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Evaluation of the SFI Discover Programme 2013-2017

Final report – 10 September 2018

1. Executive summary

This report is an evaluation of the SFI Discover Programme covering projects funded between 2013 and 2017. The review looked at the breadth, quality and reach of the funded portfolio as well as considering the funding process and value for money. Commentary from international experts provided a comparative context.

Overall, the Discover Programme main call funds a diverse portfolio of activities covering different audiences, regions, approaches, scales and types of activity. National coverage is good and succeeds in spreading beyond the large centres of population and academic research.

Higher education institutions predominate among grant-holders taking 41% of the grants and 34% of the grant money. Within this, universities dominate, with fewer applications and grants for institutes of technology.

The funded project portfolio compares well to other countries in terms of its breadth and intention, and particularly as a stable source of funding with significant opportunity for strategic influence. However, the Discover Programme tends to fund projects that have the underlying aim of promoting STEM. It is weaker in supporting engagement with underserved and under-represented groups and activities that create dialogue or empower citizens.

Projects are oriented more strongly towards science than engineering, though many also work across STEM.

Young people are often targets for projects, largely through formal education (59% of projects had a schools' component). Here, the STEM pipeline is a significant driver. Teacher CPD is also a feature of many projects.

Project quality and value for money are always difficult to gauge in programmes of this nature. The application process is effective in procuring and assessing well thought through proposals from competent and trusted applicants. Despite this, the challenges of reporting mean that assembling an accurate measure of either audience reach or total project cost has been almost impossible. Differences between projects make it very difficult to administrate consistent reporting formats for evaluation, audience reach or finances. This makes the picture in terms of project reach, cost, quality and impact unclear. Two factors are worth highlighting. Firstly, substantial volunteering and other in-kind support are essential, valued contributions to the Programme. However, these contributions are complex and varied which makes them challenging to quantify and account for. Secondly, broadcast projects offer the best value for money in terms of reach despite their high costs.

From interviews, it is clear that the Republic of Ireland has generally good networks and that there is an appetite to strengthen this.

In addition to the recommendations summarised below and given in full at the end of this report, this work has generated a logic model for the Discover Programme (appendix 2). This model takes into account the Programme's aims, funded project portfolio and any gaps and disjunctions. It provides a framework that links activities, intermediate

(measurable) outcomes and longer term goals which can be used to assess individual projects and the programme as a whole.

Summary of recommendations:

Discover Programme aims

- Address the minor, but important misalignment between Discover Programme aims and funded projects to better encompass STEM training/careers and EPE capacity.
- Encourage more projects that create debate, dialogue and critical engagement with STEM.
- Increase the emphasis on engineering-related projects.
- Be clearer about priority audiences and why it is important to put additional effort into targeting their engagement. Be more forceful in ensuring equity of access to STEM, not just for the groups currently identified but for older adults, people with disabilities and ethnic minority groups. This may also need to extend to other groups such as first language Irish speakers.

Funding process

- Support more Institutes of Technology to apply. Institutes of Technology have the potential to increase reach into underserved areas but are currently underrepresented.
- Strengthen the mechanisms for funding projects aimed at priority audiences.
- Clarify expectations around the role of volunteer time vs paid time.
- Improve end of grant reporting to make it more useful for fund holders and SFI.

Supporting funded projects

- Ensure that requested changes to proposals are implemented.
- Offer improved support for evaluation. Make sure objectives and evaluation metrics align and there is some consideration of intended impacts.
- See projects in action. Grant holders would really value visits from the funders.

Networking

- Offer more networking opportunities. Past and present fund holders really appreciate the national networking opportunities but would like more of them to take place outside of Dublin.
- Create more strategic links with industry.
- Offer more networking/best practice sharing between funded projects and formal education including teachers, teacher trainers and educational researchers.
- Improve connections to community organisations that work with underserved and underrepresented groups.
- Disseminate the latest theories and knowledge base, for example through webinars or during networking meetings.

Joining up with other strategic initiatives

- Join up with other organisations' strategic initiatives with a view to coordinating some support.
- Consider how to reward and recognise the best projects, especially for HEIs.

Contents

1. Project background

Science Foundation Ireland (SFI) is the national funding agency for investment in research in science, technology, engineering and maths (STEM) in the Republic of Ireland. SFI's remit is to fund oriented and basic applied research in STEM.

Public engagement is also central to its mission- one of SFI's strategic aims is to "have the most engaged and scientifically informed public".

SFI's education and public engagement (EPE) team supports this through its aim to 'catalyse, inspire and guide the best in STEM Education and Public Engagement.'

The SFI EPE programme can be broken down into three strands:

- The Discover Programme which seeks to promote awareness and engagement of the Irish public with science, technology, engineering and maths.
- Three directly managed programmes, namely
    - Science Week- annual event to promote science with over 1,000 events nationwide
    - Smart Futures- promotes and provides information about careers in STEM. Includes a volunteering programme though which STEM professionals can offer their time to support careers activities in schools
    - Discover Primary Science and Maths- comprises teacher training workshops and resources. It offers an accreditation scheme for activity providers and an excellence award for primary schools.
- Guiding and catalysing EPE activity and capacity in the SFI Research Community, in particular the SFI funded Research Centres, of which there are currently 17 in operation.

The Discover Programme has been running in its current form since 2013 and was acquired from another government-funded organisation following a restructure. Since then, the scheme has been developed and refined. The programme awards approximately €3.5 million annually, spread over approximately 35-50 projects a year. The Discover Programme also has two sub-schemes in addition to its main annual funding call:

- A partnership with national broadcaster RTE which supports documentaries and other programming with a STEM focus to be broadcast on national TV. This aims to weave STEM into the fabric of the programming rather than support explicit science programming in order to reach audiences not otherwise served by EPE activities.
- Science Week call to fund festivals and events specifically as part of Science Week which takes place in November each year.

The Discover Programme publishes an annual competitive funding call, and funding is awarded following an international peer review process. The programme has a broad ranging brief including film projects which are not eligible or appropriate for the RTE partnership scheme, STEM festivals, STEM activities for non-STEM festivals, afterschool clubs, and teacher CPD courses, among others. Funding is open to any organisation but excludes individuals or sole traders.

The objectives of the Discover Programme are to:

- Stimulate interest, excitement, and debate about STEM through various methods
- Support formal and informal learning within STEM
- Promote awareness and understanding of the importance and relevance of STEM to everyday life, reaching new audiences not normally engaged with STEM, as well as continuing to support existing audiences
- Encourage new ways of thinking about STEM
- Encourage high-quality inter-disciplinary practice and collaborative partnerships
- Investigate and test new methods of engagement, participation and education
- Leverage, support and broaden, where possible, existing programmes

1.1 Context

Other funding schemes

Applicants from the Republic of Ireland are eligible to apply for funding from the Wellcome Trust, but there are no other significant national funding schemes for STEM public engagement.

Other sources of public engagement activity

SFI research centres

In addition to grant funded research, SFI funds 17 research centres to undertake research in strategically important areas such as health, manufacturing and geosciences. Their funding requirements include education and public engagement. They are required to have their own public engagement strategy and related Key Performance Indicators with the expectation of a dedicated member of EPE staff. As a result of this, there is a growing number of applications for both activity and research in EPE areas from the greater SFI research portfolio. SFI research grant applicants are encouraged to include EPE in their proposals, but it is not currently required by SFI or in research grants from any of the other public research funders.

Campus Engage

Campus Engage, a national network of 18 higher education institutions (HEIs) dedicated to promoting civic and community engagement with higher education facilitates public engagement in universities. Campus Engage defines civic engagement as:

"A mutually beneficial knowledge-based collaboration between the higher education institution with the wider community, through community-campus partnerships including the activities of community- based learning, community engaged research, volunteering, community/economic regeneration, capacity-building and access/widening participation"

In 2017, Campus Engage published a framework for engaged research which has some overlap with the Discover Programme, however the framework report itself notes that there is currently a lack of leadership with respect to engaged research in Irish HEIs.

Health Research Board

The Health Research Board (HRB) is a state agency that supports research and provides evidence to prevent illness, improve health and transform patient care. The organisation manages a research investment portfolio of approximately €200m.

They have a Knowledge Exchange Dissemination Scheme (KEDS) open to invited PIs on existing grants. KEDS offers supplementary funding to support knowledge exchange activities for knowledge users and dissemination activities for publics to maximise the potential impact of the research findings on policy or practice, or communicate research and research findings to the general public.

HRB is also piloting the introduction of more Public and Patient Involvement (PPI) into their own application review processes and into funded grants via PPI Ignite awards which support capacity development. Five projects were funded through the first round of PPI Ignite awards in 2017.

2. About this evaluation

The purpose of this evaluation is to review the portfolio of projects funded via the Discover Programme between its inception in 2013 and 2017 in order to appraise the quality and value of what has been funded, alignment to project aims and the effectiveness of any related structures and support. The evaluation covers the main Discover Programme annual grant call. It does not include the Strategic Partnership projects from 2013, the Science Week calls, projects supported via the RTE agreement, opportunistic funding or any predecessors to the SFI Discover Programme.

Through this process, SFI also wish to compare the Discover Programme to best practice internationally and generate recommendations that can be used to improve the programme going forward.

3. Methodology

A mixed methodology was used that included desk research, systematic analysis of sources such as project reports, interviews with project leads, and consultation with both international and national figures. We analysed the programme against the following criteria:

- National reach
  - What is the geographical distribution of projects, how does this compare to the programme aims
- Distribution of funding
  - What types of organisation were awarded funding, what proportion of the funding went to different project types
- Target audiences
  - Who are the target audiences, what proportions of projects target each audience
- Impacts and outcomes
  - What are the impacts and outcomes from the projects, do these relate to the objectives
- Networks and partnerships
  - To what extent have these been utilised in delivery of the programme, what types of partnership exist
- Costs and value for money

- What are the average costs of projects, do some types of project represent better or worse value for money

3.1 Data sources

Both quantitative and qualitative methods have been used to offer an extensive and thorough view of the Discover Programme.

SFI provided Discover Programme funded project documentation in the form of a spreadsheet with details of 197 projects offered funding between 2013 and 2017 and 139 grant holder project reports. Of these reports, 117 were end of grant reports and 22 were interim reports. In 2016, two projects declined grants leaving a total of 195 relevant projects for this analysis. No reports were available for 25 of the 164 projects from the 2013-2016 funding rounds for reasons including No Cost Extensions and project cancellations.

Year	**Funded projects listed**	**Reports received**	**Notes**
2013	37	34	7 interim reports, 27 final reports
2014	43	38	3 interim reports, 35 final reports
2015	42	37	3 interim reports, 34 final reports
2016	42	30	7 interim reports, 23 final reports. Two-year long projects had not yet reported
2017	31	N/A	2017 grants had not yet reported.

As well as analysing the final reports of funded projects, unsuccessful projects' information, templates such as online survey questions, and documents such as guidelines for applicants and the evaluation toolkit published by SFI have all been considered and reviewed.

We interviewed project leads from a range of funded projects, including from different organisation types, projects that were funded for one year or repeat years, and projects that were funded towards the beginning of our timescale and more recently. Lead questions included asking about their experiences of the funding process, opportunities the programme has created, and whether they feel anything is lacking from the programme. In total we conducted 11 such interviews.

In order to consider how the Discover Programme performs against SFI's aim of having one of the most engaged and scientifically informed publics, experts based in comparable locations around Europe and the world were consulted to gather their thoughts and comparisons with similar schemes or programmes they are familiar with. Informal conversations were also had with two contacts working within the Irish HEI and education and public engagement sectors to inform and offer thoughts on the wider sector in Ireland. Our international consultants were:

Maria Xanthoudaki- Head of Education and the Centre for Research in Informal Education, Museo Nazionale della Scienza e della Tecnologia Leonardo da Vinci

Didier Laval- Public Engagement Associate, Elizabeth Blackwell Institute, University of Bristol. Previously Head of Public Engagement at Cap Sciences, Bordeaux, and International Projects Manager at Ecsite

Ana Godinho- Head of Education, Communications and Outreach, CERN

Angela Monasor- Director, 'Somos Cientificos, sácanos de aquí!'; Director, Kialo Comunicación y Divulgación Innovadora; Co-funder & collaborator, Escuelab; Co-director, Ciencia Volando

Jean Fleming- Professor Emerita in Science Communication, University of Otago

Graphic Science provided a UK perspective.

4. Evaluation findings

4.1 Distribution of funding

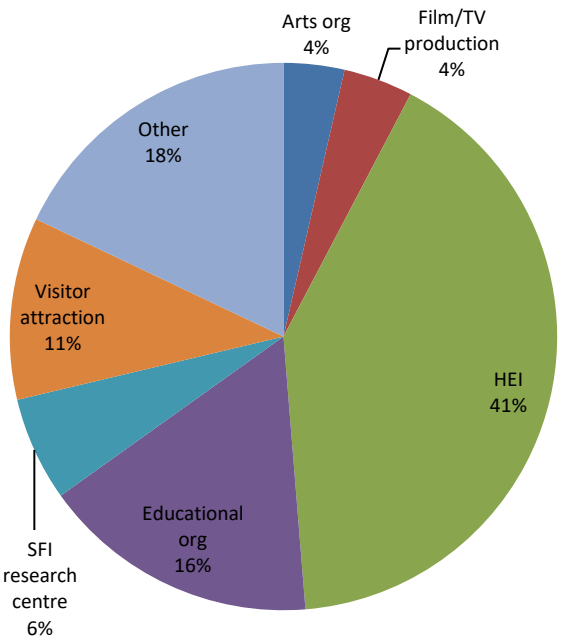
In order to analyse what types of organisation receive grants, grant holders were categorised based on their organisation's core business.

The following types of organisations were identified as grant holders:

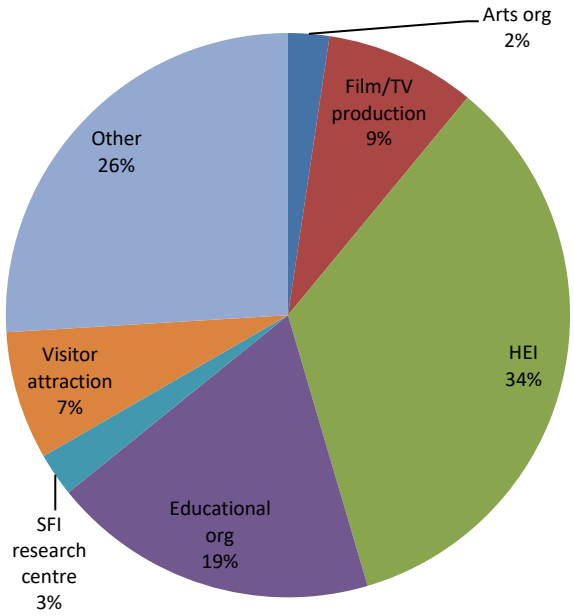
- HEI/3rd level institutions (SFI research centres were categorised separately)
- Arts organisations – this included theatre, dance and organisations that encourage artistic practice. However, art galleries, including those based at HEIs, were categorised as visitor attractions.
- Community organisations excluding youth organisations
- Local councils – three councils have held Discover grants - Cork City Council, Mayo County Council and Dun Laoghaire Rathdown County Council.
- Film/TV production companies
- Independent educational organisation –organisations with a primarily educational mission outside of compulsory and 3rd level education including private companies, e.g. Galway Education Centre, Kildare Education Centre, ECDL Ireland/ICS Skills.
- Industry – any commercial organisations whose mission is not primarily educational
- Professional bodies – networks and organisations that support the professions e.g. Royal Society of Chemistry Ireland; Cork Electronics Industry Association
- SFI research centres
- Visitor attractions – includes museums, art galleries and science centres
- Youth organisations – organisations for young people whose mission is not primarily educational.
- Other

In order to simplify the analysis the data below distinguishes only the largest recipients of funding which are: HEIs, independent educational organisations, TV production companies, visitor attractions, SFI research centres and arts organisations.

