

Figure 4.3 summarises the nature of the activities that respondents had engaged (or were engaging) in since the award finished. While the sample size was small, over 80% had engaged in joint research with the industrial partner after the award had ended and almost as many had applied for further funding to do so. One third had set up a joint laboratory or research centre, while a small number (4 individuals) had actually taken up a position in the partner organisation and one had set up a related company with them. Around two thirds had enhanced their teaching through use of examples and practices observed with their industrial partner experience and nearly half reported that their research was being commercialised through working with the partner. Most of those who reported that they were in continued contact with the partner indicated that they did have specific plans for future collaboration, through joint funding proposals (most commonly), ongoing joint projects and students, and in some cases through a subsequent position in a company research centre or similar.

Although with the caveat that the sample was small, this seems to be clear evidence that the majority of awards were leading to a sustained relationship with the industrial partner.

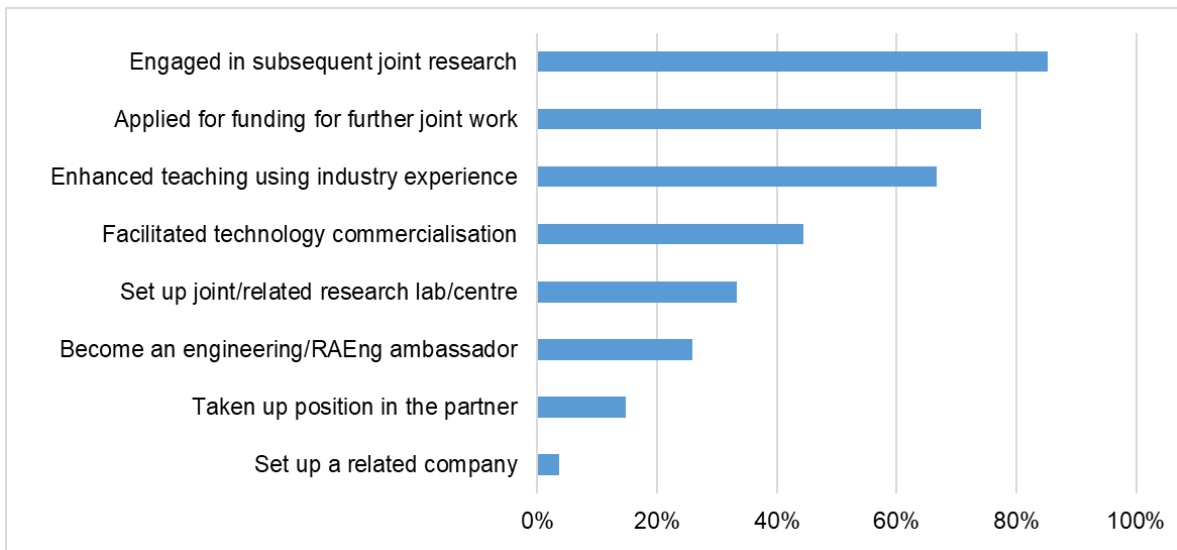


Figure 4.3 Respondents' post-award activities relating to their industrial partner (RC/RSF alumni still in contact with partner: n=29)

4.4. Impacts

4.4.1. Outputs

Figure 4.4 records a range of engineering-related achievements and outputs that respondents indicated they had completed or produced during their award. Very high proportions indicated that they had achieved the research-related outputs that would be anticipated from five years of funding at this level, including publication and conference outputs and collaborative ventures. Around half had undertaken public engagement or outreach activities and made contributions to policy-making at a senior (e.g. national) level. However, what is perhaps more impressive is the significant proportions who had developed new products or software (50%) or new patents or other IP assets (over 40%).

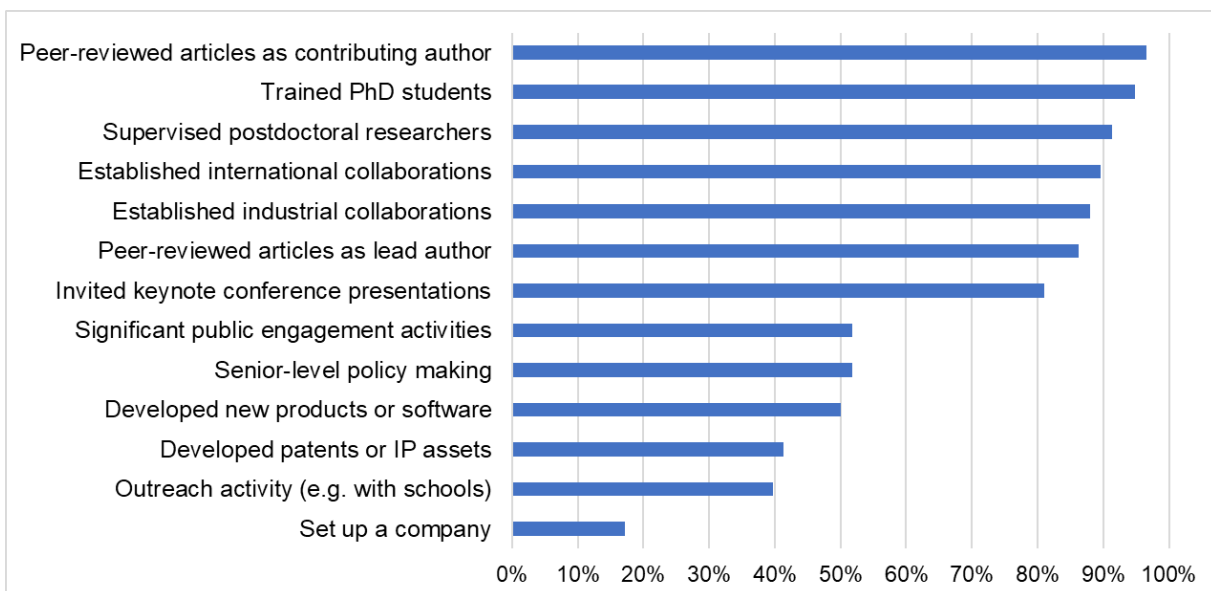


Figure 4.4 Respondents' engineering-related achievements and outputs produced during the award period (RC/RSF respondents: n=58)

4.4.2. Other achievements

All but four respondents (i.e. 93%) reported that they had won significant further research grants or funding during or since completing their award, ranging from specific EPSRC grants to multi-million pound collaborative research ventures. One third of the awardees who had completed the scheme (i.e. 14 of the 42) had been elected to Fellowship of the RAEng.

Figure 4.5 shows the extent to which respondents had been able to achieve some of the higher-level aims of the RC/SRF funding. It suggests that high proportions had to a great extent developed a research group that could be sustained into the future, and/or was world-leading in engineering research, working on research that met the needs of the industrial partner, and had disseminated the outcomes of that research for appropriate impact. In many cases these were long-term research and innovation programmes centred on key emerging technologies and they had built a strong network of industrial and other partners to facilitate commercialisation of that technology.

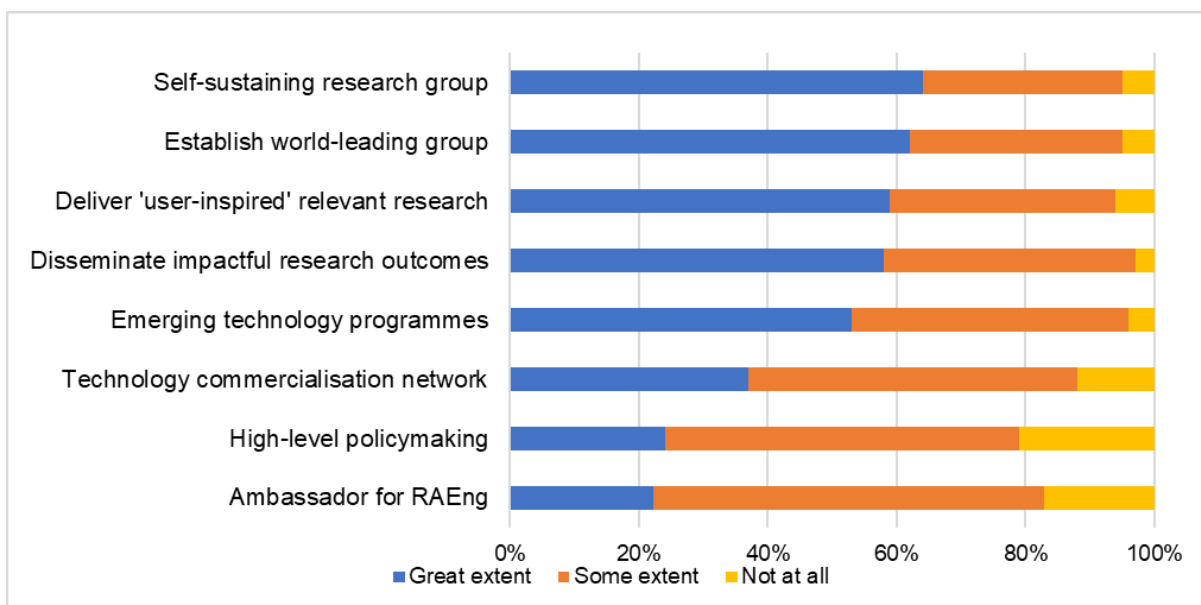


Figure 4.5 Extent to which respondents achieved high-level research goals (RC/RSF: N=57)

Asked to state the achievement of their research or research group of which they were most proud, a number of respondents related particular recognition that they had achieved personally and/or major grant funding they had won. However, most respondents reported achievements that were broadly of three types. For some, it was establishment of a particularly novel and distinct field of research in which their group was a leader:

"[group] has made world leading contributions in areas such as technology roadmapping, technology intelligence, and open innovation. Research results have been widely disseminated and applied by industrial partners, and feature in ongoing teaching, executive education and consulting activities" (SRF, early-mid 1990s)

"World's first demonstration of a fully cognitive radar system able to self-adapt its parameters to meet a chosen performance specification" (RC, mid 2000s-early 2010s)

For others, it was the impact of their research outside academia within the engineering or public policy environment that was most important to them:

“Developing accurate theories and design techniques for producing state-of-the-art low phase noise oscillators which are used in almost all electronic systems. More recently we are also developing new low phase noise atomic clocks in collaboration with industry” (RC, mid 2000s-early 2010s)

“Discovered some fundamental aspects of lymphatic system function; invented two technologies for prevention/cure of breast-cancer related lymphoedema” (RC, mid-late 2000s)

While for others still, and in fact this was the most commonly reported type of achievement, the greatest pride for them personally was to see the progression and achievement of members of their group that they had recruited, developed and worked alongside:

“PhD graduates from my team who work in my group, hold senior positions in industry and some who are working as academics. Given the relatively modest funding our team has been awarded we have delivered impact (both academic and industrial) at scale” (RC, late 2010s-present)

“The people I trained as PhD students and post docs did very well, produced some good publications and have gone on to develop good careers in research and consultancy businesses” (RC, early-mid 2000s)

4.4.3. Career Impact

Comments made by survey respondents illustrate a range of the longer-term impacts they perceived, demonstrating both impact on their career and development as research leaders but clearly also more widely on engineering research and the profession. Individuals described the transformational impact of the fellowship on their career progression and felt that it had been key to their success:

“My fellowship has helped me to develop my academic career very rapidly. Two years after the completion of my fellowship I was appointed Professor, and subsequently I became Head of Department, Associate Dean and then Dean. I believe without the fellowship my progression would have been much slower” (SRF, early-mid 1990s)

“It gave me the prestige and accelerated my career trajectory in such a way that I was promoted to Chair within 2 years of receiving the grant, and successfully led a multi-institute research centre that generated high quality output, substantial research and industry investment, and strong industrial and academic partnerships” (RC, mid-late 2010s)

“I think the RAEng Research Chairs are a unique opportunity to rapidly consolidate or build a research platform, with a gateway to uptake of research and application by the sponsoring company. The career benefits are substantial and long lasting” (RC, mid-late 2010s)

Beyond their own career success, individuals reflected on the positive impact that the award had had on their development as research leaders, supporting their ability to contribute to secure further funding, to improve research capacity at their institution, and to contribute to engineering policy more widely:

“The freeing up of time together with the prestige of the appointment generated greater confidence in leadership, as well as the space to get more involved in the research”

itself. This helped me in leading a multi-university research partnership supported by an industrial panel for a period of almost 5 years. Alongside this, I was Director of a Research School within my University, and the prestige associated with the RAEng Chair appointment added more gravitas to the role...again, it facilitated leadership that helped to build multi-disciplinary collaborations” (RC, mid 2000s-early 2010s)

“It allowed me to build a strong research platform, securing capital investment to create state of the art research infrastructure, and win funding to develop and manage a large research team. This would not have been possible without the time to focus on research supported by the RAEng and industrial sponsor. The research arising from the award has found application in industry and changed radioactive waste management and disposal practice in the UK and overseas. As a result, the credibility and reputation of our research has led to my appointment on two Government advisory boards, to support policy making in my research domain” (RC, early-mid 2010s)

Drawing on interviews with specific individuals, it is clear that the impact of the fellowship on their career was considerable. Having this duration of time in which to pursue their research area was seen as having generated a range of opportunities, many of which translated into benefits to engineering policy and the wider engineering community:

“It had a huge impact on my career. It was high status and gave my research huge impetus. The generous resources, having other staff, were massive benefits and enabled me to establish a new area of Mobile Learning which has had international influence. I have been able to attract millions of pounds of funding. The Fellowship provided the foundation for not only the rest of my career but for my subject, which is a sub-discipline which now exists within most major universities.” (RC, mid-late 2000s)

“It had an enormous impact on my career, it’s rare to be funded in this way. It’s highly respected and you get to be part of bigger discussions-the government tends to look to the RAEng for expertise on engineering so you can be part of this, especially as an FEng.” (RC, early-mid 2000s)

5. Research Fellowships

5.1. Strategic relevance and awardee profile

The Research Fellowship (RF) scheme aims to increase the pipeline of highly skilled engineers to build research capability in the UK and deliver economic and societal impact. This scheme is targeted at ECRs who have been awarded their PhD in the last four years but do not yet hold a permanent academic role, to support them to become future research leaders in engineering.

Launched in 1999, the scheme provides awardees with five years of funding to help them build a successful research career. The intention is that the award will enable ECRs to establish independence and develop an international reputation by pursuing an ambitious programme of engineering research and impact. Further, the scheme aims to develop ambassadors for the RAEng and advocates for STEM (science, technology, engineering and mathematics) disciplines more generally. The financial support offered is around £500,000 over the 5-year period.

The scheme is open for applications once per year, with applicants able to apply for the award on either a full-time or part-time basis. It is increasingly competitive, with the number of applications having doubled in the last two years to around 100 applications per year. Approximately 16-18 awards are made each round.

Successful applicants are allocated a mentor to advise on their research and career development. They also have opportunities to access training run by RAEng, including courses on business and commercialisation, media and policy, as well as outreach opportunities including work with schools. Teaching and administrative duties should be reduced by the host institution in order to facilitate dedicated time for research, allowing them the opportunity to establish a research track record in a specialised area.

Stakeholders viewed the award as an investment in research talent in UK and as a launchpad for early-career academics to establish themselves in research. Most saw it as a path for awardees to gain permanent employment such as a lectureship after the award in the institution where they were based. This was seen as beneficial not only for the awardees but also for universities to retain talented researchers, building their research profile and capacity. Further, stakeholders also considered that the scheme was an opportunity for the RAEng to identify the next leading generation of engineers and bring them into its community.

The analysis of profile of participants below is based either on MI data shared by RAEng (n=121) or survey responses (n=66).

5.1.1. Host institutions

Based on grant system records, 80% of RF awards were made to applicants at English institutions and 14% at Scottish institutions (Table 5.1). In terms of type of institution, 83% were Russell Group member institutions and most of the remainder (15%) other institutions, with very few (2%) at post-92 institutions. Regionally, of the awards made to English institutions, over half (58%) were in London and the South East and only 15% to 'northern' institutions; almost half (48%) were made to institutions in the 'Golden Triangle' (i.e. comprising institutions in London, Oxford and Cambridge).

Host institution		Awards	Awards %
Country / region			
	England	97	80%
	Eastern	13	13%
	East Midlands	2	2%
	London	32	33%
	North East	1	1%
	North West	6	6%
	South East	24	25%
	South West	6	6%
	West Midlands	5	5%
	Yorks & Humber	8	8%
	N Ireland	4	3%
	Scotland	17	14%
	Wales	3	3%
Broad type			
	Russell Gp	101	83%
	Other	18	15%
	Post-92	2	2%
Total		121	

Table 5.1 Institutions obtaining Research Fellowships, based on grant system records (N=121). Percentages for English regions are of awards made to institutions in England

This is a somewhat more focused distribution than for RC/SRF awards, with a greater concentration in research-intensive universities in SE England in particular. In more detail, the universities achieving the highest numbers were Oxford (14), Imperial College and University College London (13 each) and Cambridge (12); these four institutions securing 52 (or 43%) of all awards. Although this was a similar pattern to that observed for the RCs/SRFs, interestingly Loughborough (which was in the top four for RCs/SRFs), has obtained no RF awards to date. In total, 30 different institutions had secured at least one award at the time of analysis.

Stakeholders largely perceived that universities which have hosted RFs previously recognise their value and thus are likely to make further applications for the scheme, whereas many institutions have not had the opportunity to understand the potential benefits. This could result in the rather focused distribution, heavily concentrated in certain research-intensive institutions. It was felt by all that it would be good to widen this aspect of access to the scheme. Some concern was expressed that those whose institutions had successfully applied in the past could be better placed when making applications due to their prior experience. They felt the RAEng could perhaps do more in terms of outreach work to encourage applications from those at a wider range of institutions, particular those outside London, to communicate the benefits of the scheme and provide guidance on applications.

5.1.2. Profile of awardees

These statistics on the personal profile of awardees are derived solely from survey responses (n=66: 54 alumni and 12 current participants), rather than grant records. Table 5.2 summarises the nationality, gender and ethnicity of awardees who responded to the survey. Assuming that the survey respondents are broadly representative of all awardees in the RF scheme, this suggests that the profile is somewhat more diverse than for RCs in terms of having a higher proportion of non-UK nationality and around one quarter female. However, the ethnic mix of UK nationals participating is no more diverse, with over 90% of white background.

Awardee characteristics		Number	Proportion
Nationality			
	UK	43	66%
	Other EU	15	23%
	RoW	7	11%
Gender			
	Women	17	26%
	Men	49	74%
Ethnicity (of UK nationals)			
	Asian	1	2%
	Black	1	2%
	Mixed	0	0%
	Other	2	5%
	White	39	91%
Total		66	

Table 5.2 Personal characteristics of RF survey respondents (n=66)

RF respondents had an average of three years post-doctoral experience prior to starting their award, and all (other than two outliers with much greater experience who were from overseas) had secured their fellowship within five years of their doctorate. This reflects the experience-based eligibility criterion for the scheme (i.e. no more than four years of postdoctoral experience at time of application). This aspect of profile of awardees is somewhat different from that of the broadly comparable Royal Society University Research Fellowships scheme, for which the experience-based eligibility criterion had been 2-7 years of postdoctoral experience until 2012 but was then increased to 3-8 years, as a result of which many recent awardees have significantly more postdoctoral experience than RAEng RF awardees.¹

Whilst most stakeholders felt that the awardees were fairly representative of the wider population of engineers, one individual did express a concern that there was limited diversity in the range of both applicants and awardees. It was felt that a thorough review of the gender, ethnicity and institution of eligible researchers, applicants and awardees could valuably be

¹ Royal Society Research Fellowships: Career pathway tracker, CRAC, 2018: <https://royalsociety.org/grants-schemes-awards/career-pathway-tracker/>

undertaken to establish whether the scheme application processes were inclusive and underpin identification of actions that could be taken to support and reward quality applications from individuals within under-represented groups.

5.2. Scheme experiences

5.2.1. Positioning and rationale for applications

The stakeholders interviewed, all of whom were involved in the scheme in some way, uniformly perceived the RF as a unique opportunity within the funding landscape, given its focus purely on engineering research. It was viewed as a prestigious award which should facilitate the acquisition of permanent academic employment.

The RF scheme is positioned, as are several other schemes from other funders, to support talented ECRs and enable them to establish themselves as independent research leaders in engineering. Figure 5.1 summarises respondents' views on the features of the scheme that they had found most attractive when applying, showing that the scheme's prestige and the duration of the funding were uppermost in their minds. The prestige of the RAEng as the funder, the extent of funding and the flexibility in its use were all also considered attractive by over 60% of respondents.

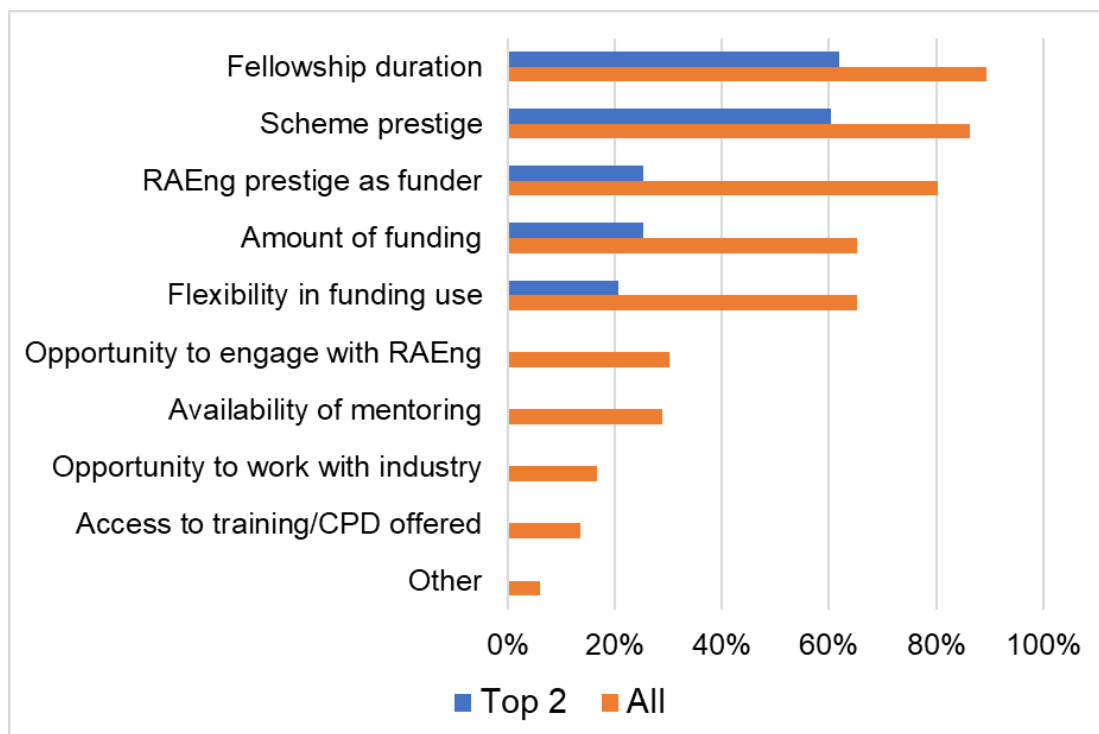


Figure 5.1 Aspects of the RF scheme that had attracted respondents to apply (n=66)

Most respondents indicated that they had found the application process straightforward (63%) or easy (11%), although 23% suggested that they had found it difficult. However, only six respondents made suggestions as to how it might be changed, when invited to do, reinforcing the impression that the application process has been largely fit for purpose from the point of view of the successful applicant. Three of these respondents considered that the interview process had been quite intimidating and could reward confident interview performers rather

than good engineering researchers, although they assumed that the process reflected how competitive the scheme was.

Just under half of the respondents reported that they had been applying for other ECR support schemes too. These included a number of universities' own junior fellowship programmes, Royal Society University Research Fellowship (URF), Marie-Curie and Research Council schemes. There was some evidence to suggest that some who had applied for a URF but had been unsuccessful had then applied to the RAEng scheme instead, whereas those applying for Marie-Curie or to other research funders were doing so in parallel with their application to the RF scheme. Several rescinded their applications for university fellowships once they obtained their RF. The volume of evidence is small but this seems to suggest that the RF is amongst the most prestigious or attractive of these alternative ECR support programmes, although not perhaps as highly sought after as a URF.

Stakeholders considered that whilst other schemes such as those funded by the Royal Society and UKRI were better funded overall, the RF scheme was perceived as very prestigious by candidates and universities alike, particularly because of its focus purely on engineering. Some acknowledged, though, that for applicants who might also be applying to other fellowship schemes which had higher levels of funding, it could come down to a financial decision as to which award to take up. However, other stakeholders perceived that the additional support received by awardees, such as the formal mentoring aspect, were of significant added value, along with the opportunities for networking within the RAEng community. Further, two stakeholders mentioned that they believed there was an additional incentive in terms of RF awardees having better chances to secure further support from RAEng in future.

5.2.2. Scheme experiences

The overwhelming majority of respondents (both alumni and current participants) felt that their overall experience of the RF scheme had been positive (81% very positive and 17% positive), with only a single individual perceiving a somewhat negative experience.

When asked to articulate the most positive aspects of their fellowship experience, by far the most commonly stated aspect was the freedom and independence that they were afforded, which enabled them to pursue the directions in research that they wished to and, in most cases, with no or a reduced commitment to other roles in their university. However, significant minorities also specifically mentioned the value of the flexibility of funding, which allowed them to move institution or to focus on what they chose, at the same time as having the stability of five years duration of funding. Small numbers also overtly mentioned the benefit of their mentor and/or networking that the RAEng had facilitated through its programme of events. These comments, collectively, reflect very closely the benefits of the scheme that are promoted, and which were neatly summarised by this survey respondent:

“The opportunity to carry out independent research with the resources to do that; the opportunity to travel as part of the fellowship and spend an extended period of time at another university; and the stability of having five years to do that, allowing me to try different / higher risk topics of research. The stability of a five year award as an early career researcher was tremendously appreciated” (RF, early-mid 2010s)

The prestige of the fellowship also emerged strongly in a separate question identifying the extent to which certain benefits had been valuable, to which 80% responded that its prestige was very valuable (Figure 5.2).

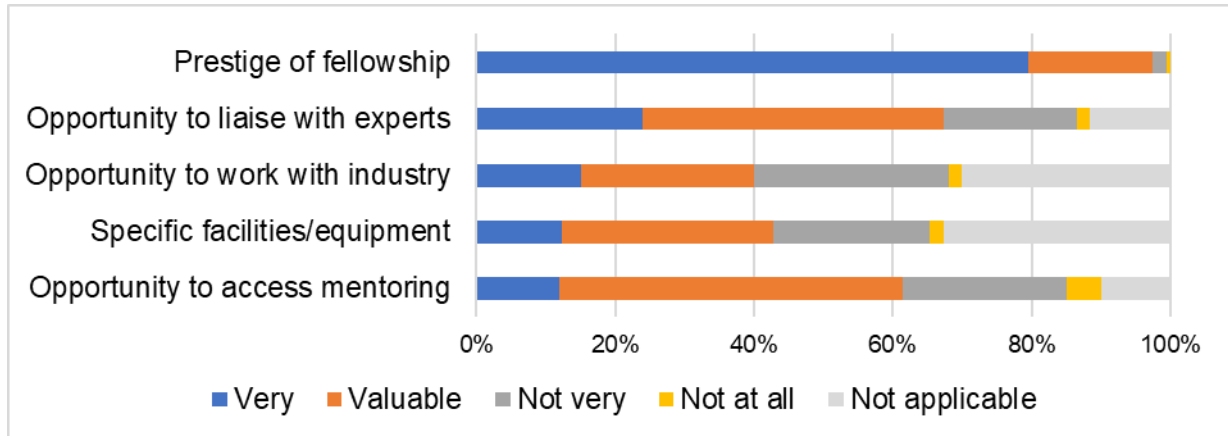


Figure 5.2 Respondents' perceptions of the extent of value of certain benefits of the fellowship (RF survey, n=65)

This was also reflected in comments made by interviewees:

“Being able to say that you are a Royal Academy Fellow gives you a certain amount of prestige which makes people take you seriously. This is very helpful, because if you approach industry collaborators as a PhD, ‘I have just completed my PhD, I have this crazy idea’ – it’s quite difficult to get people to listen.” (RF, late 2000-early 2010s)

Understandably, the high value placed on research-related interactions with industry and other experts reported by Research Chair respondents in response to this question was not seen amongst the RF awardees (Figure 5.2), presumably because of the more academic nature of their research and the focus on development as an independent research leader rather than external interactions. The chart also illustrates that almost two thirds had found the opportunity to undertake mentoring to be valuable (see also the next section).

All 64 respondents who provided a response to a survey question about whether they would recommend the scheme to others indicated that they would do so, which is an exceptionally strong endorsement of their positive experiences. In related comments they articulated very positively the beneficial aspects of the scheme and their experiences, particularly relating the independence and opportunity to progress with novel research through the freedom that was conferred with the fellowship, as well as additional developmental benefits arising from the prestige of the scheme and the potential to develop powerful networks:

“My experience was entirely positive. The fellowship is very prestigious, the 5-year duration is very generous and provides real freedom to explore a programme of research” (RF, mid-late 2000s)

“The RAE Fellowship is widely regarded as a highly competitive program and provides a fantastic launch-pad as an early-career researcher to make the transition from PhD student or postdoc (under the supervision of an experienced mentor) to independent research leader. I do not think these skills are learnt so keenly by pursuing postdoctoral research where you employed on a specific research project (under the guidance of a principal investigator) as you are not exposed to the process of defining, delivering and managing all aspects of a successful research project” (RF, mid 2010s-2020)

"I have many times [recommended the scheme] and have given advice to around 5 other applicants so far. It is an excellent opportunity to bridge between post-doctoral research and lectureship. I would advise based on my own experience, however, that to get the most out of the fellowship and related independence, it is worth doing a post-doc for at least 3 years first" (RF, late 2010s- present)

"5 years of independent research is a terrific privilege, which allows a young researcher to flourish into an independent researcher (with the security of a 5 year research position) before the shackles of teaching and admin are applied as a full academic" (RF, mid-late 2000s)

5.2.3. Support and mentoring

Amongst those who had undertaken mentoring during their award (81% of RF respondents), three quarters had found it valuable (27% very valuable and 49% quite valuable). Comments made by respondents about the value of their mentoring illustrate that in a few cases it enhanced their academic output and/or helped them to develop the direction of their research and maintain progress, but in the majority of cases awardees reflected on its value in supporting their career progression. It was also clear that in some cases the relationship had continued significantly beyond the period of the RF award.