Funded organisations: Grant distribution by number of grants



Funded organisations: Grant distribution by grant amount



HEIs are the largest grant recipients both in terms of number of grants and amount of funding awarded. However, compared to all other types of organisation, they receive proportionately less of the funding money, indicating HEIs run a greater number of smaller projects than other types of organisations, most notably production companies, who might run fewer, more expensive projects. However, in general, distribution of numbers of grants and amount of money granted is fairly similar.

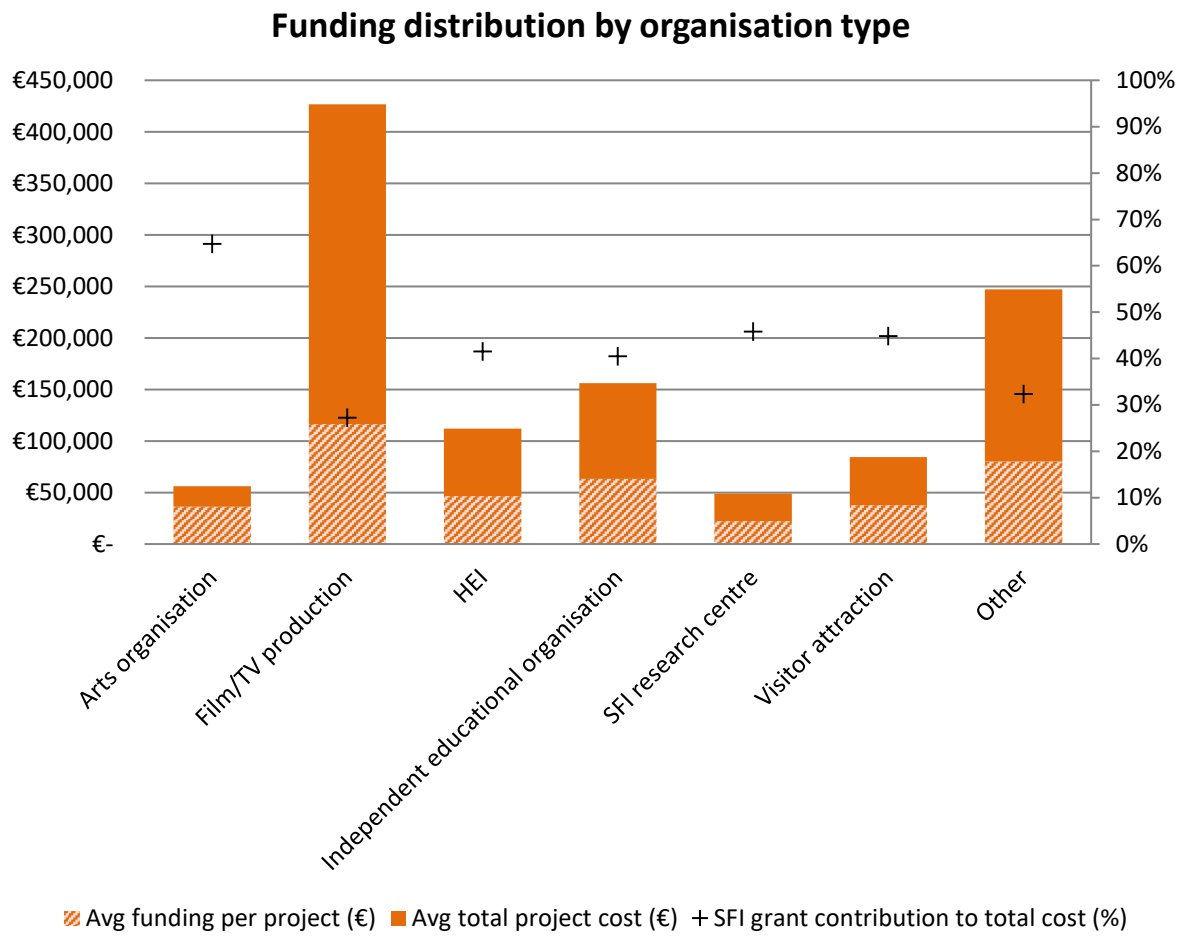
4.2 Discover grant contribution to full project costs

Discover grants contribute a varying proportion of the total project cost.

Based on projected costs given by applicants at the point of application TV productions generally have the highest overall cost and also attract the largest amount of grant funding for each project. However, the SFI Discover grant contributes the lowest proportion of total project cost from all funded organisation types (27%).

Arts projects have some of the lowest overall costs for all funded projects, but have the highest proportion of their costs supported through Discover grants (65%).

Most other organisations have a similar ratio of Discover funding to overall project cost ranging from 40 to 46%.



However, although these figures represent best estimates in terms of per capita costs and give an indication of value, they need to be viewed with some caution.

The challenges of evaluating value for money for projects of this nature are widely acknowledged. Impact is almost impossible to quantify and there is no easy way to compare a project that had a profound impact on a small number of participants with one which had a superficial effect for a much larger number of people.

In addition, reporting is not straight forward. Putting aside that some grant holders are more adept at reporting than others, there is no simple way to account for volunteer and in-kind support; projects that contribute to large events struggle to quantify their reach; and anticipated project costs and actual project costs can be very different, for example where multiple sources of funding are involved.

These challenges are reflected in grant reporting. Review of the financial reporting from a sample of end of grant reports showed considerable discrepancies and substantial differences in total project costs from what was originally projected. It is acknowledged that Discover grants do need some amount of flexibility, for example where other financial sponsors are not successfully secured. Overall, financial reporting was inconsistent between years and between projects.

For example: it was not uncommon for total project spend to be given as two different values within the same report; A number of reports gave a total grant spend that was

higher than the value of the grant (in the sample of reports we scrutinised, this ranged from €1 to €1,277); Recording of in-kind contributions was highly variable – one grant holder we interviewed described providing substantial in-kind support, but this is absent from their end of project report. Some reports omitted any record of in-kind contributions.

Within the sample of reports we looked at in detail, there were a number where total project cost was substantially different from what was originally proposed. For some, costs were in excess of what they had originally proposed; more commonly, projects reported much lower costs than originally proposed.

The SFI EPE team have made iterative changes to address some of these issues and make the financial reporting more accurate. Recent changes as a result of an audit are beyond the scope of this evaluation as they had not taken effect for reports included in the evaluation timescale. It is possible that these changes represent a major improvement. However, based on the reports we have looked at, we advise a whole-sale rethink of reporting, taking into consideration grant-holder and SFI needs while making sure that requirements are proportionate to the scale of the Discover Programme.

4.3 Funding to HEIs

- All Irish universities have received funding.
- Nearly half of all funding to HEIs goes to institutions based in Dublin.
- Just 6 of the 14 Institutes of Technology have received funding – note that:
  - Of the six funded Institutes of Technology, three are in major centres of population which also have universities (Dublin, Cork, Limerick)
  - Letterkenny Institute of Technology and Galway-Mayo Institute of Technology have applied for funding once, but were unsuccessful.

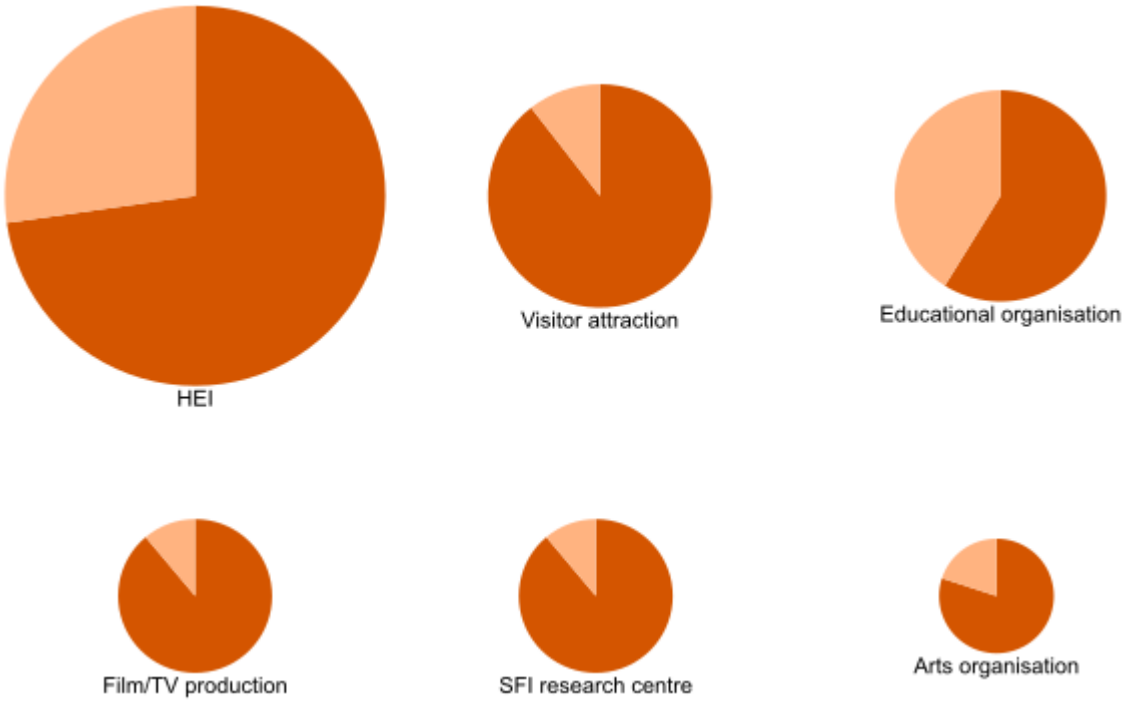
HEI name	Number of grants	Total grant funding
University College Dublin (UCD)	15	€ 535,708
Dublin City University (DCU)	10	€ 665,597
Waterford Institute of Technology (WIT)	10	€ 605,162
Trinity College Dublin (TCD)	9	€ 451,356
National University of Ireland Galway (NUIG)	8	€ 385,782
National University of Ireland Maynooth (NUIM)	8	€ 216,026
University College Cork (UCC)	4	€ 86,260
University of Limerick (UL)	4	€ 394,053
Tyndall National Institute (TNI), UCC	3	€ 122,674
Cork Institute of Technology (CIT)	2	€ 230,384
Dublin Institute of Technology (DIT)	2	€ 89,000
National College of Ireland (NCI)	2	€ 41,500

Institute of Technology, Sligo	1	€ 10,000
Institute of Technology, Tallaght	1	€ 49,211
Irish Universities Association	1	€ 33,998
Limerick Institute of Technology (LIT)	1	€ 34,294
Royal College of Surgeons in Ireland (RCSI)	1	€ 4,885

4.4 Repeat funded projects

Between 2013 and 2017, the 195 SFI Discover grants considered in this review supported 134 different projects. Of these 35 (26%) have been funded more than once (see appendix 1).

The proportion of repeat funded project varies according to type of organisation, ranging from 41% of projects from independent educational organisations to 11% from visitor centres, SFI research centres and TV production companies. Of projects originating from HEIs, 27% were funded more than once.



REPEAT FUNDED PROJECTS: AREA OF CIRCLE REPRESENTS THE RELATIVE NUMBER OF PROJECTS FUNDED IN TOTAL. THE PALE PORTION REPRESENTS THE PROPORTION OF PROJECTS THAT WERE FUNDED MORE THAN ONCE.

Just over half (53%) of all funding has gone to projects funded more than once. Repeat funded projects tend to have slightly higher costs than one-off projects and a slightly higher grant amount. However, grants make up a slightly lower proportion of their overall project cost (35% vs 40%).

The funding ratio of repeat to one-off projects has been broadly consistent for each year of the Discover Programme.

	Total SFI funding awarded	Avg. grant size	Total project cost	Avg. project cost
Repeat funded projects	€ 5,691,286	€ 59,908	€ 16,075,739	€ 174,736
One-off projects	€ 5,096,708	€ 51,482	€ 12,685,090	€ 136,399

4.5 Types of activity funded

In order to understand what types of activities were being funded and with what aims, we categorised each project where an interim or final report was available (139 reports in total) using information in the reports.

The style and content of the reports varied widely and was not necessarily a comprehensive catalogue of project outputs. Some projects also included a large portfolio of activities and in these cases only selected key activities are represented in this analysis. This means that where data is quantified, it is indicative rather than absolute and care needs to be taken to avoid over-interpretation.

Types of activity

Discover funds a wide variety of different types of activity from arts exhibitions to activities in schools. Many are traditional engagement activities such as STEM fairs and schools' workshops. Some projects are imports of tried and tested formats, often originating in the UK. Others are original projects developed in Ireland.

Grants often support projects comprising multiple activities. Some are a portfolio of separate activities that have similar importance to the project; others deliver a core activity with associated satellite activities such as the production of an art exhibition, with associated talks or workshops, or the production of resources for use in schools and associated training for teachers on how to use the resources.

Schools' workshops and classroom activities were the most frequent type of activity featuring in 28% of grant proposals.

Discover grants also support a large number of festivals and festival events – over 20% of funded projects fell into this category. Note that projects could fall into multiple categories, so a STEM festival project might also be counted in workshops, talks etc.

Online resources featured in many projects, but were rarely the main project output.

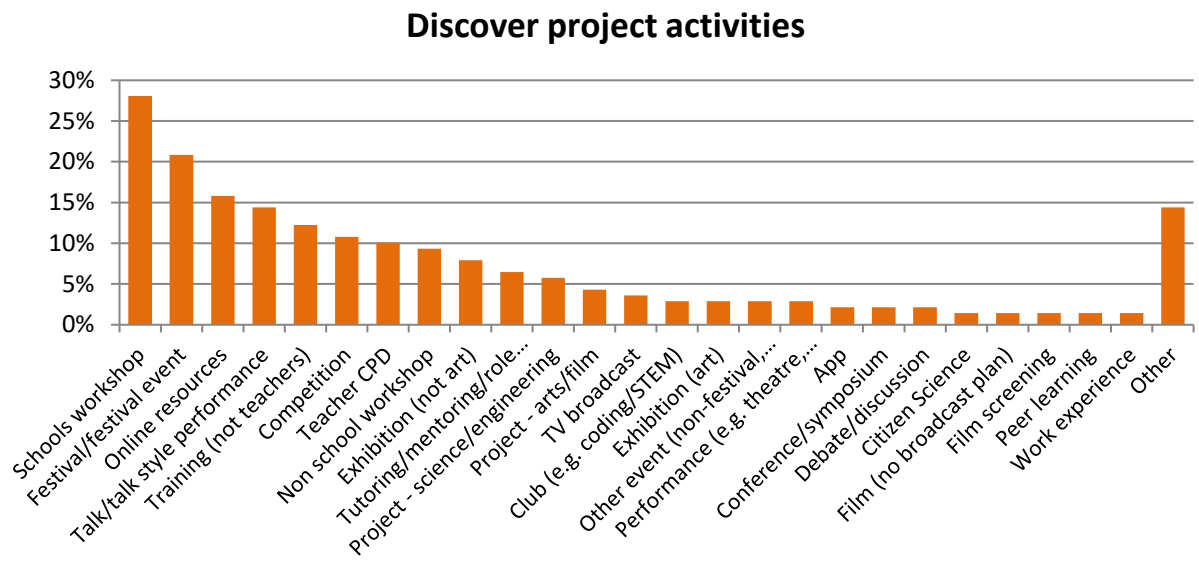
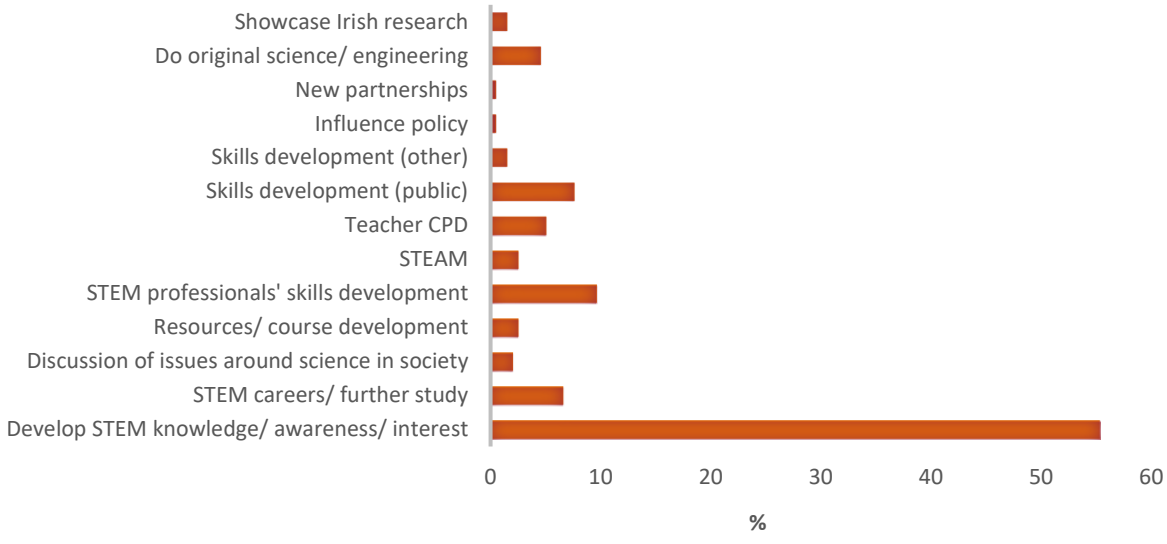


CHART SHOWING THE TYPES OF ACTIVITIES REPRESENTED IN DISCOVER FUNDED PROJECTS. NOTE THAT PROJECTS WITH MULTIPLE ACTIVITIES WILL COUNT IN MORE THAN ONE CATEGORY.

Activity aims

Our categorisation also identified a range of purposes for offering engagement activities. This identified a range of different aims for activities, some of which were more prominent than others. 'Do original science/ engineering' includes activities such as citizen science, Primary Science Fair projects and First Lego League.



PURPOSES OF PROJECT ACTIVITIES

Promoting STEM

Aims were strongly framed around ideas of promoting STEM by developing knowledge, interest, and enthusiasm. 65% of all projects had some kind of promotional aim. Reports often talked in terms of helping people to understand the "importance" of STEM or a specific STEM-related topic.

> *"The overall aim is to promote STEM amongst all ages and all people, through a series of high quality educational and engaging events, with emphasis on the importance of STEM in life and in careers."*
> *End of project report*

> *"Using the extensive knowledge, talents and connections of our network [to] raise the profile, understanding and impact of STEM among diverse audiences and further highlight the importance of science within an Irish and global context;"*
> *End of project report*

> *"…promote awareness and understanding of the importance and relevance of STEM to everyday life to share with general public."*
> *End of project report*

In a number of cases, the purpose of the activity was to bring a science presence to another event, activity or festival where you would not typically find it.

The role of science in society

Fewer projects described any part of their project or programme of activities in terms of debate or discussion about STEM-related issues – around a quarter of projects mention some kind of discussion or debate as part of their activities; around 13% of projects have this as an important feature and around 5% as a primary aim.

STEM careers

Another common aim was promotion/increasing awareness of STEM study and careers. Associated with this were projects that aimed to raise aspirations, particularly for girls and young people from poorer socioeconomic backgrounds. Over a third of projects talked about STEM careers – more than 85% of these were projects that also worked with schools.

STEM projects

A small proportion of grants (around 6%) funded projects that enable participants to undertake their own STEM project or investigation; three quarters of these are aimed at schools. Although these are relatively few in number, they offer national coverage and are available at primary and second levels. One interviewee reported anecdotally that most schools would offer their students the opportunity to participate in one of the national science fairs.

Skills development

Grants supported a variety of projects that provided skills development. The main audiences for this were teachers and university scientists, but there were also opportunities for other types of adults and young people, as well as youth workers.

Teacher CPD

More than 12% of projects aimed at schools include a teacher CPD component. In addition to this, there were four projects which included teacher CPD, but had no classroom-facing activity – two of these were exclusively teacher CPD programmes for primary school teachers and the other was Physics Busking (funded four times) where the training was open to teachers, but not exclusively aimed at them.

Although the two CPD-only projects were both aimed at primary level teachers, more teacher CPD was available to second level than primary teachers. Half of the teacher CPD within projects was aimed exclusively at post-primary teachers.

Teacher CPD generally focused on the latest science and technology. Much of it was about developing teachers' skills and confidence, for example with new teaching approaches.

However, despite the large number of projects aimed at schools, there seems to be a lack of awareness of inquiry based pedagogies - inquiry based science education (IBSE) is mentioned in just two reports.

Training for scientists/researchers

Skills development for scientists and or undergraduates featured in 15 projects and a further project focused on capacity development for university engagement.

In three of these projects, the main purpose was to turn scientists into more engaging presenters by training them to deliver a presentation about their science in a specific format for a general, adult audience in a one-off competition performance. These projects are often aimed specifically at PhD students and early career scientists. Although the audience is part of the framing for these activities, they are of relatively low significance in terms of the overall project. These programmes invest most of their efforts into supporting researchers to become better at talking about their own work. The public audience response is used as a test of success and it is therefore important that they have a positive experience, but the project's intended impact on them is relatively insignificant.

The remainder of the projects are split roughly evenly between scientist as transmitter of knowledge and scientist as collaborator, both in the context of larger projects with broader aims. In the former, scientists, including undergraduates and PhD students are given training in how to deliver activities such as busking and workshops. They are then expected to contribute to these activities on an ongoing basis where their skills will continue to develop. In the latter, scientists are mixed with a variety of collaborators, all of whom bring their own knowledge and expertise and learn from each other.

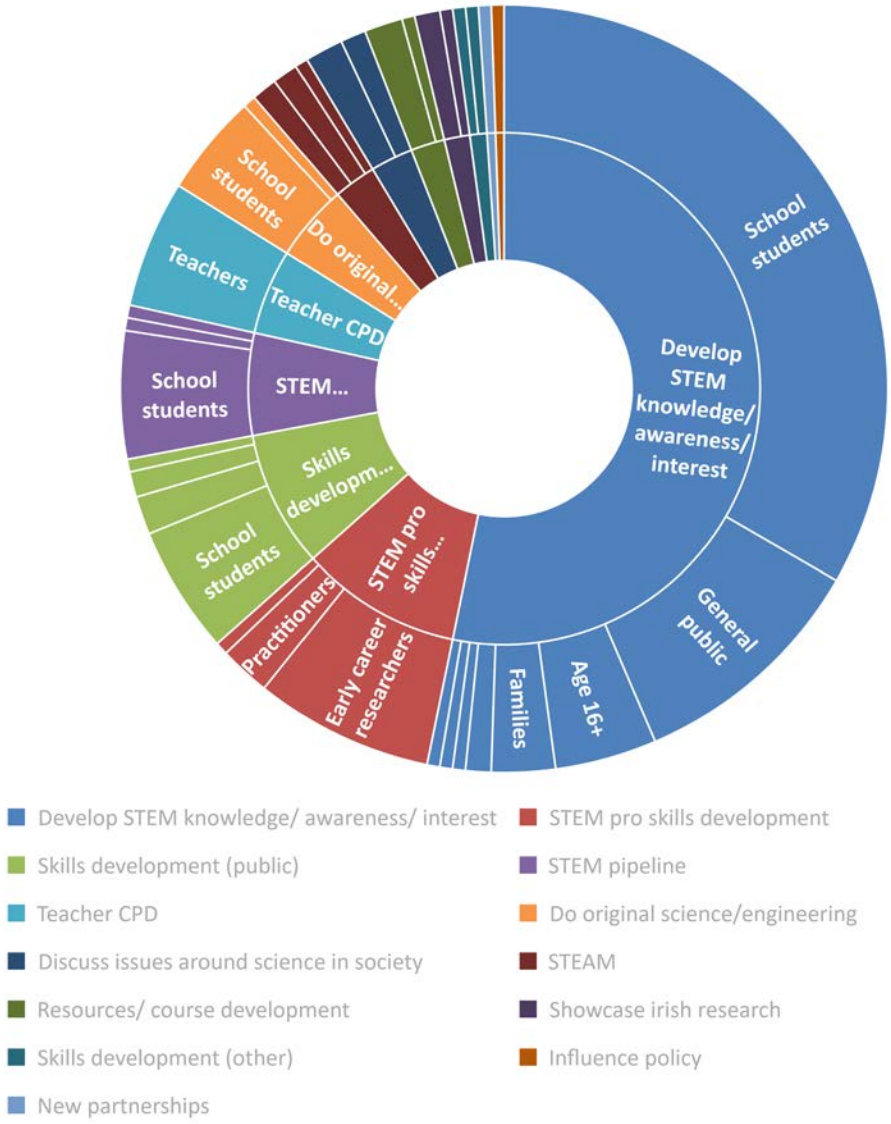
Other project aims

The majority of projects involve one or more of the aims described above. Less frequent aims are:

- Influence policy
- Learn about scientific process
- Build networks
- Creative collaborations

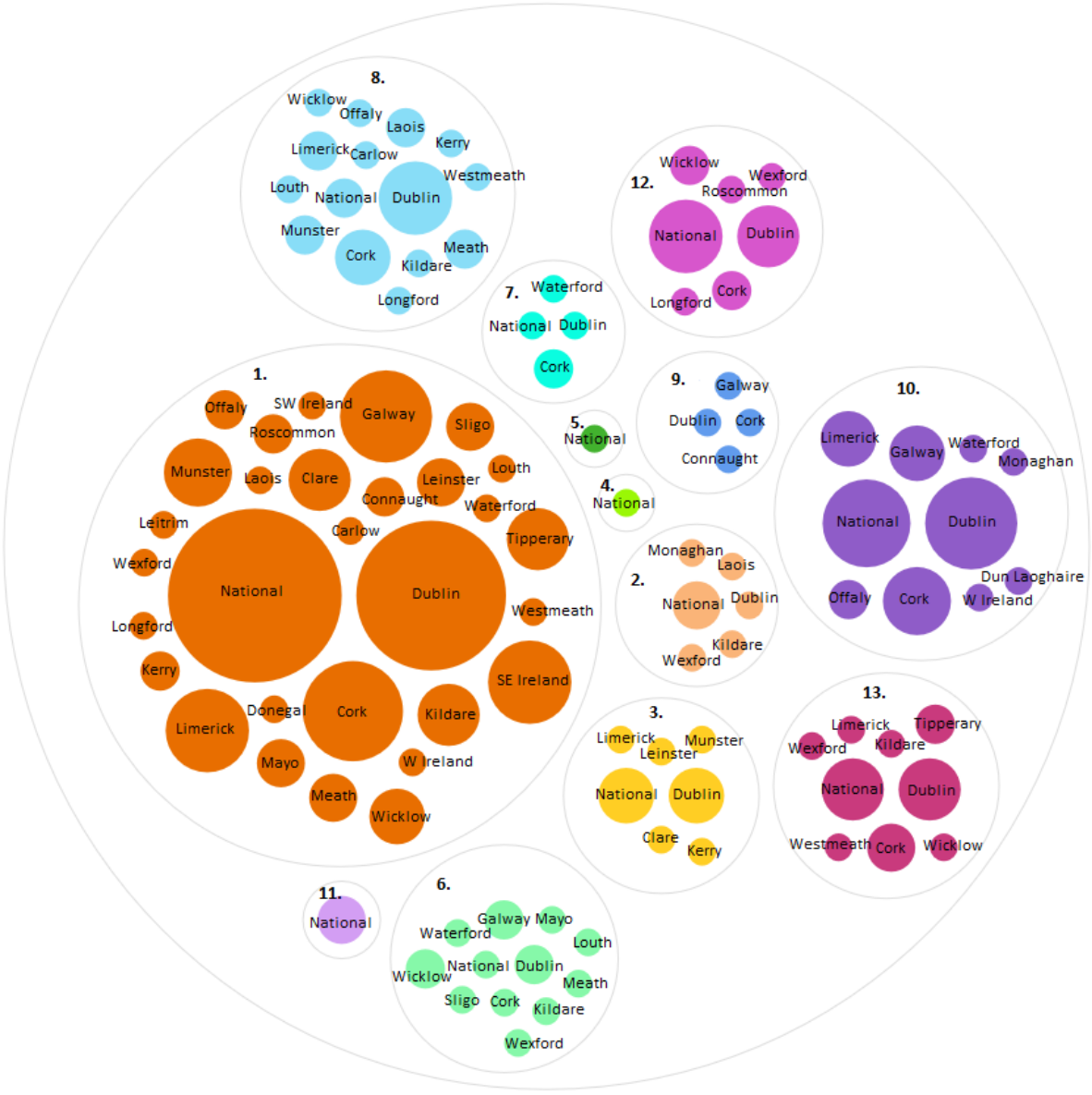
Different activities for different audiences

Almost all types of activity target school students as the most common target audience, excluding categories such as teacher CPD and STEM professionals' skills development. An interesting difference to this is STEAM (STEM with arts/making) - based activities, where school students make up 40% of the target audiences, and there are just as many projects targeting the general public as school students.



"Do original science/ engineering" includes activities such as citizen science and First Lego League.

Certain locations offer different types of activity, and some types of activity are only offered in certain areas, or as part of national projects. The visualisation below shows how activities aiming to develop STEM knowledge/ awareness/ interest are available widely across the country, but STEAM activities are mainly concentrated in larger metropolitan areas, for example.



KEY

1. Develop STEM knowledge/ awareness/ interest

2. Discussion of issues around science in society

3. Do original science/ engineering

4. Influence policy

5.Develop networks/ partnerships

6. Resources/ course development

7. STEAM

8. STEM careers/ further study

9. Showcase Irish research

10. STEM professionals' skills development

11. Skills development (other)

12. Skills development (public)

13. Teacher CPD

Alignment between activities and SFI Discover Programme aims

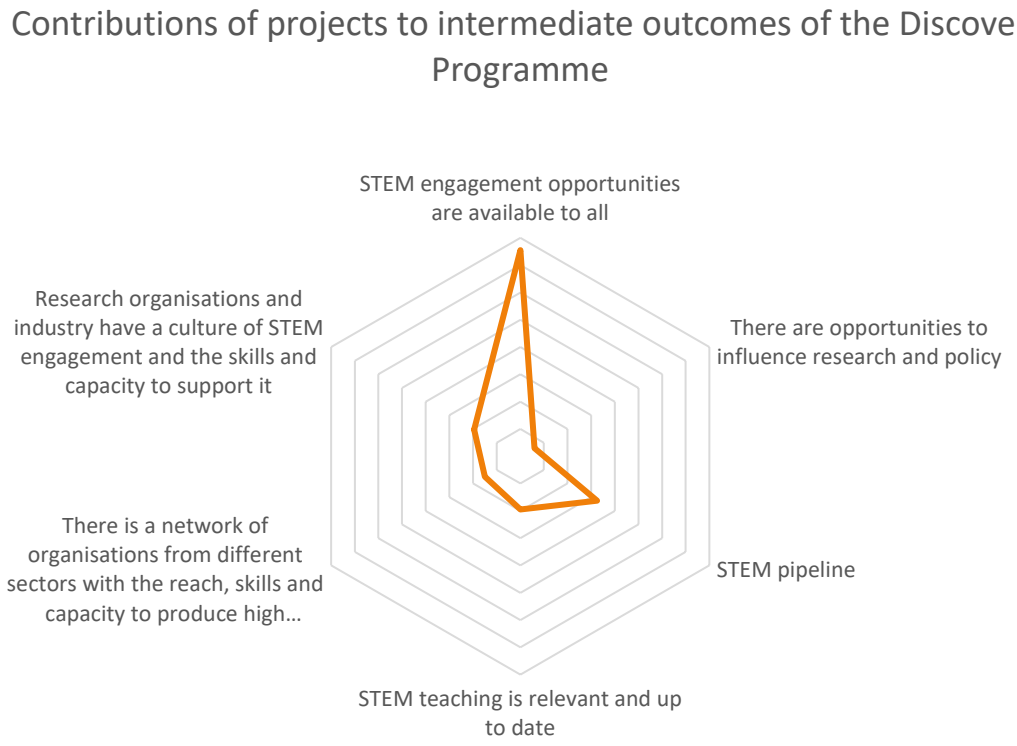
As part of the review of the Discover Programme, we have produced a theory of change logic model in order to help understand the relationship between funded activities, the funding programme's aims and SFI's overall strategic aims regarding engagement.