"I find the mentoring scheme extremely valuable for the development of the research fellowship and my career. The mentor was very welcoming to provide advice, useful links and overall oversight of the progress" (RF, late 2010s-present)

"I had valuable interactions with my mentor, who was able to provide me with very useful advice on how to best leverage the opportunities created as a result of the award and think strategically about how to maximise my research outputs to help me secure a long-term future in academic research" (RF, mid 2010s-2020)

"At key moments in my career progression, my mentor offered candid and precise advice that made a great positive difference to me. I am incredibly grateful to him for this and occasionally ask his advice even now, 5 years after the end of the fellowship" (RF, early-mid 2010s)

"I developed a great relationship with my mentor and still I am in touch with him. He is still just a phone call away and is still continuously advising me when needed" (RF, mid-late 2010s)

The 14 RF respondents who had not undertaken mentoring were a mixture of some who believed that it had not been offered to them (many of whom were participants in early years of the scheme), some who had only acquired a mentor very late in their fellowship, and some where the relationship had fizzled out because of either incapacity of the mentor or their own lack of enthusiasm for it.

From analysis of interview data, it emerged that in the early stages of the fellowship, some did not necessarily see the added value of mentoring. However, as they progressed, individuals became more aware of its utility and were more likely to seek advice and support from their mentor. In some cases it was a source of regret that they had not maximised this opportunity. Some interviewees felt that there could have been more communication from RAEng at an early stage about the purpose and value of mentoring, in order that its potential value to them could be clearer and better understood:

“Until I actually met up with him, it wasn’t obvious that there was anything to be gained from the relationship. When I did meet him, it was incredibly helpful. I really regretted that I wasn’t in contact with him throughout the Fellowship.” (RF, mid-late 2000s)

“In retrospect maybe I should have been more pushy but I don’t feel that the RAEng did anything more other than say we are going to link you with a mentor and that’s it. There was no guidance about what you should be doing in that relationship.” (RF, mid-late 2000s)

From the perspective of stakeholders, the mentoring offer for award-holders was one of the most attractive aspects of the scheme as a whole. Mentoring was seen to have both short- and long-term benefits to awardees, including advice and guidance on their research but also to support their career development at this crucial career stage. It was felt that mentoring made wider academic networks available to awardees, providing access to leading engineers in their field who were at other institutions, which could also develop into possibilities for career advancement. The structure of the mentoring programme, with an annual meeting facilitated by RAEng as well as a report on progress, was felt to be well designed and administered.

Some stakeholders were or had been themselves mentors for RF awardees and felt that providing some training for mentors might be valuable, in order to ensure that best practice is being followed. There was also a feeling amongst some that it could be difficult to identify and allocate appropriate mentors for RFs and that the RAEng should encourage more individuals to become involved with mentoring, including those with FREng status. Interestingly, one individual felt that engaging with the university in their role as a mentor was a helpful approach – they had been able to engage in a constructive way to support the awardee’s protection from teaching commitments or administrative responsibilities.

In terms of other support, just under half of the RF respondents reported that they had undertaken other training and professional development activity facilitated by the RAEng as part of the fellowship package. However, closer examination of their comments upon it and its value revealed that in most cases they appeared to be referring to training provided within their institution rather than within the RF scheme. Only one mentioned attendance at the RAEng Forums. However, individuals did indicate that other aspects of support provided by RAEng were of value, as this survey respondent noted:

“The support I have received from my RAEng mentor and [name of RAEng scheme staff] has been incredible. It truly feels like they are in my corner and are there to help me on my way. I have also really enjoyed the opportunity to network with other fellows in different disciplines through various events” (RF, late 2010s-present)

Stakeholders were of a similar opinion in considering the supported networking offered by RAEng as a significant positive of the scheme, particularly in relation to attending events that other more senior engineers would also attend. Some stakeholders felt that RAEng should focus on creating further opportunities for awardees to network and develop a feeling of being a valued cohort within the wider engineering community.

Analysis of interview data highlighted that where experiences of the fellowship had been straightforward, there were often fewer examples of individuals seeking support directly from RAEng, as they would often derive this from their host institution instead. However, there were some cases where individuals had been involved in wider education and policy initiatives through the RAEng and this way of becoming part of the RAEng community was perceived as being a valuable and distinct benefit of the scheme, as this interviewee indicated:

“The RA asked me to do all sorts of interesting things. I was asked to sit on a panel for a Grand Challenges Project – engineering ideas for the next 100 years, a documentary filmfest. These are really interesting opportunities which I really enjoyed.”
(RF, mid-late 2000s)

5.2.4. Challenges

Around 1 in 5 RF respondents (a similar proportion to those in the RC/SRF scheme) suggested that they had encountered major difficulties during their fellowship. The majority of the issues reported, through open-ended comments, appeared to relate to perceived shortcomings in the support provided by their host institution, although in some cases this appeared more to be about a specific personality clash or an issue with facilities rather than reflecting any common underlying problem. In two cases, the lack of a mentor, they now realised, had contributed to their inability to resolve these problems.

5.2.5. Other reflections

The five-year duration of the award had been an attractive feature when they applied for the fellowship so it was no surprise that respondents were very positive about this in retrospect too. Overwhelmingly they believed that the duration had been right for their needs, with only two respondents (out of 64, i.e. 3%) feeling that it should have been longer (one of whom mentioned that they would have appreciated the option of an extension to the award, which they believed was available to those in the URF scheme).

In relation to the amount of funding, 88% believed that it was sufficient with only 5 respondents dissenting, who believed that the level was not generous enough. Most of these latter respondents commented upon the very limited funding for research costs that they had access to, once their employment-related costs had been covered (one of whom believed they had not been allowed to apply for external funds for that purpose). Given that the extent of funding has not risen since around 2012, it was perhaps surprising that so many respondents (especially current awardees) appeared to be content with the financial value of the award. However, in response to a question about whether or how the programme could be made better, nearly half (16) of those who made any suggestion raised an issue relating to funding – that there should be greater total funding and/or a budget to cover research costs (including travel), and/or that they would have benefited from being able to support PhD students and/or postdoctoral researchers directly from their award (which is the case in some ECR schemes).

Conversely, the majority of stakeholders felt that the value of the award should ideally be increased, acknowledging that some other, potentially comparable, ECR support awards were higher in value, while the value of the RF had not increased in line with inflation for many years. Some stakeholders believed that certain universities were critical of the scheme as it does not pay the same extent of economic costs as, for example, UKRI-funded schemes. Whilst stakeholders generally felt that offering a higher value award would be beneficial, there was also recognition that it was a difficult balance to strike between increasing the value of each award and being able to offer as many awards as possible. The quality of applications was perceived to be very high, which led to the aspiration of several stakeholders for the RAEng to be able to slightly increase both the number of awards to around 20 per year and the value of each award, recognising that this would be contingent upon securing additional total funding from BEIS.

It was felt generally by the stakeholders that the award duration was about right, with some indicating that five years should be about the minimum amount of time needed to enable the awardees to generate useful research which would take them from postdoctoral status to a permanent position and research independence. It was felt that a period of five years free from teaching duties was necessary to provide time for both the research and for writing publications, while that period of job security should be sufficient while they wrote further research proposals. One stakeholder was of the view, however, that additional time would be more useful than more money, feeling that the potential for an extension of up to three years would be a valuable offer to include as part of the scheme.

The issue of whether an extension could be made available was also raised by three respondents in their survey responses, when answering a question about how the scheme might be improved further. A handful of RF respondents suggested that more interaction between RF awardees would be desirable, perhaps facilitated by a larger programme of networking and events. A further three respondents felt they would have benefited from greater clarification of the potential pathways (and support) available to them after they had finished their fellowship. However, for the most part these comments were made in the context of their overall, highly positive experiences of the scheme and their clear desire that it should continue.

5.3. Scheme outcomes and impact

5.3.1. Subsequent employment

The employment circumstances of the 51 awardees who had completed their RF award give some insight into the extent to which one of its key desired impacts is being achieved, as the scheme aims to build the UK's engineering research capacity. At the time of survey, all 51 alumni who had completed their RF (and the four others who had left it after partial completion) were in employment. 94% of them were working in academia while the remaining three individuals were working in industry (two as researchers, one as an engineering manager). Three of the four who had left their RF part way through were also still in academia, the other working in research in industry. Almost all were therefore working in research-related roles in engineering, essentially fulfilling the aims of the scheme. 94% had a permanent (i.e. open-ended) role and two of the remainder had a tenure-track position, suggesting that almost all had obtained security of employment in a research-related career.

Geographically, 84% of those who had completed their RF were working in the UK when surveyed. Of the remainder (eight individuals), four were working in the EU and four elsewhere. Interestingly, all the non-UK alumni were now working in the UK. As the proportion of those working in the UK (84%) was higher than the proportion of UK nationality (66%), it can broadly be concluded that one effect of the scheme could be a net import of skills (at least at the point of survey), although admittedly the data available did not identify whether the non-UK nationals were long-term residents in the UK prior to the award.

Further insight into the career trajectories achieved after the RF was available by analysis of the employment roles reported by RF respondents – as the survey specifically asked for their current job title and also the title of their first job post-fellowship if they had subsequently progressed. These job titles were coded to an occupational stratification used by the Higher

Education Statistics Agency (HESA) in its staff record.² For academic staff, the stratification runs from Level L (which includes junior lectureship positions and post-doctoral researchers/assistants) through to Level A which is Vice-Chancellors. Levels G and H are not currently used. Levels J upwards are of particular interest in this study (Table 5.3) as named scheme Research Fellowships are classified as Level J in this stratification. Lectureship positions are classified either as Level K (subject lecturer) or L (junior lecturer), depending on the seniority of the post.

Level	Description	Example job title or descriptor
D	Head of an academic centre	Head of Department; Associate Dean; Director
E	Head of small centre; senior function head	Director; Division Leader; Head of Human Resources
F	Professor; function head	Professor; Functional Manager
I	Senior academic lead	Associate Professor; Reader; Principal Lecturer; Principal Research Fellow; Senior Research Fellow
J	Senior academic staff	Assistant Professor; Senior Lecturer; Royal Society Research Fellow
K	Academic staff	Subject Lecturer; Postdoctoral Research Fellow; Research Fellow; Research Associate
L	Academic staff	Lecturer; Researcher; Postdoctoral Research Fellow/Associate/Assistant; Research Officer

Table 5.3 Extract from (revised) UCEA higher education occupational classification, utilised for coding of job titles

Using this classification scheme, 54% of alumni obtained a first job post-fellowship that was at a higher level than the RF itself (i.e. above Level J) and 42% a role at a similar level, with the remainder outside academia, as shown in Figure 5.3. However, when current roles were analysed, the most common level at the time of survey was Level F which is the level at which Professor is classified (37%, or 40% of these who worked in academia), and three quarters (75%) were now at a job level above J. This suggests there has been significant career progression for alumni, indicated by the shift of the peak in Figure 5.3 towards the right for current jobs compared with first jobs post-RF, albeit with the caveat that the sample is very modest in size for such comparisons.

² https://www.hesa.ac.uk/collection/c16025/combined_levels

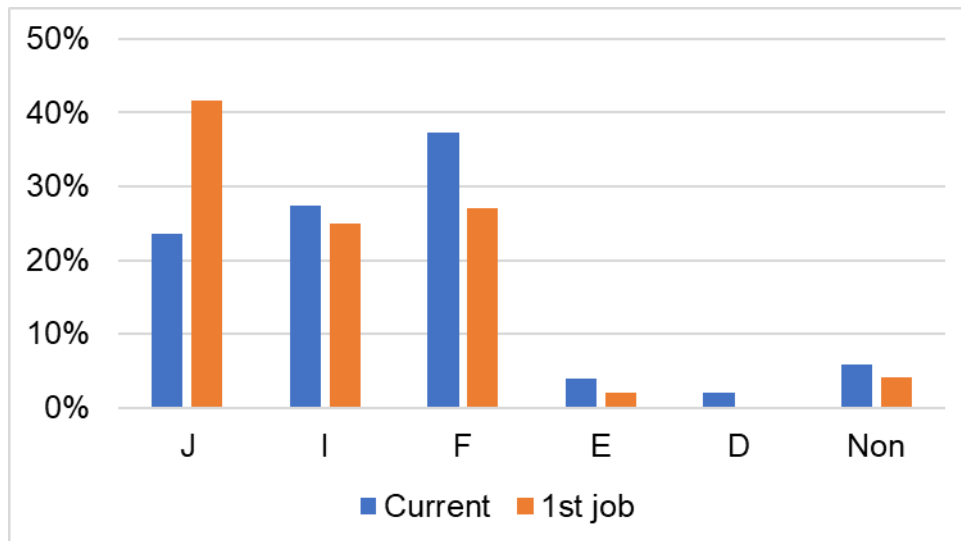


Figure 5.3 Classification of level of employment position, for first and current role of RF alumni respondents (n=48)

This classification was also used in our career tracking study of Royal Society URF alumni.³ A similar proportion (54%) of the URF alumni obtained their first post-fellowship role in academia at a level above J, the same percentage as amongst RAEng RF alumni here. Interestingly, while 42% of the RAEng RF alumni went to roles classified at Level J, none entered a lower level role, whereas some URF alumni obtained Level K roles after their fellowship. It is possible that this could reflect a somewhat stronger academic job market for engineering, than some of the subjects covered by the URF remit.

5.3.2. Research-related outputs

Survey respondents reported whether they had produced certain engineering- or research-related outputs during their fellowship. Figure 5.4 illustrates these results for alumni and current awardees, separately, with the caveat that the latter group was very small. However, this shows that the vast majority (and all current RF awardees) had published peer-reviewed papers as lead authors and contributing authors, established international collaborative research and helped to train doctoral researchers. Over two thirds of the alumni had supervised postdoctoral researchers, while over half had established collaborations with industrial partners and a similar proportion had undertaken outreach work. Significant proportions (around a third) had developed patents or other IP assets, or new products including software.

Although their results are not robust due to the small number of current awardees responding to the survey, the results for current RF awardees suggest that most are involved in industrial collaborations and all undertaking outreach work with young people, perhaps reflecting the current high attention to public engagement. This is also some evidence that many of the current awardees are achieving research-related outputs relatively early in their award.

³ Royal Society Research Fellowships: Career Pathway Tracker, CRAC (2018)

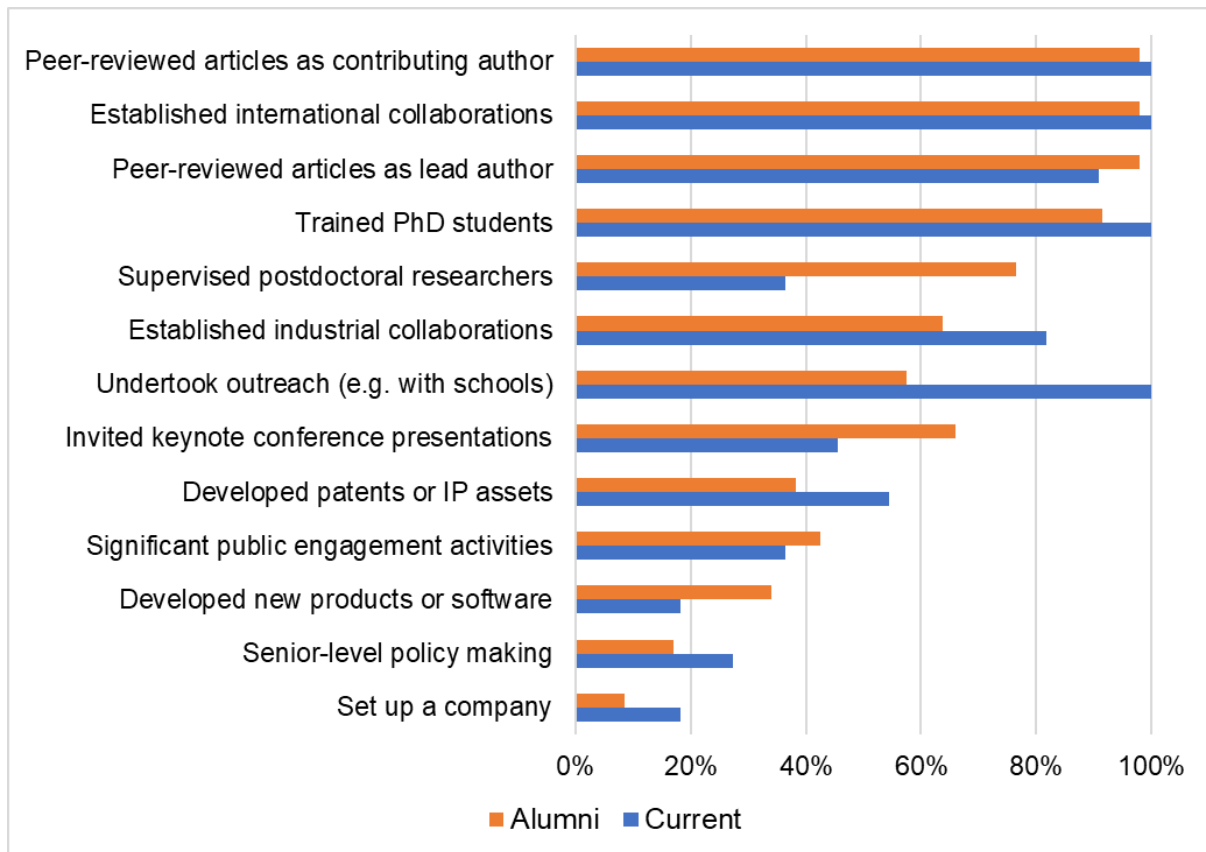


Figure 5.4 Survey respondents' achievement of a range of potential research-related outputs during their fellowship (current RF awardees, n=11; RF alumni n=47)

Over 85% of the RF alumni respondents reported that they had secured research grants or funding either during or since their fellowship. Four of the 11 current RF awardees indicated that they had already done so. While the alumni had secured a wide range of different types of research grants and awards, including many instances of EPSRC funding of different kinds, it was interesting to note that of the four current RF awardees gaining new funding, two had gained EPSRC New Investigator Awards and the other two had won significant prizes.

5.3.3. Impact on career progression

Respondents were asked the extent to which they thought the fellowship had impacted on their career so far, in a number of respects. Over 95% believed that their award had made a significant difference to their career path to date (Figure 5.5), 82% agreeing strongly that this was the case. A similar proportion felt that the fellowship had made or would make it easier for them to obtain their first permanent position. Over 90% also agreed that it facilitated faster career progression and the level of seniority they had reached to date, with over half believing they experienced these impacts strongly. Equally, over 90% believed the fellowship enhanced the way senior colleagues perceived them, with around half believing this strongly. Further analysis suggested that these results were very similar for both alumni and current awardees.

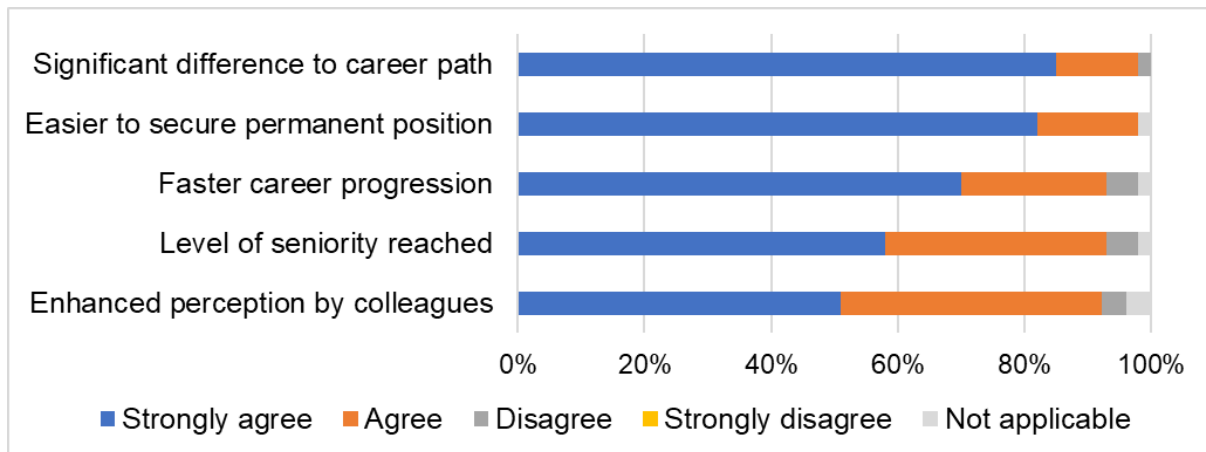


Figure 5.5 RF respondents' extent of agreement with statements about impact of the fellowship upon their career (n=64)

In addition to the many positive articulations given by respondents of the overall benefits of the scheme as their rationale for recommending it so highly to others (see section 5.2.2), they were also invited to describe the impact they thought the award had on their career. These comments were hugely positive (and the challenge here is in selecting a few to highlight, as so many are such strong endorsements of positive impact). Most commonly, respondents were clear that the fellowship had enabled them to progress in their academic career:

"Enabled my career progression to fast track to full Professor in 10 years from the start of the research fellowship" (RF, mid-late 2000s)

"I became a full Professor at a Russell Group university at age 38, which was 11 years after I started my fellowship. It is unquestionable that the Research Fellowship accelerated my career progression substantially" (RF, late 2000s-mid 2010s)

"I am currently a professor and director of a research institute of over 50 researchers. I do not think I would have been able to get to this stage by now without that precious time early on to build my research portfolio" (RF, early-mid 2000s)

Interviews with awardees reinforced this picture, highlighting the extent to which the award and its associated prestige was felt to have had a positive effect on individuals' career trajectories:

"The RAEng fellowship has had a major impact on my career. Without it I probably wouldn't have obtained a position in academia and most likely would have sought employment elsewhere. I don't think that I would have a career without the Fellowship. It was very good timing for me. It was early on, it helped set me up. Particularly for a woman, it can be very difficult to get established in academia." (RF, late 2000-early 2010s)

"I don't know how I would have got all the research done without it – I probably would have done a series of post docs and my career trajectory would have been much lower." (RF, mid-late 2000s)

"It has opened doors – it always helps to be able to say that you have done a RAEng Fellowship." (RF, mid-late 2000s)

Perceptions of impact in relation to the awardee’s development as a researcher in engineering were also investigated. The opportunity that the award afforded to establish independence in their research was the most highly rated, being considered as very valuable by over 90% of RF respondents (Figure 5.6), while the chance to explore new directions in their research was also very highly valued, as was the chance to establish an international reputation. In addition to these perceptions about impact upon their research outputs, over half believed that the fellowship had been very valuable in improving their self-confidence, and high proportions also believed that they had gained valuable new skills in addition to expert knowledge, while around 90% felt it was valuable or very valuable in these respects. Understandably, given the remit of the RF scheme, relatively few of the respondents reported great value in the opportunity it gave them to work with industry, although over half did suggest that they had gained from this to some extent.

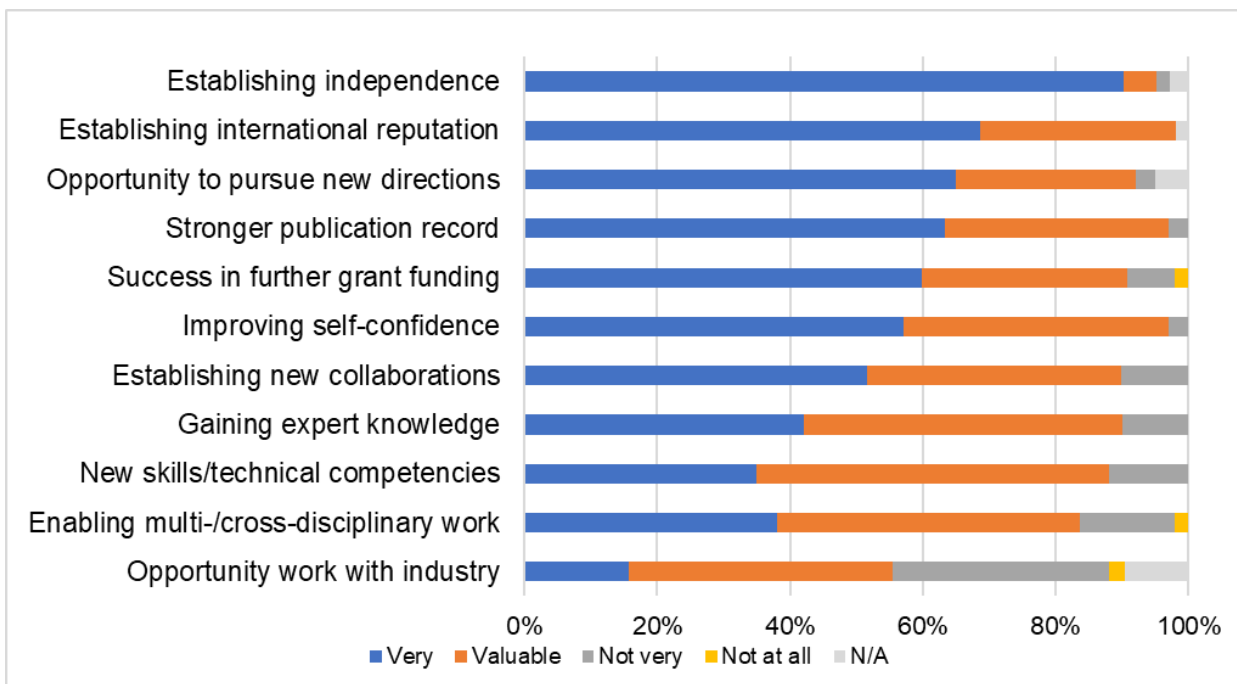


Figure 5.6 RF respondents’ perceptions of the impact, expressed as extent of value, of the fellowship on their development as an engineer and researcher (n=64)

Respondents’ reported future career plans strongly confirmed the overall picture that RF awards have been consolidating and advancing engineering research careers, dominantly expected to be in academia. Of the alumni who were in academia, only one reported that he intended to move into industry, although a small number of them indicated that they hoped to develop spin-out or start-up companies in addition to their own academic work.

The most commonly anticipated career trajectory, by far, was progression into a permanent academic role involving research in an HE institution, although many respondents indicated that they sought to undertake research that would translate to industrial and societal benefit. Given that some of the alumni had completed their fellowship many years ago, survey responses indicated that some had achieved significant progress in this respect already:

“I’m carrying on in academia. I’m now Associate Director of a research centre with 250 members and run a group of around 20 people” (RF, mid 2000s-early 2010s)

“I plan to continue building my research group, expanding the scope of my research programme, establishing myself as an internationally recognised researcher in my field, and securing a permanent academic post” (RF, mid 2010s- present)

“Stay in academia, but focus on translational research and strategic initiatives that enhance the impact of engineering on wider society” (RF, mid 2000s-early 2010s)

“I plan to stay in academia for the foreseeable future, building up my research group until we have around 8 members. I also plan to spin off some of my research into a start-up, which will begin in 2 or 3 years time once the enabling research is done. It would be very useful if the RAEng is able to help when this time comes. I would continue as an academic alongside this start-up” (RF, mid 2010s- present)

5.3.4. Personal perceptions of career impact

The question of what the fellowship had enabled respondents to achieve – i.e. that they would not have achieved without it – was also asked in the survey. In the main, this provided similar testimonies to those provided elsewhere in the survey and interviews, as many felt that they might not have their current job and positive career without the award. Several respondents identified the high impact from the freedom in the fellowship award that allowed them to focus solely on their research and/or take it in a new direction, and that this period of research had provided a pivotal foundation for them. In several cases survey respondents more specifically indicated that without the award they could have pursued a different career direction altogether:

“The RAEng fellowship allowed me to switch fields from chemical engineering to computer science. Because I was self funding, I could convince a strong computer science department to take me as a Lecturer. By the time my fellowship was completed, I had already proved myself as a computer scientist, so my department promoted me to Senior Lecturer. I wouldn't have been able to take those kind of early-career risks except that I had the fellowship. The RAEng fellowship allowed me to make deep and meaningful ties to industry. Because I had the fellowship, I had a significantly reduced teaching and administrative load, so I used some extra time to develop deep connections to industry” (RF, early-mid 2010s)

“Without the fellowship I would have definitely moved into industry, yet the scheme has provide me the opportunity to inform policy changes and strategies in key manufacturing companies. I have also worked with large global companies through to micro-SMEs helping to develop processes and materials for their business growth. I have a large amount of alumni in industry and academia who are also creating positive impacts for the UK. So I believe the UK have a seen a positive return on the RAEng investment” (RF, mid 2000s-early 2010s)

“The fellowship encouraged me to stay on in academia in the first place, rather than going into industry. I may never have applied for the lectureship position I am in if I had not been encouraged by receiving this fellowship. The mentoring has also provided me with a key contact who I expect will be very helpful in future years when I have to make some important decisions” (RF, mid 2010s- present)

Overall, these comments on impact, taken with the quantitative results to survey questions, seem to present a very consistent picture that the RF scheme has been providing to awardees exactly the early-career support that it is positioned to deliver.

6. Industrial Fellowships

6.1. Strategic relevance and awardee profile

The Industrial Fellowship (IF) scheme, launched in 2001 as the Industrial Secondments scheme, aims to strengthen the links that engineering academics hold with industry by funding collaborative research activity.

Historically, the scheme linked academics with industry through individual companies hosting an academic as a secondment, although from 2019/20 onwards there has also been a new option for an industrialist to undertake the scheme by working in an academic environment. The scheme aims to strengthen the strategic relationship between industry and academia by providing an opportunity to establish or enhance collaborative research between the two parties. For academic participants, it is intended that the awardee will use some of the industrial experience that they gain to enhance their teaching which should in turn improve aspects of student learning.

For awardees before 2019, individuals were able to take up the fellowship for six months on a full-time basis or twelve months part-time, but this has now been made more flexible, offering a duration of six months to two years, either full-time or part-time. In 2019/20 the value of the award was also increased from a maximum of £30,000 contributed by RAEng towards the basic salary costs (excluding overheads) of the applicant, to £50,000 per annum, up to a maximum of £100,000.

The stakeholders we consulted viewed the scheme as a valuable opportunity for academic awardees to develop their industrial knowledge and experience. They also felt that these recent changes to the value and duration of the scheme would increase the attractiveness of the award to potential applicants.

The analysis of profile of participants below is based on MI data held by RAEng about Industrial Fellowships (n=85) or survey responses (n=41). Unlike the other two main schemes reported in the previous chapters, for which all known alumni (and current participants other than recent starters) were included in the target sample, it was agreed for the IF scheme only to target those who had undertaken an award since 2011. The rationale for this selection was that the comparatively short duration of the scheme could mean that awardees prior to 2011 might not fully remember their experiences and/or be able to identify and isolate the specific impact that the scheme has had on them.

6.1.1. Host institutions

Analysis of the institutions at which IFs were funded in the period studied was carried out using grant system records, whereas all other aspects of award/awardee profile were obtained via survey responses. Of the 85 awards during this period, 73% were made to English institutions and 20% to Scottish (Table 6.1). Regionally, of the awards made to English institutions, one third (33%) were institutions in London and the South East, 26% essentially 'northern' and 26% in the Midlands (the remainder being Eastern and South-West England). Depending on the definition used, only 12% of the total awards were made those in institutions in the 'Golden Triangle' area. In terms of the type of institution, 59% were Russell Group member institutions, 13% post-92 institutions and 28% others.