This logic model also takes into account funded projects regardless of how closely they match Discover Programme aims. The full logic model can be found in appendix 2.

The process of creating a logic model has identified six intermediate outcomes for Discover Programme projects, these are:

- STEM engagement opportunities are available to all
- There are opportunities to influence research and policy
- There is a supply of new talent into the STEM careers pipeline
- STEM teaching is relevant and up to date
- There is a network of organisations from different sectors with the reach, skills and capacity to produce high quality, best practice STEM EPE
- Research organisations and industry have a culture of STEM engagement and the skills and capacity to support it.

A mapping of the Discover funded projects to these aims highlights two areas to which the programme currently contributes most strongly: 'STEM engagement opportunities are available to all', including that activities take place in a range of environments and geographic locations, and target a wide variety of audiences, and the 'STEM pipeline', which includes knowledge about the opportunities available for the further study of STEM subjects, the diversity of careers in STEM, and understanding what the life of a STEM professional is like.



Other areas where the programme contributes in varying extents are skills and capacity building for STEM engagement and education, for both STEM and education professionals, and network and partnership building.

An area where there is low programme activity is opportunities to influence research and policy. Associated activities for these outcomes include dialogue and discussion between STEM professionals and audiences including special interest groups and policy makers, and opportunities for the public to have a voice in informing policy or the direction of research. Other areas of growth for the programme towards SFI's aims are an increase in activities that provide opportunities to share learning from previous activities and best practice examples widely, activities that support or work towards developing a culture of STEM EPE involvement among STEM professionals, including formal recognition of their EPE activities, and activities that lead to increased senior leadership support for EPE in HEIs, research organisations, and industry.

Discrepancies between Discover Programme aims, implied aspirations and funded activities

We identified three important areas to note regarding the relationship between the Discover Programme's aims, the logic model's intermediate outcomes and funded activities.

- ***Availability of STEM engagement activities to all***
  There appears to be a good spread of activity in terms of geographic location and into television and popular events that are not primarily about STEM. The breadth of funded projects mean that the programme has been successful in infusing STEM into many areas of society where you will not necessarily find people who are already highly engaged with it.
  However, it would be valuable to pay more attention to the priority groups (certain geographic locations, low socioeconomic status, girls) identified by the programme. Currently, 37% of projects make reference to some kind of under-served audience. Often this is in vague terms, and a strong commitment to engaging specifically with these groups is rare.
  More recent rounds of the programme have invited applicants and reviewers to take priority groups into account in the scoring process, but despite this, at present, there is little incentive for grant applicants to prioritise them.

- ***The STEM pipeline***
  Activities that support careers and the STEM pipeline feature in nearly a quarter of Discover funded projects and at least one call has invited applicants to address this area specifically. However, there is nothing that indicates this as an area for potential funding within the SFI EPE/Discover aims which are firmly directed towards the non-specialist public rather than contributing to the expert STEM workforce.

- ***Developing engagement capacity within the science engagement community***
  As described previously, the Discover Programme has funded a number of activities that offer researchers/STEM professionals EPE training and skills development. However, as is the case for the STEM pipeline above, the Discover Programme is so strongly oriented towards direct engagement with the public that its current aims

do not explicitly cover projects that develop EPE capacity within the STEM professions.

- ***Dialogue/debate and engagement with policy***
  Both dialogue/debate around the role of science and society and engagement with policy makers are mentioned in documentation associated with the Discover Programme but do not feature directly within the programme's aims.
  To date, there have been few projects that create dialogue, debate or policy engagement in any depth. Where projects do talk about debate, it is often in the context of understanding the importance of science's contribution to society rather than taking into account conflicting priorities or individuals' moral and value judgements.

Arguably, all three of these areas can be inferred within the spirit of the aims, even if they are not present in the wording. They all make an important contribution to the national culture in relation to STEM and therefore should not be overlooked.

Clearer and more explicit reference to them within Discover's aims would influence potential applicants' ideas about SFIs priorities and should improve the distribution of projects across different aims.

4.6 Audiences

Grant recipients were asked to indicate the audiences for their projects. However, the lists used for this varied from year to year and there was some variation in interpretation from different grant-holders.

There was also a strong tendency to group many different types of public under the umbrella of "general public" resulting in a lack of differentiation between audiences. For example an activity aimed at adults with an existing and in-depth knowledge of science was categorised in the same way as an activity aimed at families taking part in a national festival.

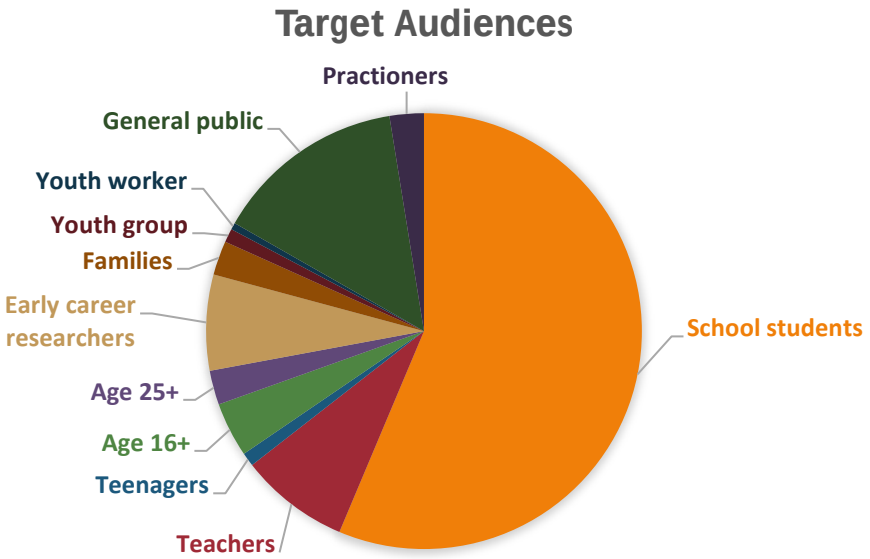
We therefore created our own audience categorisation from details given in available interim and final reports. This resulted in audience classifications for 139 of the 195 projects funded between 2013 and 2017 (N.B. Projects funded in the 2017 round had yet to report at the time of writing).

Many projects comprised multiple activities and two thirds of projects addressed more than one audience group.

Of projects that focussed on one audience group, 28% were projects with an intentionally broad audience such as television broadcasts, exhibitions and online resources or apps; 9% were training for teachers or youth workers. 57% were aimed at children, primarily in school. The remainder were activities for specific adult audiences.

- For all projects, schools were the most common audience – 59% of projects include some sort of schools' engagement.
- The general public (as opposed to a named group or type of audience) is the second most common audience – 33% of projects target the general public.

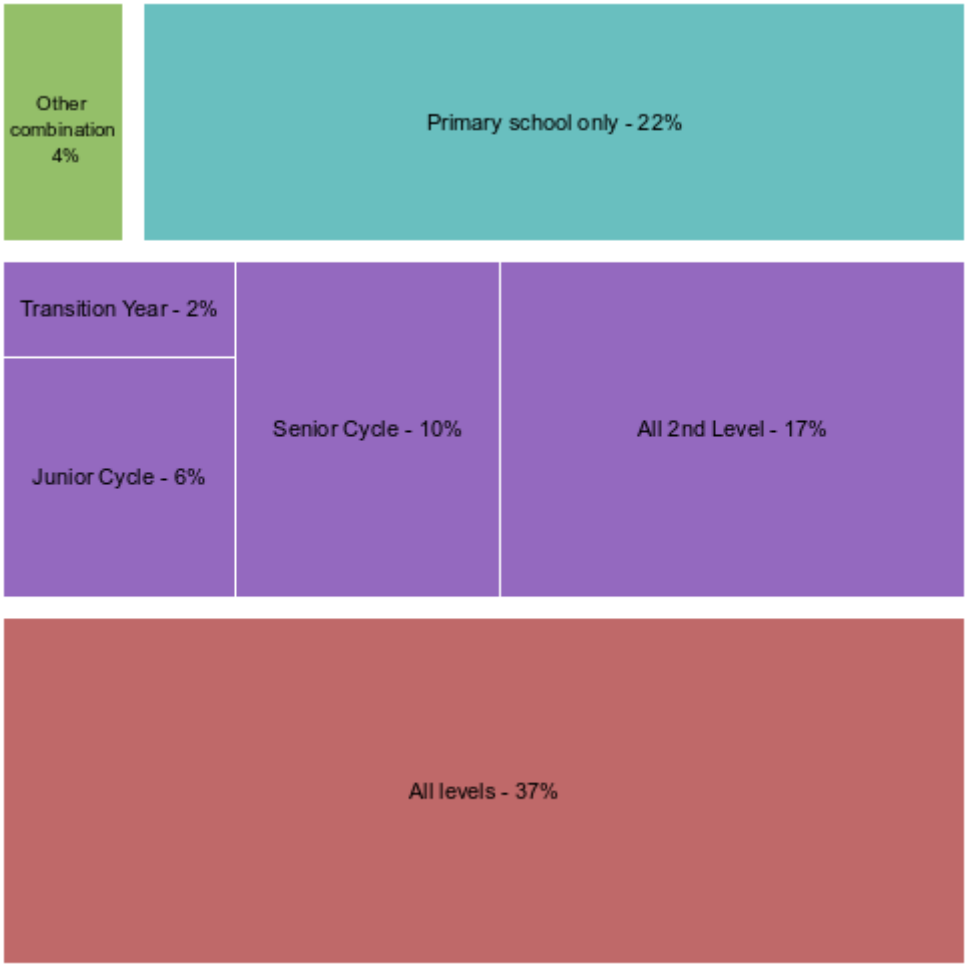
- Scientists were a direct beneficiary in 22% of projects. This was usually via projects with a training element for scientists such as Famelab, Thesis in 3, Bright Club and Physics Busking, many of which have been funded in more than one round.
- Families were described as a target audience in 11% of projects.
- 7% of projects were specifically aimed at adults.
- Teacher CPD featured in 20% of projects.
- 32% of projects make reference to SFI priority audiences (girls; some specific geographic locations including rural areas of Ireland and areas of Dublin; socially, economically or educationally disadvantaged audiences). However, very few target these groups extensively.



PRIMARY TARGET AUDIENCES OF FUNDED PROJECTS

Projects with a schools' audience

Schools are the largest target audience for funded projects and programmes. 59% of projects offer some sort of schools engagement either via in-school workshops and activities or school visits. In addition to this, a number of projects suggest schools as an audience for their online outputs – for example videos of presentations or podcasts.



DISTRIBUTION OF PROJECTS FOR SCHOOLS BY SCHOOL LEVEL

- 35% of activities are aimed exclusively at second level schools
- 57% of projects offer activities to first level schools
- 72% of projects offer activities to second level schools

- Approximately half of activities aimed at schools are whole class workshops, either delivered in class or at another venue such as museums and galleries, universities and arts venues.

- 57% of festivals have a specific offer for schools. Those that do not are typically one-day events (e.g. Big Day Out – St Patrick's Day Festival) aimed at a general audience. Around a quarter of schools' activities are available as part of a festival offer.

Other activities of note:

- 58% of projects aimed at schools have either STEM professional or undergraduate involvement; 42% have STEM professionals involved in delivery.
- 8% have undergraduate students involved in programme development and/or delivery.
- In total, 56% of projects involve direct support/involvement from STEM professionals or undergraduates in development and/or delivery of the project.

This is in addition to any role they may have in creating the project in the first place.

- Nine projects mention STEM professionals having specific mentoring, tutoring or role model purpose; seven of these are school-based, two are not. Two are specifically aimed at girls.

Teacher CPD

More than 12% of projects aimed at schools include a teacher CPD component. In addition to this, there were four projects which included teacher CPD, but had no classroom-facing activity – two of these were exclusively teacher CPD programmes for primary school teachers and the other was Physics Busking (funded four times) where the training was open to teachers, but not exclusively aimed at them.

Although the CPD-only projects were both aimed at primary level teachers, half of the teacher CPD within other projects was aimed exclusively at post-primary teachers.

Other audiences

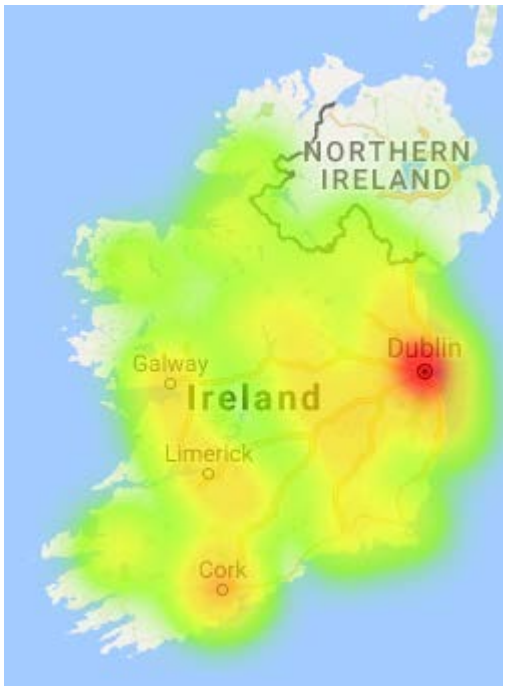
- 28% of projects were aimed at youth and community groups and their leaders
- Less than 2% of projects aimed to engage with policy makers within the funded period. Occasionally, there were plans for policy engagement downstream of the project.
- 4% of projects included artists or creative collaborators.
- Industry was an audience in around 2% of projects.

4.7 Audience reach

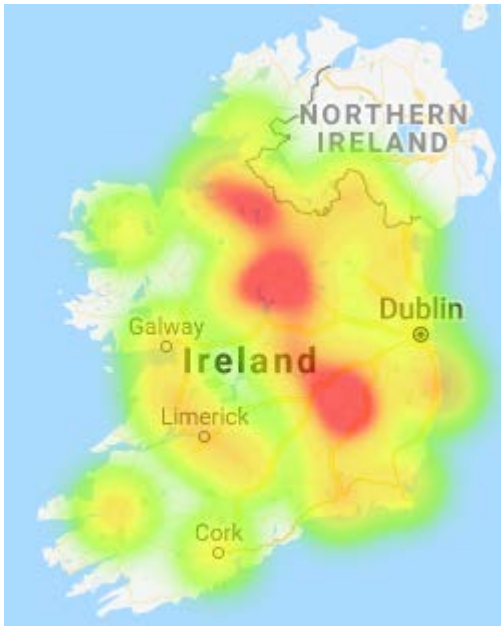
National reach

The national reach of projects was determined based on projects' own reporting of target areas of activity. All target areas were counted. Reports that listed all counties in addition to 'national' were counted as national. Analysis of potentially underserved areas was conducted at a county level, and projects targeting a national audience, including Northern Irish audiences, or whole-province audiences were not included.

Generally, the programme seems to have a good national reach, however activities in some areas are mainly limited to remotely accessed activity such as TV or online activities, or national school competitions.



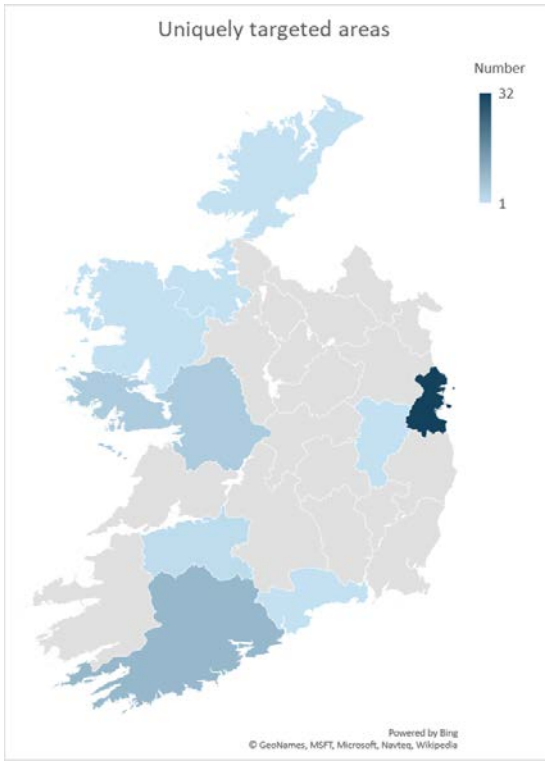
HEATMAP 1:PROJECTS' TARGET REGIONS.