Together, these statistics suggest a somewhat different profile of award-making in terms of institutions, from those hosting Research Chairs or Research Fellowships; a profile which is

more balanced both geographically and in terms of institutional type. In general, IFs have been somewhat less focused on Russell Group institutions and also less concentrated on institutions in London and the South East.

Host institution		Awards	Awards %
Country / region			
	England	61	73%
	Eastern	3	5%
	East Midlands	11	18%
	London	9	15%
	North East	2	3%
	North West	4	7%
	South East	11	18%
	South West	5	8%
	West Midlands	6	10%
	Yorks & Humber	10	16%
	N Ireland	2	2%
	Scotland	17	20%
	Wales	4	5%
Broad type			
	Russell Gp	50	59%
	Other	23	27%
	Post-92	11	13%
Total		85	

Table 6.1 Institutions obtaining IF awards, based on grant system records (n=85). Percentages for English regions are of awards made to institutions in England

This less concentrated distribution of awards was also evident in analysis of the number of awards per institution. This showed that 47 different institutions had hosted these 85 IFs, with the highest numbers at the universities of Sheffield (6), Glasgow (6), Heriot-Watt (5) and Nottingham (5), which is a very different (and 'flatter') distribution from that for the RC/SRFs or RFs, where almost half the awards had been to a handful of institutions. For example, the four institutions that between them obtained over 41% of RC awards have only hosted 7 (i.e. 8%) of IFs since 2011.

In total, 77 different companies have been partners in these 85 awards, suggesting that (during the period of the scheme studied) relatively few have hosted more than one IF.

6.1.2. Profile of awardees

In this section, the statistics presented are on the basis of results from our survey, not grant records. Table 6.2 summarises the information available about the nationality, gender and ethnicity of awardees who responded to the survey. Compared with the other two schemes analysed, the profile of IF awardees has been somewhat more diverse in several respects than

RC awardees, although more similar to the profile of RF awardees, for example in terms of the proportion (63%) of awardees of UK origin and male gender (81%). The survey evidence suggests a higher proportion of UK-domiciled participants was of ethnic minority background (particularly Asian), but this must be noted with caution as the proportion is within a sub-sample of UK domiciles that is of very modest size (only 26 individuals).

Awardee characteristics		Number	Proportion
Nationality			
	UK	26	63%
	Other EU	6	15%
	RoW	9	22%
Gender			
	Women	7	17%
	Men	33	81%
	Prefer not to say	1	2%
Ethnicity (of UK nationals)			
	Asian	6	23%
	Black	0	0%
	Mixed	0	20%
	Other	1	4%
	White	15	58%
	Prefer not to say	4	15%
Total		26	

Table 6.2 Personal characteristics of IF survey respondents (n=41)

Comparison of the year in which respondents indicated they had obtained their PhD and the year in which their IF award started suggested that awardees undertook the scheme at a wide variety of career stages, ranging from one year to 30 years after their PhD. The mean and median extent of post-PhD experience prior to starting an IF were both, however, 10 years, which is broadly what would be expected as the scheme is targeting reasonably established academics rather than specifically early-career or senior researchers.

6.2. Experiences of scheme participation

6.2.1. Positioning and rationale for applications

The IF scheme aims to strengthen links between industrial and academic institutions by funding researchers to undertake a short-duration collaborative project, full-time, with an industrial partner or in such an environment. The opportunity to work with industry was, unsurprisingly, most the highly rated factor in terms of attractive aspects of the scheme when respondents had applied to it. Figure 6.1 illustrates the most commonly cited aspects of the IF scheme that applicants had found attractive. In addition to its positioning as an industrial collaboration opportunity, it was the prestige of the RAEng as funder and of the scheme that were the most popular drivers for participation, along with the opportunity it offered to engage

with the Academy. Factors such as the duration and value of the award were less commonly cited as being particularly attractive to applicants, being listed by around one quarter or fewer respondents.

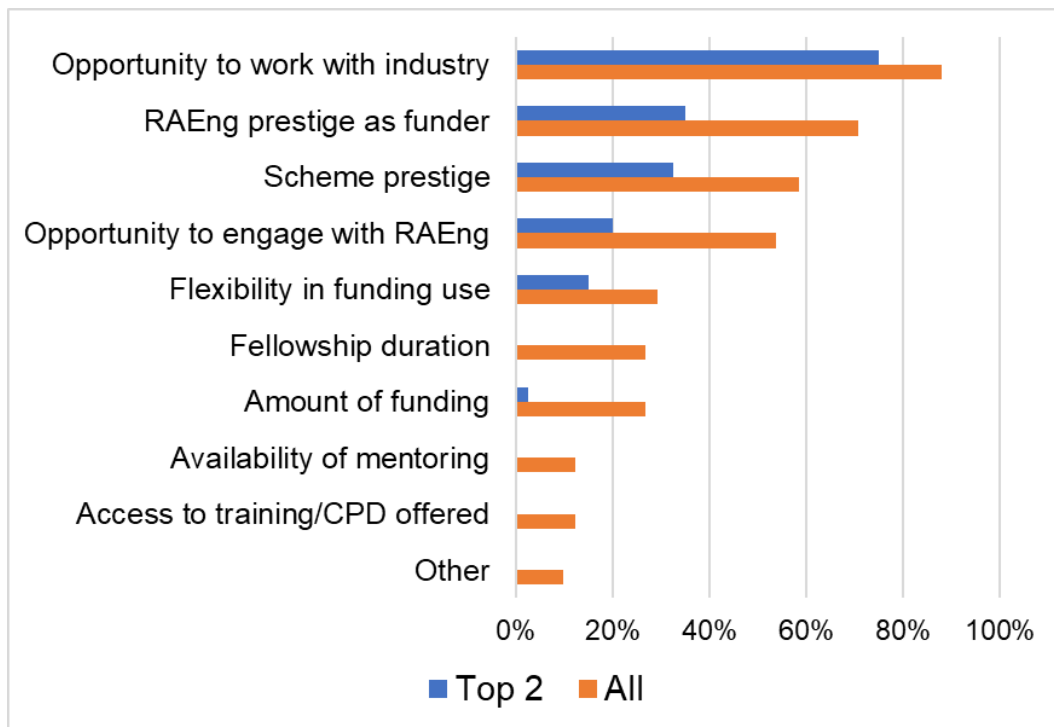


Figure 6.1 Aspects of the IF scheme that had attracted respondents to apply (n=40)

Within the broader funding landscape, the IF scheme is potentially comparable with the Industry Fellowship run by the Royal Society, which aims to enable award-holders to develop and establish collaborative links between academic and industrial organisations. The RS Industry Fellowship scheme provides the applicant's salary while on secondment for up to two years full-time or a maximum of four years part-time, in comparison.

From the perspective of stakeholders, the RAEng IF scheme serves a useful purpose, offering a low-risk way of testing relationships between academics and industry. The relatively short duration of the scheme allows the awardee to immerse him/herself in a company, to familiarise themselves with the culture and to undertake a small-scale research project. Thus the IF acts as a potential test of whether an awardee could work successfully with the company in the long-term to conduct research which produces solutions to the company's problems. Stakeholders felt that whilst some industries have used the scheme as a means to undertake small-scale research projects (that they might not have been willing or able to afford otherwise), the best examples in the scheme are where awardees and companies use the award as an opportunity to begin a programme of sustained collaborative research. One stakeholder felt that the RAEng had a key brokerage role to play in ensuring both that each award funds academics to do work that companies will benefit from, but also that the awardee's institution provides sufficient support to them in terms of reduced their teaching and administrative loads during the award.

95% of IF survey respondents reported that they had found the application process either very easy (29%) or straightforward (66%), while the remainder said they did not remember so none reported that they had found it hard. Few (only three) respondents had also been applying for

other comparable types of funding opportunity when they applied for the IF, perhaps illustrating the distinctive purpose of the IF scheme. Those who had made a comparable application had applied for a Royal Society Industry Fellowship. One respondent commented specifically on how he considered the application process and standing of the award to be valuable:

“RAEng stand out as having one of the fairest application systems available. Industrial secondments are straightforward to get, providing you have a good plan and collaborators. This is exactly how development stage funding should be. There are already more than enough “moon shot” fellowships out there that are hard to get and mostly create a time-sink through the application process. I think it’s really important to have funding available for which you have a reasonable chance of success (by which I mean at least 50%), and where there is a degree of trust that you know what you’re going to do. The funding level was relatively low (23k) but it was used very effectively” (IF, early 2010s)

6.2.2. Scheme benefits and experiences

Four out of five (80%) of IF respondents felt that, overall, they had had a very positive experience of the scheme and the remainder (20%) positive, so within this relatively recent sample of participants their experiences were wholly positive overall.

Asked to identify the aspects of their experiences that had been most positive, through open-ended comments, the strongest messages coming through were that the award gave them a period of freedom where they could focus on real industrial problems and potentially develop a new direction in their research, as well as enhancing their networks through contacts made with new people in industry and gaining experiences that they could relate to others in their university role.

That importance of the opportunity to undertake bespoke collaborative work with the industrial partner also emerged clearly from respondents’ consideration of the benefits of the award, in a closed survey question (Figure 6.2). The opportunity it afforded to link up with new experts outside their existing network was also valuable to three quarters of respondents, while nearly half found some value in access to industrial facilities or equipment. In parallel with the other schemes, the kudos (prestige) of being an awardee in a RAEng fellowship scheme was again reported to be valuable by almost all awardees.

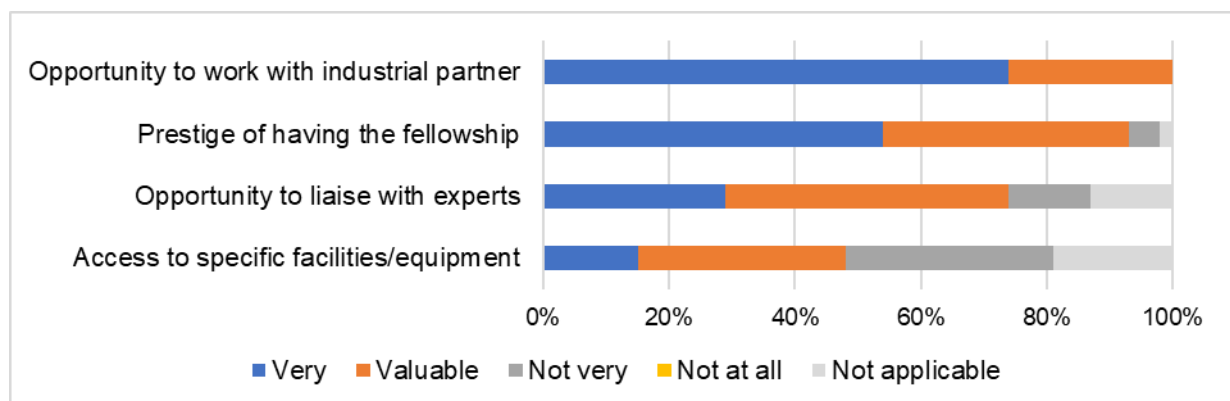


Figure 6.2 IF survey respondents’ perceptions of the extent of value of certain benefits of the fellowship (n=41)

When commenting on their experiences, a small number of individuals also mentioned the value of the support that they had received from the RAEng and/or its staff in this context, including the following observation:

“The application form and process made me feel like the RAEng wanted to support and develop me as a person/engineer as much as to support my research. This is a much more mentoring approach than I have found with other funders and actively influences my choice to engage with and contribute to the RAEng” (IF, late 2010s)

As most respondents had experienced the IF as a relatively short-duration secondment, they had not benefited from a bespoke package of allied training or development opportunities, although nine respondents reported that they had received mentoring as part of their award (NB. in fact mentoring has only been offered to those IFs with an award of a year or more in duration). In all cases such mentoring was reported to have been very or quite valuable. However, several of these respondents indicated that the person they regarded as their mentor was the person supervising them at the industrial partner, so in the main it seems likely that these were not formal mentoring relationships per se (i.e. with a designated third party appointed for that purpose).

Two respondents reported that they had taken part in the RAEng Research Forum and found that valuable, giving a further indication that this event has value to some participants in a variety of award schemes.

Only six of the IF respondents reported that they had experienced significant difficulties or challenges during their award, although it should be remembered that for many of them the award was relatively short in duration. The challenges stated by them were all different, ranging from frustration at the time taken to get fully set up at the industrial partner to difficulties getting access to its senior staff, and in one case an intellectual property problem arising with their host university. Two individuals who did report such personal difficulties indicated that they had been well supported by both the RAEng and the industrial partner.

6.2.3. Other reflections

Asked about their perceptions of the duration and financial value of their award, respondents were generally positive, although to a more modest extent than reported by RC/SRF or RF respondents. 71% felt that the duration of the award had been about right for them but 27% felt it was not long enough. Interestingly, the proportion reporting that they believed the award was of insufficient duration was as high or higher amongst those starting awards in 2018 (which included those with an award duration of a year) as amongst earlier awardees for whom the duration was limited to six months on a full-time basis.

In relation to the amount of funding, just over two thirds (68%) believed that it had been sufficient but 27% felt that it had not been enough (while the remainder were unsure). Of those who suggested that it had not been enough, most commented that they would have appreciated some access to funding for direct costs of research consumables, i.e. to support the research they undertook, or for travel costs. Two indicated that the level of funding had not been sufficient to cover their employment costs, which had meant some issues with their host institution. There was some evidence to suggest that a higher proportion of those with awards in recent years (2016-2018) reported insufficiency of funding, compared with the proportion amongst those with awards in the earlier years studied (i.e. 2011-2015), although the size of the response sample means that this is not a robust analysis. With that caveat, it is worthwhile

noting that half of those who started an award in 2018 (albeit this was only 6 individuals), felt that the extent of funding was not enough.

In response to a question about whether or how the programme could be made better, most of the suggestions referred to these issues of duration and, especially, the desirability of additional funds or greater basic funding. Two suggested that they had obtained buy-out from their university of only half their time; this meant that the university struggled to hire in replacement support, and so for several reasons funding to the level of full buy-out would have been preferable. A few other respondents reflected that some of the potential longer-term benefits of the award would have been realised more effectively with greater support from their institution (and/or, potentially, from the RAEng), i.e. to capitalise on or exploit things that they had developed. One respondent adversely compared his experience with that of a subsequent Royal Society Industrial Fellowship, within which he had had access to a significant range of training and development opportunities.

Overall, the evidence from respondents suggests that there are many aspects of the IF award that are positive and sound, but there is also some scope to consider some adjustments to its format and a review of the offer could be timely.

However, these comments need to be placed in the context that all the IF respondents said that they would recommend others to apply for such an award, which is another exceptionally positive overall endorsement. A number of their statements about the positive impact they derived from it as academics, and on their research as well as teaching, are included in section 6.4.3. These are strong reflections of the valuable positioning of the scheme in relation to its aims of connecting academia and industry.