HEATMAP 2: NUMBER OF PROJECTS PER POPULATION

Heatmap 1 based on projects' target regions shows areas of higher and lower programme activity, whilst heatmap 2 shows the relative numbers of projects per population numbers in each region. Comparing how areas rank on the HP index[1] as a rough indicator for those not normally engaged with STEM, to population numbers in target areas for projects, there are 6 potentially underserved areas of Ireland by the programme: Donegal; Mayo; Offaly; Wexford; Cavan; and Tipperary.

Unsurprisingly, HEIs usually work in the regions closest to where they are based. Where their projects have a wider reach, they are activities such as regional festivals, regional or national competitions, or expansions of outreach programmes, often partnering other organisations for delivery in areas further from their own institution. This highlights the importance of networks and partnerships to ensuring the Discover Programme continues to have and improve on its national reach, with all areas of Ireland having access to a range of activities.



Several projects had activities targeting a specific area. Of these, Dublin was the most commonly targeted, with 60% of these projects targeting this area. Other specifically targeted areas are Cork and Galway, with 17% and 9% of these projects targeting these areas. Other uniquely targeted areas made up between 1-4% each.

It is common for projects to target a wider region or province, such as Leinster, Munster, West Ireland, South East Ireland and other collections of neighbouring counties. 25% of projects target regions such as this. 7% of projects target several areas of the country not geographically connected but connected in other ways such as the presence of HEIs, for example Dublin, Cork, Galway and Limerick. 40% of projects target or have an aspect targeting a national audience.

[1] Haase and Pratschke, 2017. The 2016 Pobal HP Deprivation Index for Small Areas draws on data from the 2016 census to provide an analysis of the geographical distribution of deprivation

Reaching rural audiences is a well-known challenge and the inclusion of remotely accessible projects in the Discover Programme, as well as the delivery of activities at some regional fairs and locations outside the main metropolitan or HEI centres goes some way to ensuring the programme is accessible to a variety of geographic locations.

In reporting, projects have a tendency to list many target areas, even if they are not necessarily active in these areas for project delivery. It seems there is an impression that projects should be targeting multiple regions/ as many regions as possible rather than focussing on specific areas, something not necessarily desired by SFI or likely to influence likelihood of funding. This results in a level of ambiguity in the actual reach of projects.

Audience reach figures

Grant holders were asked to give total direct audience reach figures in their end of grant reports. There is considerable variability in how fund holders have chosen to report this and many examples where the figures provided are unlikely to represent direct reach accurately.

SFI's EPE team are well aware of this issue, and measures have been taken in the past to remedy this, but to little effect.

4.8 Unsuccessful applications

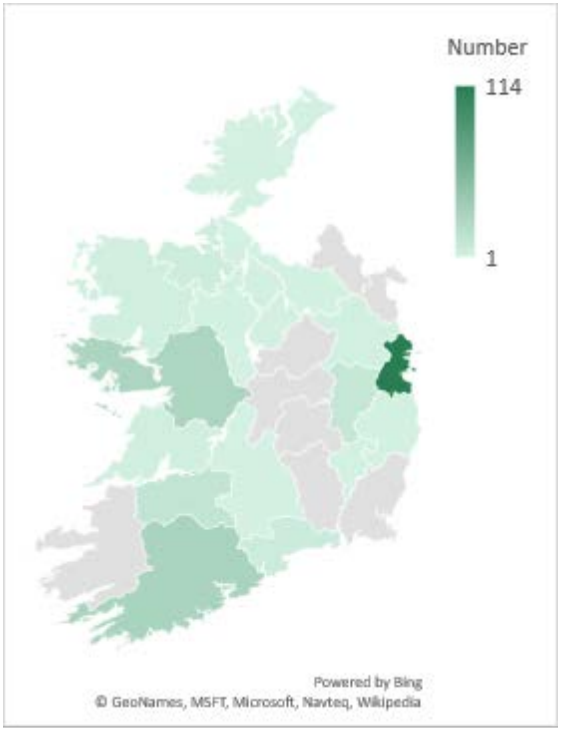
Non-funded projects were analysed to determine any trends in project types, organisation types, and target audiences between non-funded and funded project proposals. Limited information was available regarding these projects therefore no comparisons can be made regarding intended impacts or the prevalence of networks and partnerships between applicant organisations, for example.

There was a total of 232 unsuccessful proposals between 2013 and 2016. In 2013 and 2014 there were 45 and 40 unsuccessful applications respectively, with success rates of 45% and 52%. This number grew to 75 and 76 in 2015 and 2016, with success rates of 36% and 37%, suggesting a growth in the awareness of the programme during that time.

Applicant organisations are mostly based in the main metropolitan areas of Ireland, although some projects did not necessarily target only the area in which they are based.

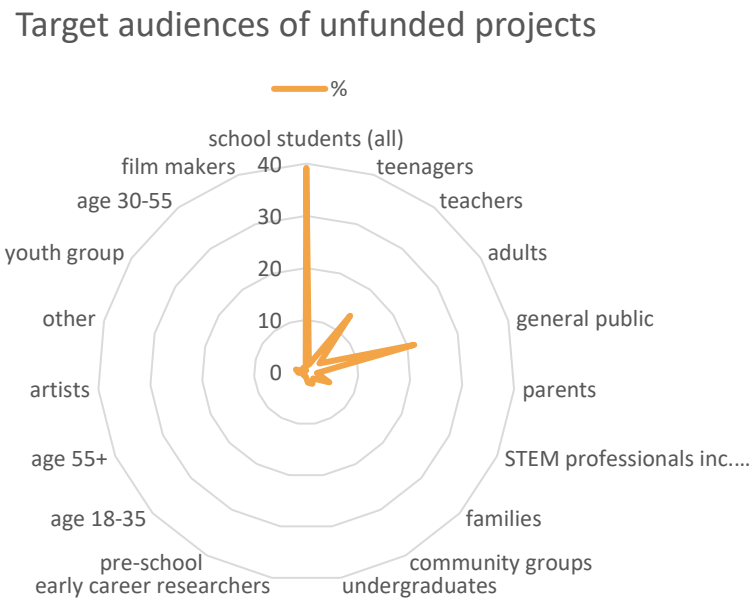
Looking at universities and institutes of technology as two types of higher education institution, institutes of technology make 8% of both funded and non-funded projects. Looking at the success rates of universities and institutes of technology, institutes of technology have a slightly higher success rate, with 47% of proposals from institutes of

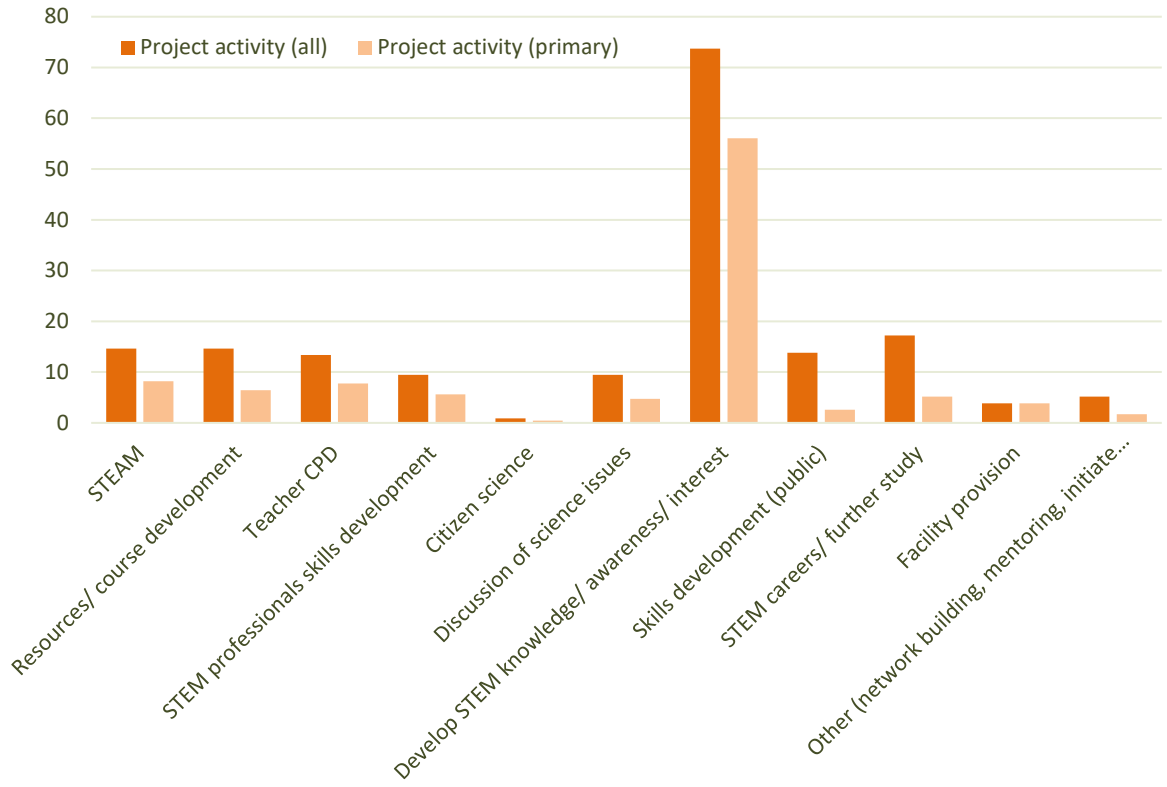
LOCATIONS OF UNSUCCESSFUL APPLICANT ORGANISATIONS



technology being awarded funding, and 40% of projects from universities.

Similar to funded projects, target audiences for the proposed projects focus mainly on school pupils, teachers, and the general public. Where specified, other target audiences include community groups, STEM professionals, and families. School students were a target audience for 39% of declined projects. The general public is targeted by 21% of projects, with teachers also a commonly targeted audience, by 14% of unsuccessful projects.



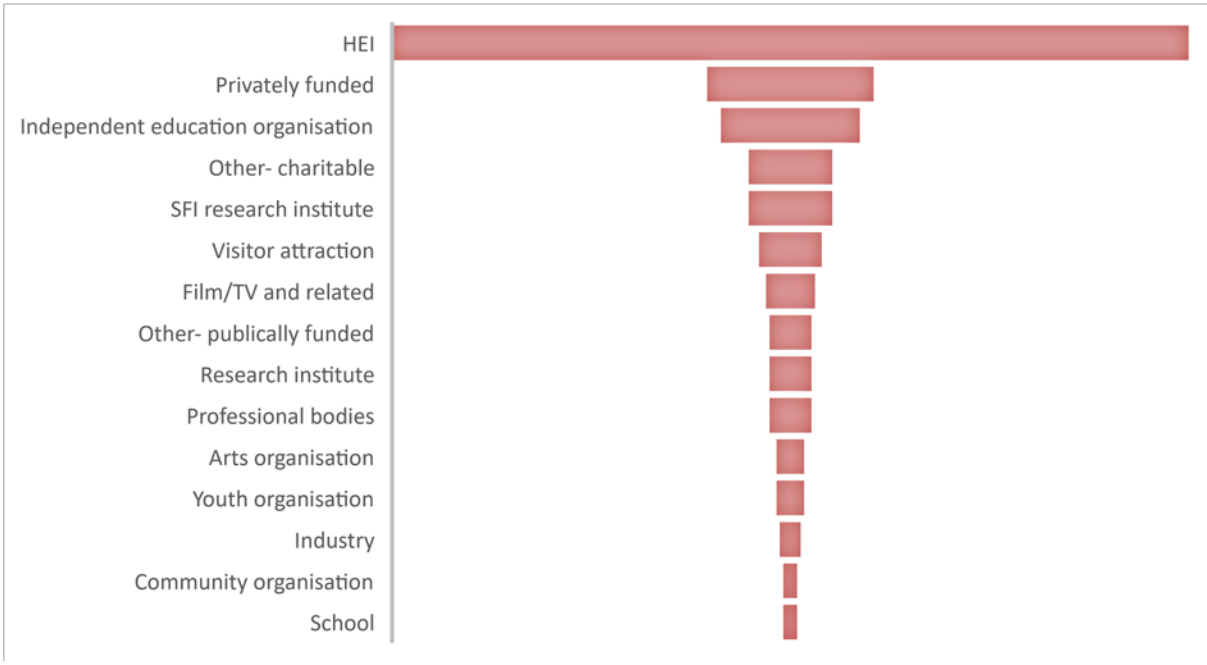


PRIMARY PROJECT ACTIVITY VS ALL PROJECT ACTIVITY OF UNSUCCESSFUL APPLICATIONS

Projects involving STEAM activities, either as the primary, or additional activity, were included in 15% of unsuccessful project proposals, but were the primary activity of just 2.5% of funded projects. 'Other' types of activity include mentoring, network building, and activities aiming to initiate behaviour change in their audience.

STEM careers/ further study activities made up 5% of projects' primary activities, but in total 17% of projects comprised some activities with the aim of promoting STEM careers/ further study, even if these were not the primary focus of the project. Teacher CPD above includes formal CPD courses as well as more informal teacher training and development activities such as conferences and training to use specific resources.

After HEIs, the most common unsuccessful applicant organisation type was privately funded organisations, such as production/publishing companies, development companies and software companies, among others. These types of organisation totalled 10% of unsuccessful applicants. Independent educational organisations were also common applicants, making up almost 9% of applicants.



UNSUCCESSFUL APPLICANT ORGANISATION TYPES

4.9 Impacts and outcomes of funded projects

Evidence on impacts and outcomes was analysed from end of project reports made available to us by SFI. Most reports followed a standard reporting format, but some 2015 and earlier awardees inserted their own project report into the reporting form. The reporting procedures have since been tightened.

It was relatively unusual for projects to report their evaluation in terms of clear impacts on audiences, as opposed to a more general appraisal about the success of activities in creating and engaging with audiences. This makes it challenging to create a coherent and fair narrative across the programme regarding impacts and outcomes for audiences.

Project evaluation

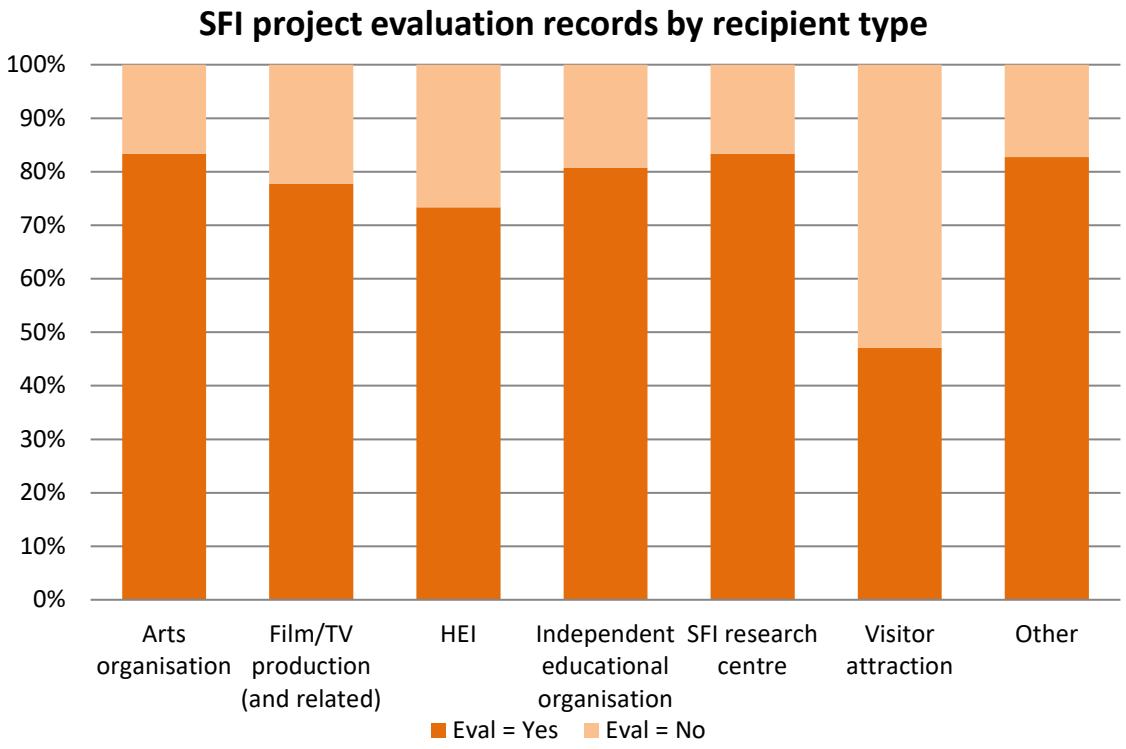
Projects varied widely in their commitment to evaluation. Some had external evaluation and use the findings formally while others take a more hands-on, learn as you go approach. On the whole, evaluation tends to dominated by "feedback".

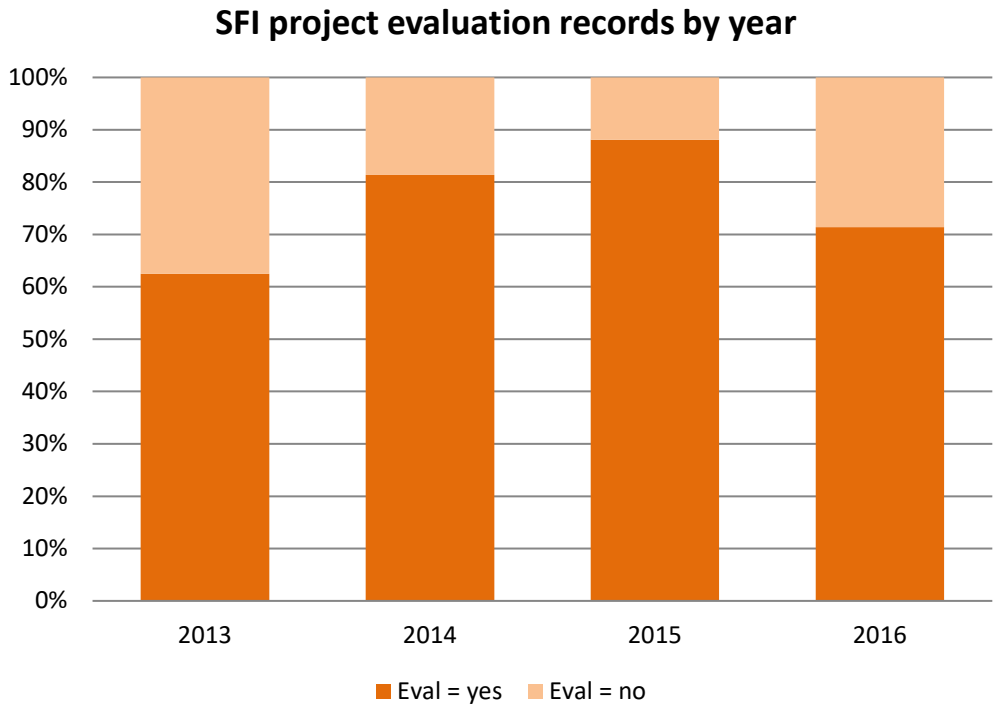
> *"I've been collecting feedback. This is what I call evaluation; this is one level of evaluation. […] What [SFI Discover] really want in the end I think is evaluation research, but I don't think they can get that from people running activities."*
>
> *Interviewee*

A combination of our own classification and SFI's records shows that 77% of projects completed some kind of evaluation.

This varies a little from year to year and between different types of recipient. Projects run by arts organisations and educational organisations are most likely to evaluate.

Projects from visitor attractions are least likely to evaluate. There is some variation from year to year, but nothing that suggests a trend.





The evaluation reported tends to look at quality of experience for participants and effectiveness of project delivery overall.

Successes are generally reported in terms of:

- Successful delivery of the project – especially with respect to reach
- Positive audience reception
- Increased knowledge, interest and skills in relation to STEM
- Improved networks and new collaborations

> *"The main thing we learned is that people enjoyed the event immensely and rated it very highly"*
>
> *End of project report*

> *"The evaluation has revealed that through a comprehensive year-long calendar of events, [our project] has been appreciated by the general public and contributed to further engagement in STEM learning."*
>
> *End of project report*

> *"Overall feedback was very positive with 97% of respondents replying [project] raised STEM awareness in their school while 95% indicated a willingness to participate again."*
>
> *End of project report*

Main areas of learning are:

- Improved understanding of audience interests, needs and motivations
- Development or establishment of good practice
- Specific skills in relation to the project (e.g. exhibition development)

> *"Working together with the Oughterard Youth Café allowed us to connect more deeply with the local community and to have access to the expertise and skills of local youth workers and capitalise on their familiarity with the young people in question."*
>
> *End of project report*

> *"Audience members frequently cited the mix of ideas, clear presentation of scientific content, and thoughtful community as reasons for coming back to [project name] and telling their friends about it."*
>
> *End of project report*

Main areas for advice to others or improvement are:

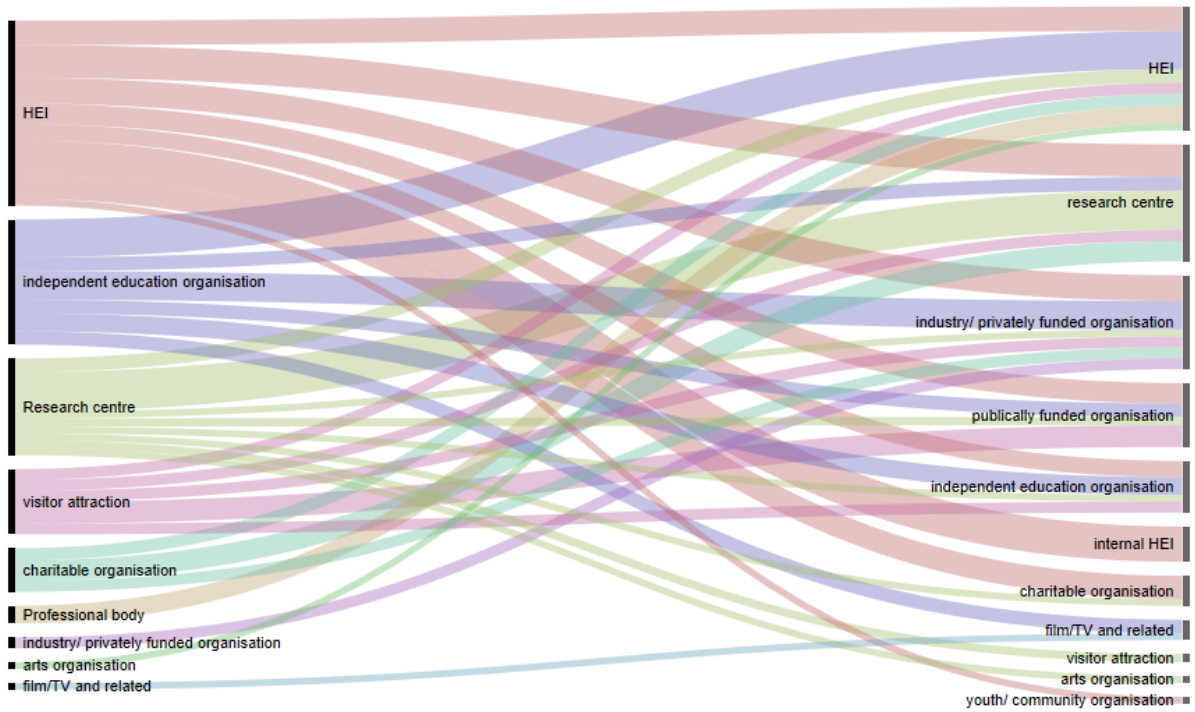
- Finding the right partners and stakeholders, developing strong relationships with them and using the relationships well
- Taking care to get your content right for your audience
- Being aware of timeframes, especially in relation to schools
- Project management and practical advice for example around venue hire, project design and publicity.

Some projects reported on challenges that were specific to the personal circumstances of specific members of the team. While this undoubtedly had an impact on the project, whether it is appropriate and necessary to report them is less clear.

4.10 Networks and partnerships

There are many different types of partnerships that have been formed or utilised in delivering the Discover Programme activities. The most common type of partnership is between research centres, demonstrating the strong network between them. Similarly, the most common partnership to exist from a higher education institute run project is internally within different sections of the same institution. Independent education organisations seem particularly proficient at working in partnership, with multiple partnerships existing between independent educational organisations and HEIs, industry/ privately funded organisations, other educational organisations, research centres, publicly funded organisations and so on. The diagram below shows where there are five or more partnerships between grant-holders on the left, and the types of organisation they partner with on the right. For example, professional bodies have only partnered HEIs in projects where the professional body is the lead organisation, but projects where HEIs are the lead organisation partner several types of organisation.

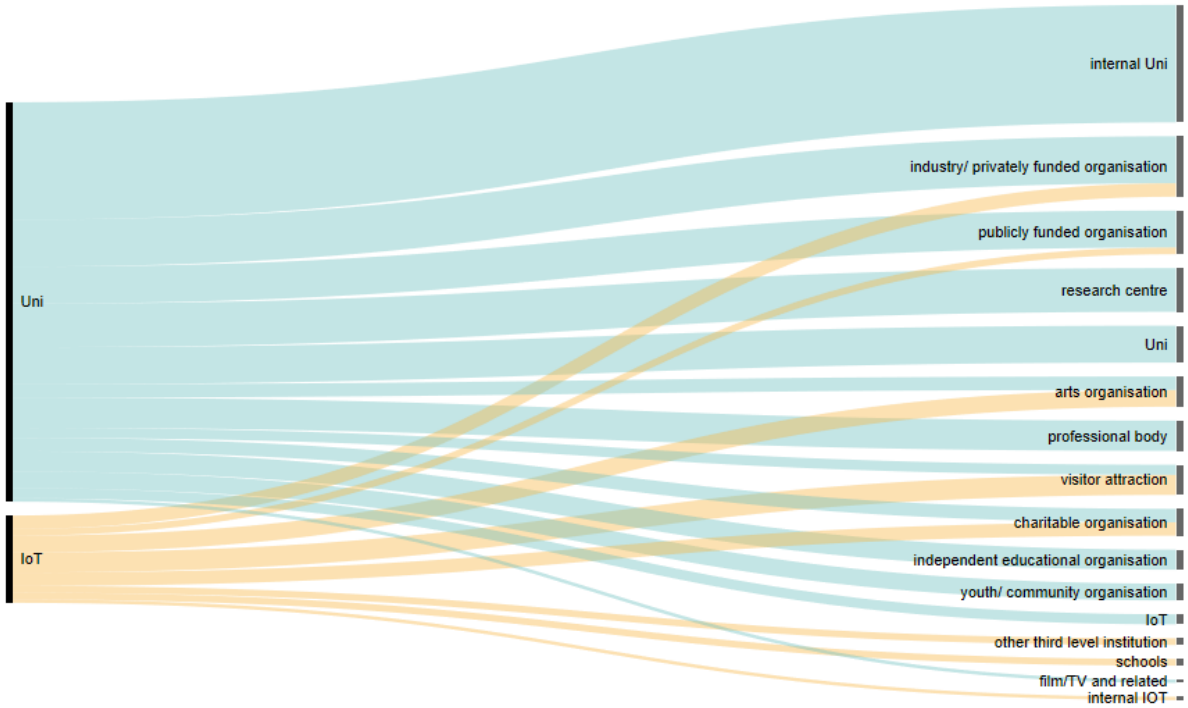
It is worth noting that independent educational organisations come out very favourably across a number of measures including their ability to network across different organisations and sectors.



Partnerships in HEIs

Looking at universities and institutes of technology as two sub-groups of higher education institutions, we can see how their partnership types differ. Universities commonly partner other departments within the same institution and are four times as likely to partner another university than an institute of technology. No institute of technology grant holder

partnered other institutes or universities, partnering other types of organisation such as arts organisations, visitor attractions and so on. Where universities did partner institutes of technology, these were the larger institutions in the same cities. The diagram below represents 120 university-run projects, and 26 institute of technology-run projects. There are thirteen institutes of technology and seven universities across Ireland, therefore institutes of technology will require more support if they are to be proportionally represented in terms of grants awarded, and seen as valuable partners by other higher education institutions.



As noted above, the presence of active networks and partnerships are important in enabling the Discover Programme's aim of reaching new audiences, as well as the higher SFI goal of having the most scientifically informed and engaged public, as organisations offering STEM education and public engagement activities can partner organisations that work in more isolated geographical regions, or with currently underserved audiences that other organisations may not be able to engage alone.

Networks and partnerships are important not only to the Discover Programme, but in the sector more generally, in terms of sharing learning and best practice when organising and delivering STEM EPE activities. It is worth considering whether it would be valuable for these to be reported more clearly in final project reports, distinguishing between organisations that donate money, and those that work closely in partnership to deliver projects.

SFI grant holder meetings

There was a mixed response when asked to comment on the SFI hosted meetings. Some interviewees described them as not helpful at all, and that they seemed geared towards individuals from certain types of organisation or with certain job roles that included education and public engagement capacity. Most comments about the grant holder meetings were generally positive, seeing the meetings as a good opportunity to find out

more about other grant holders' projects and any similarities or opportunities to work together. Comments were made that SFI could do more, especially for projects based outside of Dublin. Time-taken and cost of travel were both mentioned as challenges in attending the Dublin meeting. More frequent meetings or informal events held outside of Dublin were suggested by multiple interviewees. It was also commented that the meetings seemed to be helpful for people whose day to day job includes working in engagement or education activities, or for those who work at organisations where they may have greater flexibility in how they spend their time, or are able to dedicate some of their working time to their projects, however it was felt for those people for whom that wasn't the case, they were coming from completely different places and the networking events aren't useful for them currently. Other types of organisation appreciated the chance to meet other grant holders, especially types of organisation they do not traditionally have links with, and the opportunity to see what others do and link with those trying to achieve similar things or working on similar projects.

> *"…it was a fantastic opportunity to see what other people were doing and see where the kind of possibilities were for coordinating…"*
>
> *"it's great that they do a general partner meeting because we have a chance to see who else is funded, but it'd be nice to have like a conference or informal meeting place where everybody in Ireland can meet and talk about what they do, something very informal"*
>
> *"I would have a little criticism there. I mean not that they don't do it they do it very well but it's always in Dublin and I think that they are a national organisation… I kind of feel like they really need to be doing some of the work even in like the provinces like it could be in Limerick… I think they should be making the effort to come to us because it's an investment of time and money for us and I feel that for that which is more service their broader goal would be more useful to them to come and visit and see some of the organisations in situ and then do some kind of networking event in, you know nationally but in different regions"*
>
> *Interviewees*

Other partnership and network building opportunities

In addition to the opportunities provided by the annual grant holder meetings, some interviewees mentioned other partnership or network building opportunities that they felt would not have been available to them without the support of SFI. This was due to increased time available as the grant had allowed for an extra member of staff, freeing up time to approach and work with other organisations.

Others mentioned that there are existing networks in their communities of organisations that are well utilised, or that they are not really part of any networks with organisations doing similar types of activity, but for both situations a wider network where any interested organisation or individual could meet or talk informally was suggested.

The presence of extensive partnerships and networking is a strength of the programme and one that should be encouraged further. Grant-holder meetings and networking is unusual

for an open funding call and suggestions regarding expanding these into different geographic regions and having more frequent, more informal meetings should be considered.