That said, two of those endorsements suggest that scope exists for greater appreciation by some academic institutions of the importance and value to engineering of these types of experiences, which in the short term institutions may not see as immediately tangible to their research outputs:

“The Fellowship is a great platform for connecting Academia to Industry and enhance the network of contacts, and expand the real-world applicability of research. I would be very happy to undertake a further fellowship with the RAEng, However, I would make sure the academic institution involved values the experience and recognises the efforts” (IF, early 2010s)

“It’s a good thing for the right person and not everyone makes a good fellow so I wouldn’t recommend it without reservation. I’m also at a reasonably senior role in my University now and have a considerable responsibility for fellowships in engineering. It would be fair to say that fellowships can be disruptive to core business and that in the grand scheme of things the scheme I was funded under would be considered marginal in terms of its cost/benefit analysis for the University in terms of the tangible benefit it brings” (IF, early 2010s)

6.3. Collaboration with the industrial partner

6.3.1. Collaboration experiences

For the large majority (83%) of IF respondents, the experience of working with their industrial partner had been very positive, while the remaining 17% reported that it was quite positive. In order to understand the depth at which awardees had managed to immerse in the company

and understand how it really worked, a specific question was included to probe this. Almost three quarters of respondents (73%) felt that their engagement with the partner had enabled them to understand its business and working culture to a great extent, and the remaining 27% to some extent. This is positive evidence that awardees have been sufficiently engaged with, and/or immersed in, the industrial environment and working culture through their secondment under the award.

Open-ended comments made by respondents backed up these perceptions but indicated a range of experiences practically. In some cases, the awardee had been located at an R&D facility which was at arm's length from business operations. At the other end of the spectrum, others had been regarded in the same way as a company staff member and had participated in a wide range of business meetings and processes. In the latter cases, it was clear that they had developed a whole range of new skills and an understanding of the industrial world that they did not encounter in academia. What was common to all, including both of these groups, however, was gaining better understanding of the differing timescales, pressures and priorities in the industrial setting compared with the academic research environment. Such understanding is thought to be crucial to developing successful industrial collaborations, hence an underpinning aim of the IF scheme.

“Through working in [industrial host], I understood the projects that mattered to the company. They considered [me] a member of the company and I was involved in a lot of project discussion and meetings” (IF, mid 2010s)

“Being located at the partner and being involved in meetings helped me to better understand the pressures industry partners are under. In addition, I benefited from the external view industry holds on academia, which enabled me to understand how the 2 perspectives can be connected for future work” (IF, early 2010s)

“I enjoyed working with my industrial partner and fully immersed myself in the team. I was also able to engage with the organisation more widely by visiting offices in other parts of the country. I have maintained these relationships through regular email contact and by visiting placement students that we now place in the organisation each year” (IF, late 2010s)

In spite of these very positive responses, when asked if the RAEng could have done or provided more to support the awardees to work more effectively with their industrial partner, almost a third (13 respondents) suggested that more could have been done. Six of these individuals suggested that mentoring would have been beneficial to them, which seems quite a distinct message. The other more structural issues raised were that there should be clearer expectations of the role that the industrial partner might play following the award, and a request that the RAEng should increase the profile it gives to highlighting successes of industrial collaborations through IF awards and more generally.

6.3.2. Sustaining the collaboration

A clear issue for evaluation of the IF scheme is the extent to which an award results in a sustained research collaboration, i.e. beyond the duration of the award itself, as the aim is for the award to be a trial period of collaboration which can lead to more sustained research work. Amongst the 40 respondents who had completed their award, 88% (35 awardees) said that they were still in contact with their industrial partner subsequently. Notably, all five who were not still in touch with their partner completed their award five or more years ago.

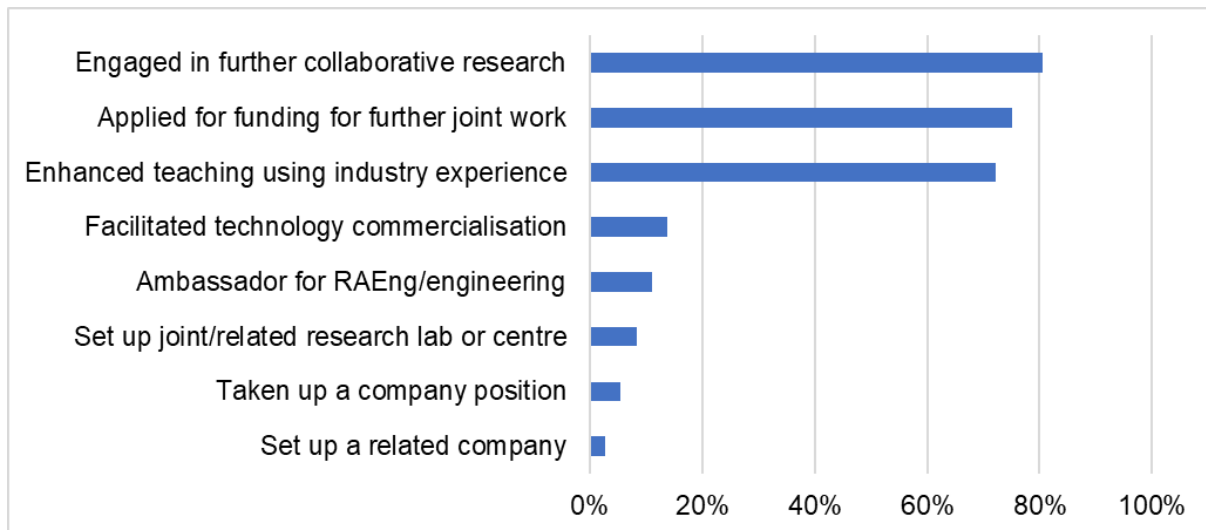


Figure 6.3 IF respondents' post-award activities relating to their industrial partner (IF alumni still in contact with partner: n=36)

Figure 6.3 illustrates the activities in which respondents who retained contact with their industrial partner following the award were engaged. Although the sample size was admittedly small (only 36 respondents), 80% of them had engaged in subsequent joint research with the industrial partner after the award had ended and almost as many had applied for funding for further joint work. Given the short duration and relatively early-career nature of the scheme (compared with, for example, a Research Chair), it is perhaps not surprising that very few individuals (3) had set up a joint laboratory or research centre or a related company. Two individuals had taken up an employment position in the partner organisation (one of whom was now working outside academia for another company, the other had returned fully to academia). The key result on enhancement to teaching is addressed in section 6.4.3.

Examples of how relationships had been sustained in the longer-term were identified in interviews with awardees:

"I continued working with [company] when the IF ended. I have a really good strong relationship with them. They supported a couple of research grants that I submitted and won. We have set up a [research centre] in the uni which they supported and they will be able to use some of the latest equipment and technology that they wouldn't have access to otherwise and they will showcase the work they are doing to our students." (IF, mid 2000s)

"I keep in touch with my supporter at [company], especially as my university places 3 students there for their industrial placement year who I supervise, so I can regularly catch up with everyone there. After the Fellowship ended I met up with them a few times to discuss new potential research ideas." (IF, late 2000s)

Some respondents indicated that the experience had led directly to continued leverage of the collaboration with their industrial partner in terms of further research and/or new projects that had emerged following the fellowship:

"The Industry Fellowship has had a huge impact on my research by allowing me to build contacts and raise my profile within my sponsor's organisation and their supply

chain. This provided leverage in a successful funding application for the £4.8M EPSRC-funded ACHILLES Programme. More recently the contact and exposure to the rail industry has allowed me to gain financial support from [another organisation] as part of a RAEng Senior Research Fellowship application” (IF, late 2010s)

“Specifically, this fellowship allowed me to do some exploratory work with [sponsor] on the assessment of new ways to measure material properties [...]. This has paid off over the long term - we've now published around 25 papers on the subject and have a patent successfully licensed to a US spin-out. The fellowship was particularly valuable in gaining insight into the needs of industry and this guided the commercialisation of their technique. We're very pleased to have followed a licensing model that is geared to providing long term impact and societal benefit over short term profit” (IF, early 2010s)

“My research line addresses the engineering science of [field], so my work is closely related to engineering challenges facing the industry. The fellowship enabled me to get closer to the problems at hand, communicate with practitioners in the field and formulate research programmes to address major technical challenges in process engineering” (IF, early 2000s)

A high proportion (80%) of those still in contact with their partner said they had specific plans for future collaboration. These included applications for grant funding from bodies such as EPSRC, setting up CASE PhD studentships, developing Knowledge Transfer Partnerships (and in one case a degree apprenticeship programme), and in a few instances the intention to formalise their continued collaboration through a partnership agreement or joint research centre. These all seem to be very positive potential sustained relationships, albeit with a range of levels of ambition.

6.4. Impacts

6.4.1. Outputs

Figure 6.4 illustrates the engineering-related outputs that IF respondents indicated they had completed or produced during their award. The purpose of the scheme is reflected in the high proportion achieving an established industrial collaboration and, despite the short duration of the award and its nature as an industrial secondment, half or more of respondents reported that they had published papers or given invited keynote presentations at conference, and a similar proportion supervised or trained doctoral students during the award. A substantial minority (over 40%) had developed a new product or new software. Smaller but still significant proportions had undertaken public engagement or outreach activities during the secondment.

Although a number of these results (proportions) are lower than amongst those who undertook RC/SRF awards, this is understandable given the much shorter duration of the IF award and/or its different focus in terms of career stage and purpose.

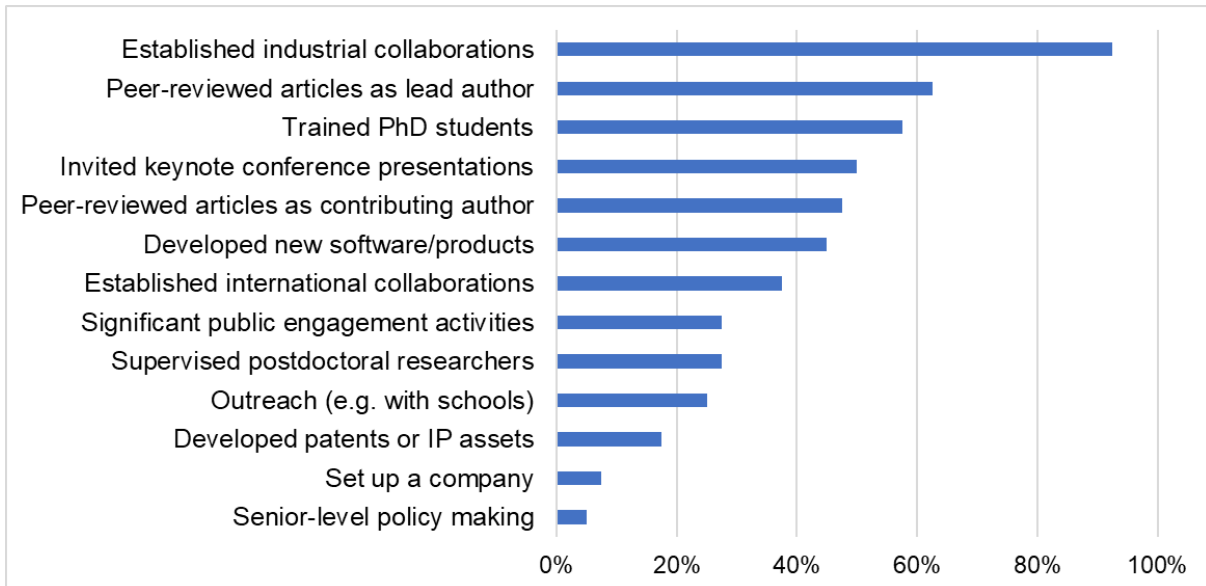


Figure 6.4 IF respondents' engineering-related achievements and outputs produced during the award period (n=40)

6.4.2. Career impacts

Despite the relatively short duration of their award, almost all the IF respondents felt that the award had impacted positively on the level of seniority they had reached (almost 60% agreeing strongly that this was the case). Around three quarters agreed to some extent that it had made or would make a significant difference to their career path, and nearly as many in relation to accelerating their career progression and enhancing how senior colleagues perceived them.

In contrast, very few felt that the award had had much impact in making it easier for them to obtain a permanent position. However, for most respondents this was because they did already hold such a position. The extents of these perceived career-related impacts were generally lower than for RF awardees who were asked the same question, but those variances reflect the differing purposes of the two schemes (i.e. the RF is positioned to be transformational, whereas the IF is more developmental and often undertaken at a more established career stage). In that context, we regard these IF results as positive.

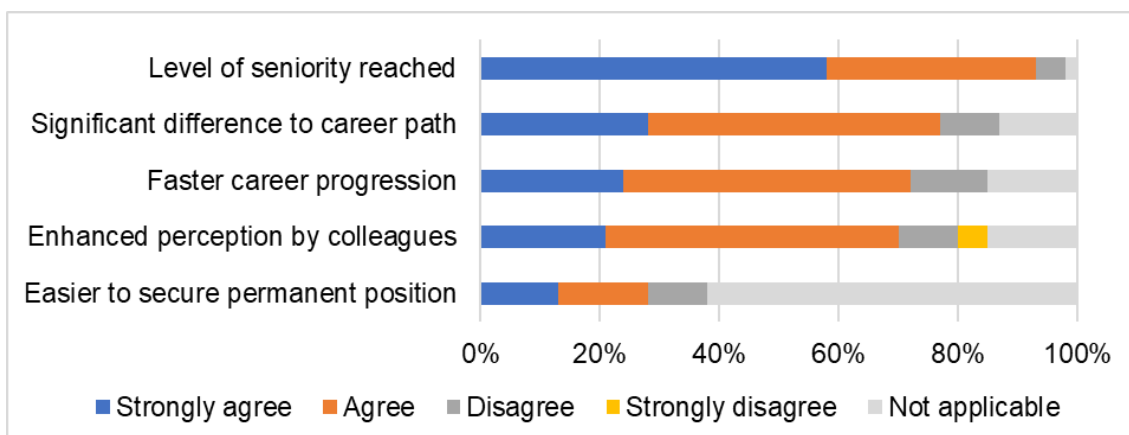


Figure 6.5 IF respondents' extent of agreement with statements about impact of the fellowship upon their career (n=40)

Unpicking the benefits of the IF award in terms of development as an engineer and/or researcher further, more detail emerges in the results shown in Figure 6.6. Aside from the self-evident benefit of developing partnership work in industry, high proportions of respondents reported that the award had enabled them to gain new skills or technical competencies (over 90%, of whom half felt it had been very valuable), gained expert knowledge and improved their self-confidence, all of which could be anticipated of those undertaking a positive secondment into another sector. However, the high proportion who said that they had pursued a new line of research, in many cases enabling them to undertake multidisciplinary work, was notable and appeared to result in success in further grant funding. While lower proportions (around one quarter) reported that it had been very valuable in helping them establish independence as a researcher or their international reputation, around two thirds believed that it had helped this to some extent, and up to a half felt that their publication record was actually better as a result. Again, given the nature of the scheme and its short duration, these seem to be very positive developmental benefits.