4.11 Cost and value for money

There are a number of challenges with calculating per capita costs and considering value for money. As noted previously, both grant-holders' audience reach figures and project cost reporting are not reliable and even if these are assumed to be accurate, it is problematic to judge the relative value for money of lower and higher cost per head projects where the type and depth of engagement is so totally different.

The information presented here is based on grant-holder's own reporting of direct audience engagement and total projected project cost (including Discover grants and any additional sources of funding) and should be interpreted with caution.

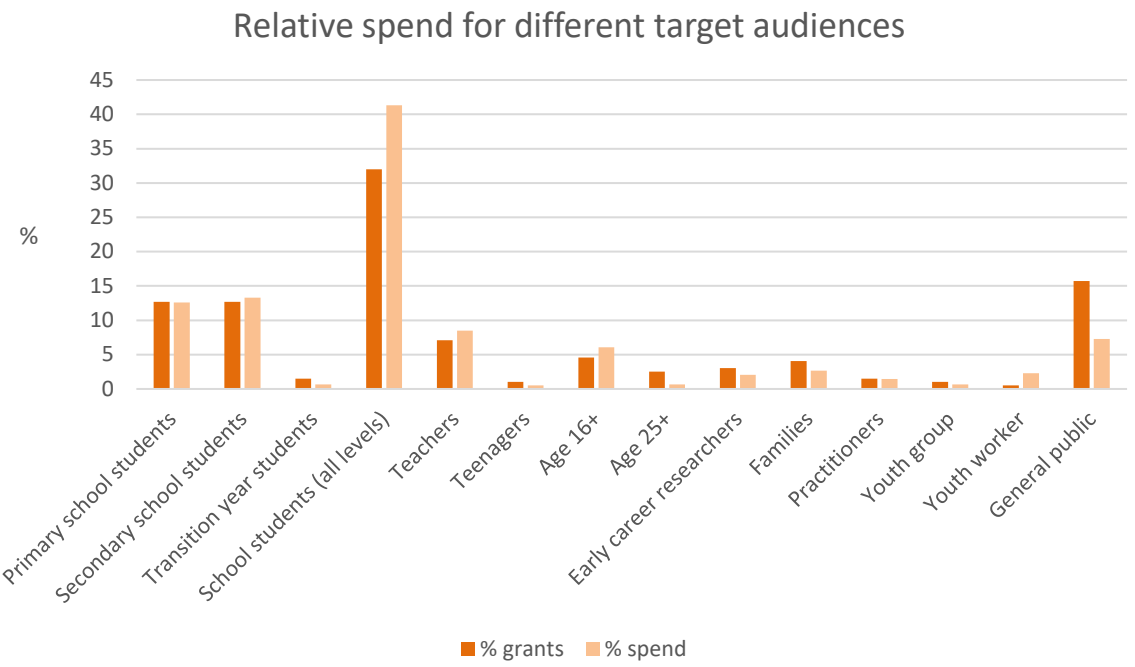
Based on grant-holders' own figures, projects cost an average of €216 per person directly engaged. Of this, an average of €120.54 comes via the SFI grant.

The median per person cost for all projects of €18.93 with the Discover grant making an average contribution of €8.03, or 42% of total project costs.

There are 16 projects with a much higher per person cost. These tend to be projects with deeper or longer-term engagement with participants such as teacher CPD and longer duration science clubs. The average total cost per audience member of these projects is €1988.78 with SFI funding contributing €1168 per person. Looking at the most expensive 10% of projects, these cost an average of €1737.94 per person, from all funding sources, of which SFI contributes €1007.67.

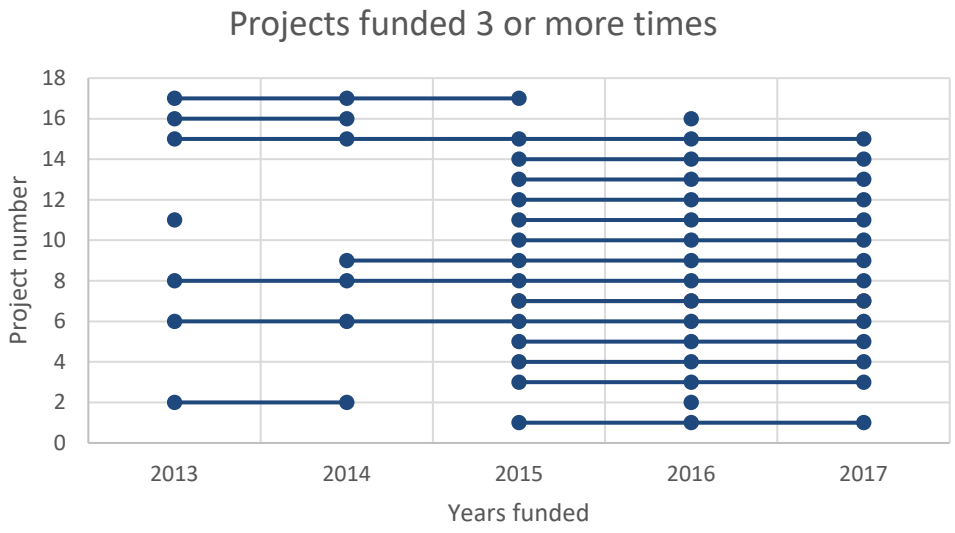
Broadcast projects cost an average of €1.40 per person reached, of which the Discover grant contributes €0.38. The average total project cost of the 10% least expensive projects is €0.79 per person, but this rises to €1.12 when broadcast projects are excluded. The SFI grant contributes €0.31 and €0.49 per person respectively to the least expensive 10% of projects, including and excluding broadcast projects.

It must be highlighted that these figures alone cannot tell us the intensity of the interaction, and activities such as teacher CPD which seem to have a high cost, may actually have a larger impact than activities such as broadcast or shows at a festival, at which people may only have a brief interaction or not give the activity their full attention. The value for money here depends on the aim, if the aim is to permeate society with STEM broadcast items, these projects would represent very good value for money.



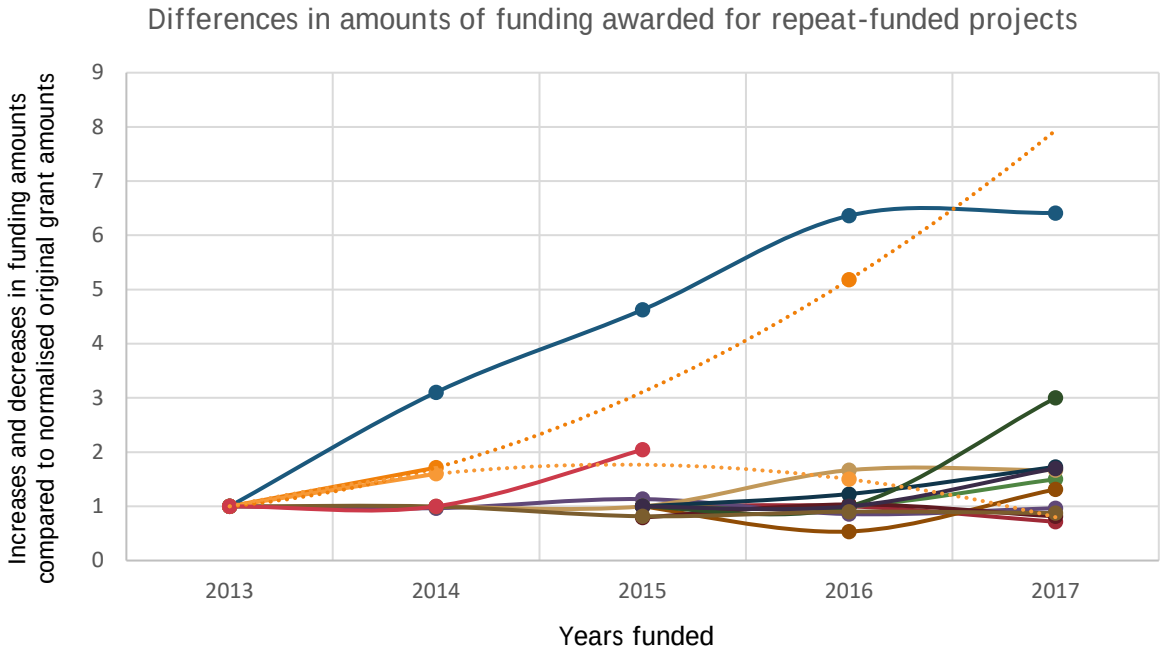
When comparing the number of grants with the amount of spend focussed towards particular audiences, we can see that projects targeting school students as their primary audience required a higher proportion of funding than number of grants, while conversely the spend on projects with the general public as their target audience is a lower proportion of the total money given, than the proportion of grants. As noted above, although the figures alone cannot tell us the intensity of interactions, this does imply a very plausible inverse relationship between cost per head and depth of engagement.

Looking at projects that have been funded 3 times or more under the Discover call, most repeat funding comes in the years since 2015, possibly reflecting a conscious or incidental shift towards promoting the sustainability or longevity of activities.



While the amount of grant given to repeat-funded projects is consistent for most of these projects, there are some whose funding has increased. It may be expected that funding

increases as projects grow, but also decreases or negate this effect as they become more efficient and require less baseline effort.



The graph above shows how amounts of funding awarded to projects funded three times or more through the Discover Programme differs. A value of 1 indicates no change from the first grant given, a value higher than 1 indicates an increase in award from the first grant amount, and a value less than 1 indicates a decrease in the amount of grant awarded compared to the first grant amount given.

Comments on value for money arose spontaneously during interviews with grant-holders, where some expressed surprise regarding the differences in grant sizes, the amount of activity they funded and what SFI viewed as value for money - for example when a project receiving a larger amount of money and was perceived to be delivering less than a similar project that received a smaller amount of money.

To some extent this is a reflection of differences in approach between those for whom high production values are important and those who take more of a make-do attitude regardless of the quality of the engagement itself. It would be helpful for SFI to address this in their guidance so that applicants taking either approach are clearer about SFI's expectations.

There was some uncertainty over whether grant holders were undervaluing their contributions to projects or selling their project short and should aim for more funding to cover time spent- in short, uncertainty over the exact guidelines of what Discover funding can cover and what SFI expect the money to be used for.

> *"One of the surprising things for me was seeing the amount of funding other projects get and what they could use for the amount of money they are given…clarity on what people you can pay for. When you get fifty thousand Euros, would it be feasible that if you are doing quite a cheap project materials-wise, maybe ten thousand Euros of the fifty*

> *thousand could be on just setting up all the equipment and then forty thousand on a person to run it for a year? Is that feasible or a huge big no-no and there is no point even putting in for that"*
>
> *Interviewee*

SFI guidance needs to be clearer about circumstances where it will and will not contribute to salaries and project management costs.

Although many interviewees said that the projects they ran would not have been able to go ahead in the way that they did, or at all, without the SFI funding, comments were also made that a large proportion of projects' costs are not provided by SFI but come in the form of time given to enable the projects to be delivered, by project managers and coordinators but also other volunteers who contribute significantly to the Discover Programme activities. The two main consequences for projects without SFI funding are described by interviewees as projects being less concise and coordinated, or that the scale or growth of projects would have been severely limited. Most interviewees said they would have delivered some form of activity, however the quality and reach of these would have been seriously affected.

> *"the richness of activities that we can showcase you know at our annual reviews and things like that would be so much less"*
>
> *"we would never be able to run [the activities] at the scale we're running them at now without SFI funding"*
>
> *"[without the funding] it would have been all over the place"*
>
> *Interviewees*

These comments show the importance of grant schemes like Discover to fund activities to happen concurrently and create momentum for this type of activity. Without this, activities happen in more of a trickle, are less timely and have less impact.

4.12 Professionalisation of STEM engagement

Via interviews, it came to our attention that project delivery is hugely reliant on people offering their time voluntarily to run projects. While a number of those we spoke to had funding to pay for essential administrative personnel, several grant recipients we interviewed were committing large amounts of their own time to running their project on a voluntary basis.

> *"Our biggest issue with funding for this programme is actually the admin side of it so we have had companies who are willing to give us money to put towards travel costs, bus for the school to come in, even some food to feed them when they are here. But we have to, the girl who runs all the admin for bringing in the schools; making sure they are there, making sure the people are in the lab to teach them, she is not permanent there. So currently in our funding we have about two grands worth of admin to pay her which doesn't go anywhere what she does. Ideally what we need is a wage for her for the year and we could do a huge amount of really impactful stuff but from my experience of seeing what these funds will cover, it is not really going to do that."*

Interview with HEI grant recipient

For those working outside of universities, the project was not necessarily linked to their professional life. The unpaid-for time had to be found in evenings and weekends or by juggling work commitments.

> *"It's the weekends really, so I would regularly have a whole Saturday and a Sunday which would be spent doing [project]. I could then have a day out during the week I suppose. I'm a partner in the business so there's nobody monitoring what I'm doing, but I could spend a day maybe, I'd have a meeting, I'd fly into Dublin, and then I'd spend the rest of the day meeting people to do with [project]. […]*
>
> *This is not an [company] project, you know. It is a [grant holder name] project that [company] know she's doing, if you know what I mean. The support is they turn a blind eye a lot of the time but it's not their project."*

Interview with non-HEI grant recipient

For those working within universities, there was usually an obvious relationship between their SFI Discover project and their day job, but despite this, time spent on the project often went un-recognised even where it brought benefits to the university or department. The project could only happen courtesy of the grant recipient's university salary with the accompanying access to people, resources and expertise.

> *"I spent something like 200 hours, and I think I've racked up another 200 hours on top of that, in the project, on top of the full-time job I have in the college.*
>
> *"[…]You have to get agreement from your Head of School, Head of Department, to do this. You can't just do it because it does impact on your ability to then do the other job. But in terms of hours, no, there were no hours applied, no allowances made for hours on the project. The job of work we have to do at the moment is convincing the third level institute that this is worthwhile to do, for them."*

Interview with HEI grant recipient

> *"When you go to primary school people think it's a hobby or it doesn't have an impact or unless you have a very understanding Head of School or Dean who is convinced. Most of it is running into the background…"*

Interview with HEI grant recipient

Although the funding was also effective to give people in relevant salaried roles both inside and outside academia the capacity to develop new materials and resources.

> *"Worldwide there are very few associations who have full time professionals who physically are developing materials[…]*
>
> *"We are multi skilled and everything can be done in house; we don't have to bring in anybody else[…]*

> *"From our point of view on the [organisation] context, our salaries are being paid by government grants so they are already covered off. We generally wouldn't have that amount of money on the resource so with ten thousand quid to print it, we would have to look for that money from somebody else's budget. So the Science Foundation Ireland coming in to give us that grant, allowed us to produce higher quality materials that we may not have otherwise done, and send them out in the post and things like that."*
>
> *Interview with non-HEI grant recipient*

> *"The richness of the activities that we can showcase you know at our annual reviews and things like that, would be so much less if we didn't get these types of funding; they really augment what we are given as our budget within the centre. You know, just keeping activities ticking over and having equipment or even just paying for rooms, teas and coffees, and get people into the rooms to do communications training and you know, our budget is already covered with those types of activities and to get the funding to run these bigger ones, really we couldn't do it without getting grant funding."*
>
> *Interview with HEI grant recipient*

Using people's salaried time as in-kind support works well where the individuals running projects have an EPE-type role. Here, the grants add value to what they are doing anyway and their contribution is an expected part of their role.

Where the individuals running the project have a non-EPE role in their organisation, for example as a research scientist, their in-kind time contribution is often additional to their existing workload and not recognised by their organisation even where it is relevant to the organisation's mission. While this is not necessarily a problem – there is no reason why people should not volunteer their time if they want to – not recognising this time is an obstacle to creating a culture within HEIs that values engagement.

SFI needs to consider how Discover Programme Grants awarded to HEIs should contribute towards culture change within HEIs as well as directly enabling projects to be delivered. It needs to decide how the funding should support the initiatives already in place such as Campus Engage and professionalisation and recognition of EPE within SFI's own research centres to ensure that there is appropriate reward and recognition for those undertaking Discover projects and that this is visible to the HEI as a whole.

5. International perspectives

The full reports from our international consultants are attached in appendix 3. Here we provide a brief summary against each country and in general.