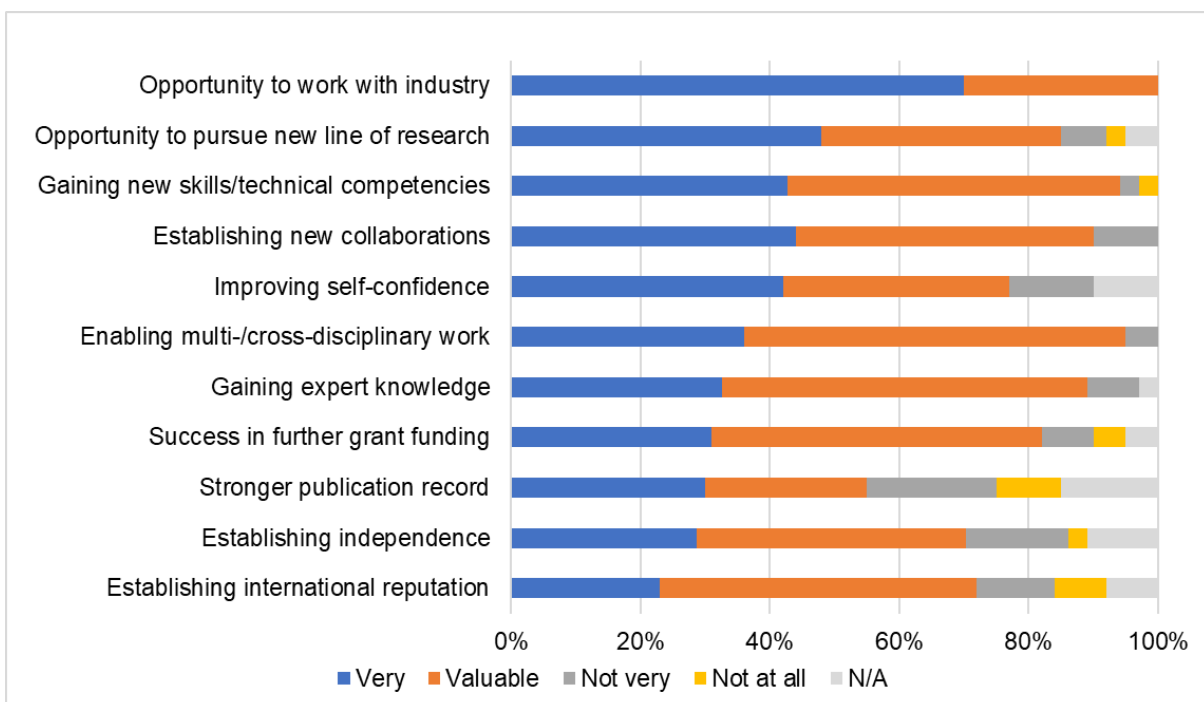


Figure 6.6 IF respondents' perceptions of the impact, expressed as extent of value, of the fellowship on their development as an engineer and researcher (n=40)

It was clear, from comments invited in the survey about their next intended career steps, that many of these relatively recent IF awardees were mid-career and either seeking progression to a full professor role or had recently achieved such progression, and that most saw that the award was seen as or had been a contributory factor in that:

“The Fellowship has impacted my career in the medium and long term. It provided a platform for me to drastically improve my research, communication skills and confidence in a way that I could not have done without the Fellowship. It has enabled me to gain further funding that will direct my research for the next 5-10 years and establish myself as both a researcher and an engineer” (IF, late 2010s)

“I got promotion from Senior Lecturer to Reader for 2 reasons, one of which was due to the funding which resulted from the fellowship” (IF, late 2010s)

“Research and building a clear impact case for the research is critical in the current UK academic environment. This allowed me to further that, which helps my career, and the achievements (REF rankings) of the university” (IF, late 2010s)

6.4.3. Engineering and research impacts

One of the aims of the IF scheme is to give engineering academics a period of exposure to industrial engineering practice, through which they gain experiences and use these to enhance both their teaching at university and their research role. There was ample evidence from comments made in the survey, that awardees were doing this:

“I have updated my knowledge of and experience in up-to-date industry practice in the area of antennas and communications. This has fed into my teaching and research activities” (IF, mid 2010s)

“I think it is a great opportunity for academic staff to experience a different aspect of industry that is likely to be more directly relevant to the students they lecture. Being able to bring that personal experience, but then also have the contacts to bring industrial staff to help support engineering teaching I believe to be very important” (IF, early 2010s)

“I think all academics should enter back into the industry for a certain period after being in academia for a certain period. This ensures their knowledge is current for industry practice and relevant for the student body” (IF, mid 2010s)

As was shown in Figure 6.3, Reflecting one of the explicit objectives of the scheme, nearly three quarters (72%) reported that they had enhanced their teaching through use of practical examples they had observed with their industrial partner. This came through strongly in interviews with awardees:

“I have lost count of the number of guest case studies, guest seminars, speaking at conferences I have run where they come and talk about the industry based research that they are doing...I still maintain a close relationship with them and I use some of the work they do as case studies for my post-grads and they also helped me to set up a couple of new modules for our PG provision.” (IF, mid 2010s)

“The Industry Fellowship allowed me to develop problem-based teaching material that I was able to use for undergraduate lectures and coursework. I was also able to improve my understanding of health and safety for design, which has changed the way that I lead design-based teaching at the university” (IF, late 2010s)

“I was also able to show my teaching materials to [company] to check that I conveyed the correct information and draw on their experience to improve the courses. When I talk to students about health and safety now, it’s not just theoretical. I actually have lots of examples. Consequently they are much more engaged because they see the point of it.” (IF, late 2010s)

Meanwhile, in the survey, awardees articulated the impact of the fellowship on their research strategy and capacity more generally, in some cases suggesting that it had quite a transformative effect:

“I now have multiple concrete experiences in developing [technology], including one from the fellowship. This provides me an opportunity to develop several [...] projects. My future research and career will be more focused on [these] areas” (IF, early 2010s)

“This has been a most enjoyable, impactful and tremendous opportunity for profound and productive interfacing with industry, which I extremely appreciate. It has made a great difference to my scholarly output and vision development, while also affording me the time and freedom to think beyond my current duties and obligations” (IF, late 2010s)

“The RAEng Industrial fellowship has been able to provide an industrial touch to my academic and research activities. Through this industrial knowledge applied to my research, I am able to provide solutions that are more suitable to the wider industry and my research is able to have a higher impact not only in academia but also in industry” (IF, late 2010s)

The benefit of the fellowship in enhancing the understanding between academics and industry, and enabling them to connect and interrelate better, was very clearly articulated by several of the IF alumni. These were strong reflections of the purpose and positioning of the scheme:

“I would certainly recommend academics to spend time working within industry on industrially relevant problems, and the Royal Academy of Engineering awards are particularly good for that. This experience helps academics to understand the way engineering companies operate, what are their priorities and needs, and how they can best collaborate with academia” (IF, early 2010s)

“As an engineering academic in order to increase the impact of our research, it is important to have close ties with industry, and this fellowship addresses this need exactly” (IF, early 2010s)

“It can be difficult for academics to properly engage with industry and work outside of the university, given the many other pressures related to teaching, university duties and specific research projects. The Industry Fellowship enabled personal development, the development of ideas and exposure to the current state of our industry that I could not have obtained without the Fellowship” (IF, late 2010s)

7. Chairs in Emerging Technologies

7.1. Context

Unlike the three schemes considered thus far, most of the respondents who had obtained a Chair in Emerging Technology (CiET) award were current participants. Although the scheme was launched over 10 years ago, only two awards had been made until it was rejuvenated and accelerated in 2018 through Government funding from the National Productivity Investment Fund and subsequently the 'Investment in Research Talent' initiative. As a result, 10 new awards were made in 2018 and a further nine in the 2019 round.

The idea behind the scheme is that the new technology areas developed by Chairs in Emerging Technologies have the potential to benefit society and the UK economy significantly and will enable the UK to be at the forefront of such areas of engineering innovation globally. The research topics reflect the UK's wider technological priorities, with many projects directly aligned to the aspirations of the Industrial Strategy, designed to tackle some of the biggest current and pending industrial and societal challenges.

The scheme aims to provide ten-year support to global research leaders who are innovators; the funding provided will enable them to progress their pioneering ideas from basic science through to full deployment and commercialisation. As part of their appointment, the Chairs will develop a 'Centre of Excellence' in their area of emerging technology, building and maintaining contacts with industry and other partners to accelerate commercialisation.

11 of the current Chairs in Emerging Technology responded to the survey, including nine of the cohort who started in 2018. The sample size means that quantitative analysis of their responses is not appropriate and this chapter, instead, reports more qualitatively upon their responses as current award participants. Three women and 16 men comprise the two recent cohorts in this scheme, of whom two thirds are of UK domicile. The awards are held at 14 different universities, all either Russell Group members or research-intensive in nature. Awards were gained on average 20 years post-PhD (range 9 to 32 years).

7.2. Experiences to date

Survey responses suggested that the awardees had been attracted to apply for a CiET award on the basis of its prestige as a scheme and the 10-year duration of funding and support provided. Only one respondent felt that the application process had been difficult, but several commented on certain physical limitations of the grant application system software (i.e. that it was somewhat unsophisticated in comparison with that of some other funders).

Almost all respondents were very positive about their experiences to date, albeit all are in the very early years of their award. In particular they reflected upon the apparent flexibility available to them in use of the funding and, especially, their very positive engagement with the RAEng through the programme manager. All reported they were receiving mentoring through the scheme, and around half reported that to date it was proving very valuable (the remainder that it was too early to say). The appointment of a mentor from industry rather than academia was reported, in two cases, to be particularly helpful.

Perhaps unsurprisingly at these early stages of a 10-year award, respondents felt that its duration would be about right, although one cautioned that the ambition of the award was to create great momentum which if successful would require support beyond the award. On the other hand, not all were sanguine about the extent of funding. Six of the nine 2018 awardees

believed the funding was not great enough, exacerbated by their awareness of the significantly greater funding (essentially double) that was granted to those in the second cohort. The most common comment within the 2018 cohort was that they felt they lacked research funds and/or that the top-up funds available could be larger. For example, they felt that more research funding could enable them to employ more research staff who could give them a stronger and faster start. One respondent, who had obtained supplementary grant funding, argued that this could be achieved by greater flexibility in the award, i.e. decreasing the extent to which it funded his own employment and diverting more to research funds. It was generally felt that these perceived shortcomings had been rectified in the second funding round.

It is clearly too early to assess outcomes and impacts from these awards, but many of these respondents reported outputs already that would be seen as highly desirable in the context of the scheme. Most prominent was the catalytic effect they felt the award was having on their ability to attract other funding:

“The Chair has elevated my reputation, opened doors, and been a firm rock upon which to build large research proposals. It has given research proposal reviewers more confidence in the capability of the holder to deliver what they propose. This has helped increase grant income and research” (current CiET)

“The Chair has given me freedom to lead large research grants, a large research group and to engage in more industrial engagement and initial commercialisation. This would be impossible without the award” (current CiET)

“Having 10 years underpinning funding has already enabled me to increase my research activity by 50% in terms of researchers and support staff, which has resulted in over £600k in new industrial funding, £1m in new grants and established key international interactions. These new interactions are already yielding new technology and results in key publications” (current CiET)

In answer to a separate question, all but two of these respondents felt that the award had enabled them to develop a self-sustaining group, through the ability they now had to secure other income. They also suggested that they felt the prestige of the RAEng award was very valuable towards this end. The opportunity to put together a highly ambitious plan and have the time and freedom to concentrate solely upon it was clearly giving confidence to them:

“It is probably too early to tell the direct impact of the CiET, but I believe I am rapidly gaining an internationally leading reputation in a new field which is likely to dominate [field] for the next 5 to 10 years” (current CiET)

“It has enabled me to put together a really ambitious research plan that has the potential to change the landscape of [my field]. It has enabled me to crystallise my view for the area and assemble a group that works in an integrated way towards that goal. It has also forced me to focus all my effort on that vision” (current CiET)

Amongst other specific outputs reported were the development of patents or other IP assets (by half them already) and contributions to senior-level policy-making activity (again, about half of them), while almost all were engaged in significant public engagement and/or outreach activity. It will be valuable to revisit these awardees in future evaluation exercises, when it seems likely that a wide range of impacts will have been achieved by these individuals who have benefited from this prestigious and impressive scheme.

8. Overall findings and recommendations

8.1. Overall findings

Our evaluation of these RAEng research support programmes, including several of its key fellowship schemes, has revealed what seem to be overwhelmingly positive perceptions of the schemes by stakeholders, alumni and current awardees alike. Our mixed-methods approach to this evaluation has enabled a range of insights to be obtained about each of the main schemes, for which a range of key findings are summarised here.

The healthy response rate to the survey allowed some findings to be established on a quantitative basis despite the modest number of alumni (for any one scheme), while some results are based on information about and perceptions held by current awardees. Together they have been supplemented by qualitative research which confirms and illuminates many of the findings and has allowed for a selection of case studies to be generated (Appendix 1), while grant system information has enabled analysis of some trends in applications/awards. We are confident that together they provide reasonably robust findings given the relatively limited number of awardees who together provide much of the evidence base.

Below we present our overall findings within sections which correspond to the objectives of this evaluation. We have set these out in a way which takes each scheme in turn, noting the different positioning, purpose and operation of each fellowship.

8.1.1. Position of research programmes in the research funding landscape

All stakeholders we consulted perceived the Research Chairs and Senior Research Fellowship (RC/SRF) scheme to be amongst the most prestigious fellowship opportunities available in the UK to support senior engineering researchers. The direct engagement with an industrial partner makes it distinct from some other funding options. Further, the opportunities for engagement with the RAEng and to take advantage of mentoring were viewed as attractive additional features of the scheme, as was the possibility for those awarded a Senior Research Fellowship to upgrade it to a Research Chair once they become a Professor at their institution.

Stakeholders felt there was scope for work to widen access to the RC/SRF scheme, however, which is backed up by our analysis of a relatively concentrated pattern of award-making in terms of institutions (with a small number of institutions hosting nearly half of all awards). The success rate for applicants has historically been around 50%, so arguably these awards are not as competitive as could be hoped. We infer that some institutions are more aware of the scheme than others and more likely to apply for the funding (and confident that they might win it), while some stakeholders felt that other institutions could be put off by the requirement to secure industrial funding. They also expressed some concerns around whether the scheme is effective in supporting riskier and/or more interdisciplinary approaches or projects. Some further work to encourage a wider range of institutions to apply for this funding, and provide support for their applications, seems timely in this context.

Considering the Research Fellowships (RFs), although the model is similar to early-career schemes from other funders, stakeholders uniformly perceived this scheme to be a unique opportunity within the funding landscape for engineering researchers. It was viewed as a prestigious award which should facilitate transition to a permanent academic research position and act as an opportunity for the RAEng to identify the next generation of engineering research leaders and bring them into its community. Awardees confirmed the value of the additional support available, particularly the formal mentoring, along with opportunities for networking

within the RAEng community. Some stakeholders felt that RAEng should focus on creating further opportunities for awardees to network in order to develop a feeling of being a valued cohort within the wider engineering research community.

Despite the very positive perceptions of the scheme, stakeholders considered that awards in this scheme too were too heavily concentrated in certain research-intensive institutions, again backed up by the pattern of awards made. So, again, there is scope to widen access through more outreach work by the RAEng, to encourage applications from a wider variety of institutions and locations outside London and SE England. Most stakeholders with a view on this scheme indicated concerns that the value of the award should ideally be increased, acknowledging that some other, comparable, early-career awards were of higher financial value (not least as they commented the amount offered within the RF has not increased for many years). To some extent this was also felt by some awardees, although it did not emerge as a strong message. Whilst an increase in the award value would be ideal, we recognise that it would not be wise to increase this at the expense of the number of awards made, as the scheme works so well; rather the aspiration needs to be for increase in value and maintenance (or ideally increase) of the number of awards made, which is of course contingent upon greater total funding being available.

Stakeholders viewed the Industrial Fellowships (IF) scheme as a valuable opportunity for awardees to develop their industrial knowledge and experience, enhancing their teaching especially and providing a platform to develop effective industrial collaborations. It was expected that recent changes to increase the value, duration and flexibility of the scheme would increase its attractiveness. Some viewed it as a low-risk way of testing relationships between academics and industrial partners, although it is not necessarily currently transparent to awardees and partners that they should use the award to test their relationship in this way (i.e. to assure compatibility in order to start a programme of sustained collaborative research). In this respect the RAEng is playing a brokerage role in which it needs to ensure that awards fund academics to do work from which companies will benefit, while also ensuring that the awardee's academic institution also buys in to the overall benefits and provides sufficient support in terms of reduced teaching and administrative load.

8.1.2. Operation of research programmes – applications and experiences

For the RC/SRF scheme, there has been a recent increase in the total number of applications for the most recent round of funding, with twice as many applications as in previous rounds. There has also been a rise in the number of applicants at the SRF level of the scheme in particular. In terms of prior postdoctoral experience of successful applicants, those commencing a RC award had a mean of 18 years of post-doctoral experience, and those starting an SRF 11 years, suggesting that applicants are coming through with broadly the intended levels of experience or seniority.

The overwhelming majority of RC/SRF respondents reported very positive experiences of the scheme, that its duration had been appropriate and the amount of funding sufficient, although a minority expressed the view that a greater level of funding of research costs would have accelerated their progress. This also emerged from the experiences of current Chairs in Emerging Technologies. Of the 81% of RC/SRF respondents who indicated that they had undertaken mentoring during their award, three quarters found it valuable but 23% did not, although we do recognise that it may be challenging in all cases to provide appropriate mentors as some of these awardees are very established academics. Relatively few awardees had

encountered major difficulties during their award; most of these related to issues with the industrial partner, some of which may be inevitable in long-duration collaborations (i.e. changes in interests of the partner due to acquisition or strategy change, or the departure of a key staff member).

On the crucial question of that relationship with the industrial partner, the vast majority (96%) of RC/SRF respondents felt their experience of working with their industrial partner had been positive and that they had gained a deep level of understanding of its business and working culture. Nearly two thirds of those still in academia were still in contact with their industrial partner when surveyed and 80% had engaged in joint research since the award, indicating that sustained research collaborations were underway; as many as one third had set up a joint laboratory or research centre, catalysed by the award.

Based on levels of postdoctoral experience of awardees obtained here, the RF scheme is being implemented with its intended target focus, although several stakeholders felt that the range of both applicants and awardees displayed somewhat limited diversity. We are aware that several other early-career fellowship schemes are currently undertaking reviews of the diversity profile of eligible researchers, applicants and awardees; it could be timely to undertake such work for the RF scheme to ascertain whether the scheme application processes are as inclusive as they could be. Given the transformational aim of the scheme, the diversity of its awardees will be a key element in determining the future diversity of engineering research leaders in the UK.

The vast majority of RF respondents reported positive scheme experiences and that the duration of the scheme was about right for their needs. This is perhaps slightly surprising as some competitors are offering longer durations, mostly through established extension processes. Again, most respondents (88%) felt that the amount of funding was sufficient, although stakeholders and some more recent awardees believed that the level was not generous enough, perhaps again influenced by knowledge about other schemes. Most (81%) had received mentoring during their award and, again, around three quarters of these found it valuable, particularly in relation to supporting individuals' career progression. Around 1 in 5 respondents indicated that they had encountered major difficulties during their fellowship although these did not indicate common systemic issues, other than several cases where the institution was not fully releasing the awardee from teaching duties and also a desire expressed by some that there was not more support for their progress post-completion of the fellowship.

Interestingly, the profile of HE institutions at which IF awardees have been based is much more diverse (than those hosting RCs/SRFs or RFs), being less concentrated both geographically and in terms of institutional type. A minority of the awards are being made to those in the institutions which are dominant in the other schemes, presumably reflecting that the large research-intensive institutions may not see great value in secondment of its academics into industry. While the overall greater diversity of awardees (in terms of their institution) is welcome, given the powerful role that large research-intensives play in research overall, their lack of engagement with these awards could be to the detriment of engineering research as a whole, as this evaluation demonstrates that these awards play a catalytic effect in the development of use-inspired engineering teaching and research and, potentially, have long-term effect in terms of more impactful research activity.

The majority (80%) of IF respondents felt that, overall, they had had a very positive experience of the scheme, and all had recommended it to others, which is a very strong endorsement. Whilst 71% felt that the duration of the award had been about right, 27% felt it was not long

enough, although it should be noted that very few in this sample had undertaken awards as long as those that are now available. Two thirds believed the level of funding was sufficient but a significant proportion insufficient, with a particular message emerging about the potential benefit of having access to funding for research costs (in addition to employment costs). In parallel with the other schemes, a modest proportion of respondents reported significant difficulties or challenges during their fellowship, facing challenges with the time taken to get fully set up at the industrial partner, and/or difficulties getting access to its senior staff (issues which may ease with longer duration awards). Intellectual property problems were not widely reported.

In line with the other two main programmes, the majority (83%) of IF respondents felt the experience of working with their industrial partner had been very positive, while 73% thought that the secondment had enabled them to gain a good understanding of the partner's business and working culture. A significant minority felt that provision of mentoring would have been beneficial. A high proportion of IF alumni (88%) were still in contact with their industrial partner and over 80% had engaged in subsequent joint research with them, suggesting that sustained partnerships had been developed in most cases.

8.1.3. Impact on individuals' careers, engineering research and industry

Participants in the RC/SRF scheme suggested that the award had a significant, and in some cases transformational, long-term impact on their career, which could be key to their success as a senior research leader. Many reflected that it reinforced their ability to secure further funding, to improve research capacity at their institution and contribute to wider engineering policy. One third of respondents who had completed their award had been elected to Fellowship of the RAEng.

The vast majority of these respondents had developed a research group that could be sustained into the future and/or was world-leading, working on research that met the needs of the industrial partner. They had also been able to disseminate outcomes of that research for appropriate impact. In many cases these were long-term research and innovation programmes centred on key emerging technologies and they had built a strong network of industrial and other partners to facilitate commercialisation of that technology. All but four respondents (i.e. 93%) reported that they had won significant further research grants or funding, ranging from specific research grants to multi-million pound collaborative ventures. Some of the positive impacts of the awards on industry and engineering policy can be seen in the case studies in Appendix 1.

It seems clear from survey responses that RF awards are having the desired impact of enabling awardees to progress in their academic careers to positions of research independence. Over 95% believed that their fellowship had made a significant difference to their career path to date (82% agreeing strongly that this was the case). The opportunity that the fellowship afforded to establish independence in their research was rated as a very valuable aspect of the scheme by almost all respondents, as well as the chance to establish an international reputation and explore new directions in their research. Analysis of their first jobs following the fellowship revealed that some did immediately become a Professor, while others secured positions demonstrating progress in that direction (some of whom had later acquired professorial roles). Many felt that they might not have their current job and such a positive career without the fellowship and in some cases indicated that without it they could have moved in a different career direction altogether.

Despite the relatively short duration of an IF award (until recently), the perceived impact of the award on participants was perhaps surprisingly high. Almost all respondents felt that the award had impacted positively on the level of seniority they had reached (almost 60% agreeing strongly that this was the case), with around three quarters feeling it had made some difference to their career path, accelerating their progression and enhancing how they were perceived by senior colleagues. Many recent awardees were mid-career and either seeking progression to a full professor role or had recently achieved such progression; most believed the award was a contributory factor in such progression.

There was also strong evidence not only that the secondment enhanced the awardees' understanding of industry which contributed to more effective collaborations, but that sustained research collaborations were ensuing. A significant proportion of respondents (over 40%) had already developed a new product or new software by the time of survey. The impact of the awards on some of the industrial partners comes through in a number of the case studies in Appendix 1.

Overall, results obtained through the survey and interviews seems to provide strong evidence that for most awardees the desired career and research capacity impacts of all three of the major schemes are being achieved.

8.1.4. Impact on engineering and the profession

In addition to evidence about the positive impacts that all three of the major schemes are having on individual awardees' career progression, results from the survey and interviews do reveal a certain amount more about progression in academic engineering research. Overall, all three schemes appear to be delivering most of the career impacts that the individual awardees seek, at the different respective stages that the schemes target, and in that respect they are having much of the intended impact of sustaining or enhancing the academic research pipeline. There is also some evidence to suggest that the two schemes (RC/SRF and IF) which aim to develop and reinforce research collaborations with industry are effective, as sustained collaborations are being reported and some awardees indicate that the strategic direction of their research has shifted to being more industrially focused and use-inspired.

What is also clear, however, is that almost all the awardees remain on academic career tracks; there were very few instances where awardees had left academic positions to enter industry in a research role, although a few Research Chairs reported that they held a joint position. There was no evidence for intersectoral mobility the other way, i.e. that an awardee had left academia for industry and then at a later point returned (other than specifically within the context of an industrial secondment through the IF scheme). However, several Research Chairs indicated that industrial partners were supporting further doctoral and postdoctoral researchers, and that some of these people had entered the companies. The schemes are not currently designed to catalyse or lead to more substantial intersectoral mobility, and it may be that current research metrics do not encourage academic institutions to release talented researchers to undertake mobility which, in the long-term, would have benefit to engineering research as a whole. Without the existence of much mobility of that kind within the overall engineering research labour force, these schemes probably remain crucial in fostering positive industry-academic research collaborations.

Beyond the academic outputs and impacts, there was evidence that awardees had also made wider contributions during their fellowships. Around half of all those who participated in the RC/SRF scheme had undertaken significant public engagement or outreach activities and

made contributions to policy-making at senior level (e.g. national level). In leading their research groups, they had also trained numerous doctoral and postdoctoral researchers. Over half of those who had held a RF award had supervised other postdoctoral researchers, and again most had undertaken outreach or public engagement work, although their contributions to policy work were more limited as might be expected at this less senior stage.

For IF awardees, a major (and intended) outcome was on their teaching practice. Almost three quarters of respondents reported that they had enhanced their teaching through use of practical examples observed on secondment to their industrial partner, but there was also a high proportion who said the direction of their research had been impacted by their industrial experience and that it had helped them gain further research funding.

8.2. Future career tracking

In order for the RAEng to undertake ongoing career tracking of research programme participants and alumni, and further evaluative activity, we have considered options for a future engagement and research strategy. Options are constrained by the modest numbers of participants within each annual cohort and within any one scheme, bearing in mind that analysis is only really meaningful within the context of a single scheme (as opposed to analysis across all schemes in aggregate). The size of cohorts means that a systematic approach to longitudinal tracking is simply not feasible, and a more pragmatic approach is required.

There are essentially three groups of awardees to consider at any one time in future: those who were surveyed in the 2020 exercise reported here; those who have completed an award since this exercise but not undertaken a baseline survey (i.e. new cohorts of alumni); and those who are at that time current awardees. Pragmatically, we suggest that a baseline survey similar to the one we undertook here is implemented for the middle group, i.e. new alumni only, every 4-5 years. This instrument could also be targeted to alumni who were invited to participate in the 2020 survey but did not respond, in order to maximise the total extent of tracking and engagement. Running such a survey every 4-5 years should enable a large enough sample of alumni for reasonably robust analysis of their survey responses.

Potentially at the same time, we suggest that a parallel survey is undertaken of those who did not respond to the 2020 survey, essentially to update key aspects of what is known about them. This parallel survey would be broadly similar to the 2020 instrument but with certain sections removed (for example, questions about application to and experiences of the award, and basic demographic questions) while key questions in the sections on current employment and perceptions of impact should be maintained in order to obtain updated information and views. However, the number of open-ended questions could be reduced – or respondents invited only to write about what has changed since the 2020 survey – in order to minimise the burden on respondents.

What this strategy will require is some careful work on the database of awardees, to ensure that the correct survey is deployed to different sub-groups of awardees. In addition, some time will be needed during analysis of the 'update' survey responses to align these with existing response information (i.e. ensuring that the response is matched with existing information and to undertake tracking of a respondent's successive responses to questions about current role).

If that level of effort and attention is not considered possible by the RAEng, an alternative would be to invite all awardees to undertake a single survey similar to that in 2020 irrespective of whether they had responded before, although this is not a strategy we would advocate

because respondents will feel that they are duplicating effort in re-providing information that they have already supplied.

This strategy deliberately does not include current awardees, assuming that there will be existing engagement with them and that more robust views of experiences and especially perceptions of impact will be obtained from alumni rather than those part-way through a scheme (and in the knowledge that all will be included once they are alumni).

In order to support implementation of this type of ongoing tracking, as a separate document we are providing some comments on the instrument and questions used in the 2020 survey and how the data were analysed, to assist in development of future instruments and ensure that analysis of the future data obtained can be comparable with the existing data. In addition, we are providing the 2020 survey response data combined with the grant system data with which we were provided, as an integrated file, marked up based upon the consents given by respondents in the survey.

8.3. Recommendations

1. The first, high-level, recommendation is that all the main current research support programmes should be continued as, on the basis of the evidence obtained in this evaluative study, most awardees are achieving the intended objectives.
2. We do not recommend major changes to any of these schemes as they appear to remain largely fit-for-purpose and appropriate in terms of positioning in the research funding landscape for engineering in the UK.
3. We do not recommend substantial changes to the operation of the schemes as in the main they appear to be functioning effectively and the experiences of almost all awardees are reported as positive.
4. Given these high-level recommendations, the following lower-level issues emerge which should be considered as recommendations for possible enhancements or adjustments to specific schemes:
 - There would be benefit in further clarity in requirements for industrial partners within the IF and RC schemes, as some respondents report issues in relation to differences between their expectations and lived experiences of support from those partners;
 - In parallel, while most respondents report positive experiences, there is scope for revised guidance or greater clarity in the requirements of host HE institutions in relation to the support they offer RF and RC/SRF awardees (around release from teaching and administration loads and potentially more support as awardees progress at completion of the fellowship);
 - The extent to which RC and CiET awardees can access funding to cover research costs, including support for additional posts, should be reviewed to ascertain whether this could materially accelerate the progress made in early years of these awards (this also applies to IF awards in relation to modest additional research cost funding);
 - The total extent of funding of the RF award should be reviewed to ensure that costs of buying out time from the institution are fully covered and the scheme remains competitive within the range of early-career fellowships available;

- Given the current levels of competition for awards and the quality of applications, could consideration also be given to increasing the number of RF awards made?
 - There would be benefit in greater outreach and/or application support being offered in order to widen the range of institutions at which RC/SRF and RF awards are made (based on a review of applications);
 - We recommend consideration of undertaking a review of the inclusiveness of the application and award-making processes in relation to diversity, for the RF scheme in particular given its pivotal position in the research pipeline;
 - Additional promotion of success stories within the IF scheme, to industry in particular, could be beneficial as evidence suggests that few industrial partners are repeating their participation (contingent on review of applications);
 - The offer of mentoring is a clear success in most cases so further effort should be made to ensure that all awardees in all the main schemes can benefit from this support;
 - In parallel with other early-career fellowship schemes, consideration should be given to ways in which the RAEng and host institutions could support RF awardees approaching the end of their fellowship who have not yet secured progression to permanent employment;
 - Given the positive reported experiences of awardees' engagement with the RAEng, including their peers and other scheme awardees, exploration of potential additional opportunities to facilitate networking and cohort benefits would be valuable.
6. Finally, we recommend that further career tracking of scheme participants and alumni, together with periodic evaluation work, are undertaken on a planned and systematic basis, to build upon this initial study (for which we have provided some specific recommendations and guidance).

Appendix 1: Case Studies

Provided as a separate document.

Royal Academy of Engineering Research Programmes: Evaluation and Career Tracking

**Report by the Careers Research &
Advisory Centre (CRAC)**



**Published by the Careers Research & Advisory Centre (CRAC),
with support from the Institute of Employment Studies (IES)**