5.1 Italy

Similar to the activities in Ireland, a variety of activities including science festivals, education projects for teachers and students, and online tools are seen in Italy. These activities are usually developed and run by museums, science centres, associations and

research institutions, funded either by public or private bodies. The Discover Programme is seen to be most analogous to a funding channel of the Ministry of Education, University and Research- '6/2000 law for the dissemination of scientific culture'. This annual calls funds either 3-year collaborative projects at a national level, or smaller 1-year projects, with an average annual spend of around €8,000,000. This call is mainly aimed at museums, education or science communication agents.

Compared with the 6/2000 law, the Discover Programme is seen to be a stable, permanent funding opportunity, not subject to political turbulences or delays that prevent it from being a lasting and strategic funding tool. The Discover Programme is seen to include important aspects such as key target groups, young generations, teachers, capacity building and CPD, as well as a sensibility towards innovative approaches and a will to embrace new ways of public engagement.

Current activities such as working with students, teachers, and researchers, and opportunities for capacity building or the development of an enquiry-based approach that contributes to the development of an attitude rather than a temporary interest, are activities recommended to continue, as are activities such as science festivals for their role in citizen awareness. Types of activity to be encouraged are those that build an active role for citizens and learners, creating opportunities in which researchers and citizens engage in meaningful dialogue, where there are clear mechanisms through which the civil society influences the innovation process, and that move from promoting debate to ensuring impact. It is recognised however that while there is a movement towards this kind of activity, there are currently few high quality, authentic examples of this across Europe.

5.2 France

The public engagement funding landscape in France is described as considerably different to that of Ireland. The French state invests in public engagement mainly through state institutions based in Paris, such as Universcience, or the Museum d'Histoire Naturelle. Although national research bodies can fund some PE projects, or PE activities can be embedded within research grants, this is not an obligation of research funding. Outside of the Paris area, each region is given its own public engagement budget in a decentralised process. Although the strategy and main priorities are set at a national level, the application of these is conducted at the regional level, taking into account the specificities in various regions.

Some differences in the aims of public engagement activities in France and those of the Discover Programme projects are noted. A higher prioritisation of the special target groups was expected, and the little focus on debate and critical dialogue related to STEM is noted as a weaker point of the Discover Programme. French universities are described as often relying on their own budgets, and on partnerships with science centres to deliver public engagement activities, benefits of which are seen as fostering mutually beneficial collaborations between researchers and public engagement professionals, a good level of quality, and quickening the adoption by researchers of new engagement practices, such as participatory approaches. An area noted to be less prevalent in France than Ireland however is the presence of engaged research.

The Discover Programme is seen to have a good variety of activities, although more citizen science, co-creation and living lab approaches is expected. A strength of the programme is described as its impact on formal education, and the influence of current research on what happens in the classroom. Another strength is seen as the focus on careers, especially side effects such as creating connections with researchers and decreasing the gap between the scientific community and society as a whole. Other notable differences between the Discover Programme and funding in France is the inclusion of broadcast projects, and the smaller focus on engineering.

5.3 Portugal

There is no sustained funding scheme for public engagement with STEM in Portugal. There have occasionally been funding calls by either the national funding agency for science and technology (FCT), or the national agency for the promotion of scientific culture (Ciência Viva), however these typically awarded small grants of a few thousand Euros. The main sources of funding for public engagement with science come from the European Commission, local councils, and foundations. Some form of public engagement is included in FCT-funded social science research grants, namely those that investigate the social, ethical or economic impact of science and research.

It is noted that there are few projects that encourage a critical engagement with STEM, or that create space for dialogue, debate and deliberation, within the projects funded by the Discover Programme. Another highlighted area which has little focus are projects targeting audiences with disabilities, and those in disadvantaged areas. The types of projects funded such as festivals, training for scientists, and collaborative work with artists are all projects expected to be seen in a programme such as Discover, as are projects that feed into the more recent 'hackathon' and 'maker' movement. A suggested innovative component is the application of the hackathon concept to the resolution of socially relevant problems, i.e. the application of scientific and technological skills in addressing problems in fields of environmental impact, humanitarian causes, and healthcare.

The programme is thought to have the potential to be a real stimulus for innovative approaches to public engagement with STEM.

5.4 Spain

In Spain the main public funding agency for science communication activities is the Spanish Foundation for Science and Technology (FECYT), part of the Ministry of Economy, Industry and Competitiveness. The FECYT runs a funding call approximately once a year for projects that promote science, technology and innovation culture. This funding call is a similar size to the Discover Programme, awarding approximately €3,250,000 in total. Given the difference in size of the two countries, the Discover programme is therefore more significant in terms of the level of the funding vs. the national population. A difference to the Discover Programme is that this funding is split into three streams:

- Promoting science, technology and innovation- this is allocated approximately half the funding
- Promoting science education and science capital among students
- Science and innovation communication networks- only public institutions such as universities and museums can apply in this stream

The emphasis of Discover Programme projects on targeting young audiences is noted, with a recommendation to increase focus on audiences such as the elderly, those living in disadvantaged areas, those with disabilities, or adults who may not already have an interest in STEM subjects. Positives in the Discover Programme which are not included in the FECYT call are the inclusion of smaller pilot projects, and the ability to apply for 2 years of funding, which is not possible in the FECYT call. However, no important cultural differences are seen in terms of approach.

Self-sustainability of projects is not seen as a necessity, particularly where projects aim to work with underserved audiences. Aspects such as progression of costs (a project's costs should not increase, and should even decrease over the years as it gets more efficient), innovation costs (introduction of an innovative project might have high initial costs, but these should be recovered in future editions), and cost per participant (with justifications) should be considered. For projects where sustainability is desired, offering guidance, contacts, and links with other STEM companies and private organisations interested in funding public engagement projects is a suggested consideration.

5.5 New Zealand

The original political drivers for public engagement with science over the last decade in New Zealand were to improve science literacy and the awareness of the public in the importance of innovation and research, resulting in the emergence of a strong programme of science communication and public engagement. A more recent drive for scientists and researchers to engage with the public about their research has resulted in the creation of national prizes for science communication, a requirement of research funding to include communication of findings, as well as specific funding for programmes involving public engagement.

The diversity of public engagement projects in New Zealand is described as similar to those in Ireland, although there is a greater focus on citizen science, and less prevalence in broadcast media. A recent focus on environmental projects is said to have had more impact on community involvement than previous "celebrating STEM" projects, and community engagement as one of eight principles in the New Zealand educational curriculum provides a strong culture of school involvement. The citizen science programmes described have evolved from science fairs and festivals, with a measure of success taken as the enabling and empowerment of those less likely to be doing science.

A change of government and increased emphasis towards environmental projects, particularly predator control and habitat restoration, over the last five years is said to have made engagement projects more sustainable and coincided with an emergence of demand in both primary and secondary schools for STEM engagement.

Although the ivory tower remains in New Zealand, the success of projects is attributed to empowering local citizens, along with the existence of networks such as a Citizen Science network, SCANZ (Science Communicator's Association New Zealand) and a directory of citizen science projects and emailing list. The small population of New Zealand is said to aid networking, with national meetings organised to bring people together, which are expected to grow.

5.6 UK

The public engagement funding landscape in the UK is more complicated than that of Ireland. Government funding is distributed through UK Research and Innovation (UKRI), who distribute the UK's research budget, not only for STEM but also social sciences, arts and humanities. There is currently no dedicated PE funding stream from UKRI, PE activities are funded as additional and optional components of research grants. The Department for Business, Energy and Industrial Strategy (BEIS) also fund PE activities, through programmes such as STEM Ambassadors, the British Science Association, and the National Coordinating Centre for Public Engagement. The presence of the Wellcome Trust in the UK skews any international comparison, as an independent body with a research and engagement spend comparable to many governments and who uses its financial muscle to influence the prevailing culture of PE throughout the UK HEI sector.

Similar to Ireland, the UK has a large focus on working with schools, although the diversity of funding sources gives rise to a number of different agendas. There is seen to be significant political support for programmes that improve educational attainment, contribute to the national skills base and thus to future prosperity; in this regard social inclusion is seen as a key factor in maximising the return on human resources and BEIS is tasked with delivering on these aspirations.

There are also many in the field developing and focussing on a model of engagement that is more reflective, critical, and concerned with the relationship of citizens with science outside the context of professional skills or employment. Elements of both these approaches can be seen in the recent work around science capital, which is becoming a major feature of funded work in the UK and represents an opportunity to diversify and deepen practice in Ireland. Another potential impact of a programme like Discover is the normalisation of PE within a researcher's portfolio of professional activities, for the benefit of both society and the researcher in question.

5.7 General summary

Both similarities and differences are seen with the Discover Programme to other education and public engagement funding internationally. Generally, the variety of activities funded by SFI is commended, although citizen science or dialogue-focused projects are noted as areas for growth of the programme. The programme's activity in education and for the STEM pipeline are also seen as areas of strength, as are the capacity building aspects of the programme.

Areas it is suggested the Discover Programme increases its focus are specific audiences such as those in disadvantaged areas or those less likely to engage with STEM, activities that include a critical dialogue or debate, and activities that use a participatory, co-creative approach or citizen science.

6. Conclusions

Overall, the portfolio of projects funded by the Discover Programme is varied, relevant and seems to be of high quality. The programme funds a high volume of basic, more traditional STEM activities such as schools workshops and science festivals, as well as some that are more innovative including interdisciplinary approaches such as new artist collaborations and youth-led cross-disciplinary projects.

National coverage is good. Somewhat inevitably, activity is greatest in large centres of population and Dublin in particular. When comparing against population numbers however, these areas are not over-represented.

The presence of SFI funded activities on terrestrial television and at large national events such as St Patrick's Day and the Bealtaine Festival makes a solid contribution to creating the idea that STEM is part of ordinary culture and everyday life.

Funded activities are heavily weighted towards working with schools and are dominated by projects led by third level institutions and universities in particular, with Institutes of Technology being much less well represented.

Independent educational organisations are well represented in the funded projects and the overall impression is that they are well networked, work well in partnership, evaluate thoroughly and offer opportunities across the whole country for effective, sustained projects which reach a mixed audience of young people.

Assessing value for money of funded projects is intrinsically challenging, but also problematic due to inaccurate reach figures and very limited impact evaluation. This means it is hard to ascertain whether projects with high per head costs deliver impacts proportionate to their expense. It is also difficult to work out the true cost per head for projects with large reach due to their disparate reach reporting.

Project evaluation is patchy and grant holders have differing levels of understanding of its value to their project and how to do it well. They are also unclear about the programme's expectations regarding evaluation and reporting. Existing evaluations tend to focus on success in producing deliverables and audience feedback in terms of quality of experience. Impacts linked to aims are rarely discussed. In many respects, this is justifiable. Reporting on project impacts is often expected for even the most fleeting styles of engagement where this type of evaluation is neither practical nor credible. However, the general tendency not to report on impact is an area of weakness for the programme and something that needs addressing.

Projects receive a lot of their in-kind support in the form of unpaid time. This mobilises considerable capacity through volunteering which contributes significantly to projects' value for money, with many project leads and organisers giving their time unpaid, in addition to their day job. However it also gives contradictory messages to the emerging culture of public engagement in academia by reinforcing the idea that EPE activities are the territory of those who care passionately enough to put in their own time and effort rather than them being part of the usual, fully-costed business of the university. This is different to project leads who do not work in STEM or carry out publicly-funded research but give their time to these activities because they have an interest or are passionate about them.

Not all areas of STEM are equally represented – science, including current Irish research, is most represented, several projects focus on maths and although these are not a large number of projects it has a larger presence than in the UK where maths is often overlooked. Technology is also fairly well represented (e.g. coding, robotics) but outside of technology and projects that cover STEM as a whole, engineering is almost entirely

absent. Only the STEPS project, funded across four years is solely focussed on engineering. This is a high cost project which makes up 6% of all Discover funding between 2013-2017. Science, including health, space, and environmentally focused projects, received 37% of funding during this period.

The peer review process seems to be effective in identifying high quality projects, but under its current guidelines, it does have some blind spots. For example, projects that originate outside the Republic of Ireland are well positioned to score highly in peer review due to a well-evidenced track record and established brand. However, they were created in a different strategic context from that in Ireland. This means that while they are not necessarily inappropriate, more attention needs to be given to how to re-focus them to fit better within the Irish setting. The current peer review process does not have the capability to do this. It also has a weak mechanism to prioritise projects that work with SFI target groups (girls; some specific geographic locations including rural areas of Ireland and areas of Dublin; socially, economically or educationally disadvantaged audiences). This means that, while these priorities exist in principle, in practice little is done to elevate them.

SFI's position as the principle funder of STEM engagement in Ireland means it needs to create a sensible balance between supporting a broad portfolio of high quality projects and ensuring that under-served and under-represented groups and areas are not overlooked. A simple prioritisation of those groups risks compromising the portfolio overall, so a more considered approach is needed appropriate to SFIs leadership role in setting the agenda and influencing what, how and why engagement happens.

Although projects were high quality, imaginative and often worked with the latest science, two prominent ideas around STEM education and engagement, Science Capital[2] and Inquiry Based Science Education (IBSE) were notable for their almost complete absence – each was mentioned in just two project reports. Science Capital – the combination of what you know about science, how you think about it, what science related activities you do and who you know and how much these make you feel that science is "for you" - has gained great currency in the UK and would be expected to be mentioned in all recent STEM engagement projects. IBSE, a science education pedagogy where students learn about science via a process of inquiry, is viewed as best practice in formal science education and has received a lot of support from the European Commission, although uptake remains variable.

Both of these ideas are in circulation in Ireland – for example Irish universities have been involved in a number of EC funded IBSE[3] projects and SFI themselves frequently refer to Science Capital – and ideas from both of these theories were present within many Discover funded projects, but the absence of the terms "Science Capital" and "IBSE" imply a more general lack of awareness of theoretical frameworks that apply to and shape STEM engagement and pedagogy. This suggests that many of those involved in engagement are

[2] Science Capital Made Clear: https://www.bp.com/content/dam/bp-country/en_gb/united-kingdom/pdf/science_capital_made_clear_INTERACTIVE.pdf

[3] https://cordis.europa.eu/project/rcn/108650_en.html, https://cordis.europa.eu/project/rcn/109072_en.html

relying on their own experience and interest rather than making use of the most up to date knowledge base.

Applicants feel well supported during the application process and are very appreciative of SFI staff willingness to discuss and advise on projects. Applicants also hold this support in high regard in relation to other funders. However, feedback and support once the grants have been awarded, during project delivery and after submission of final reports is lacking.

As a small country, Ireland is well positioned to create and maintain excellent professional networks. Reports of this happening, both formally and informally were very encouraging but also acknowledged that more could and should be done. The potential for excellent networking is a real opportunity in Ireland. If SFI can find ways to support this better, it will help to address many of the weaker aspects of the programme (e.g. industry engagement, reaching target audiences and areas remote from large HEIs, bringing practice in line with the latest theories and pedagogies).

7. Recommendations

We have developed a logic model-provided in appendix 2- that gives a framework for the Discover Programme. This is not intended to be a definitive guide, but a working document that helps to clarify the Programme goals and how activities contribute towards these. It aims to encapsulate all aspects of the Discover Programme and many of the recommendations below map into currently less represented areas of the logic model. It can be used to assess individual projects and the Programme as a whole, and map areas of less activity and areas where activities overlap.

Discover Programme aims

- Address the minor, but important misalignment between SFI Discover Programme aims and funded projects. The logic model provided as part of the evaluation represents an elaboration of the existing aims of the project. We advise SFI to revise and develop this to help them think about how to review, clarify and better communicate the programme's aims. We also advise ongoing use and revision of the logic model as a tool to understand and improve the programme.
- Increase the proportion of funding awarded to projects that create debate, dialogue and critical engagement with STEM. To create a scientifically engaged society requires debate, dialogue, critical engagement and opportunities to influence policy as well as promotion of STEM. This is currently a significant gap in Ireland's engagement portfolio and SFI needs to find ways to enable this through the Discover Programme. For example, this could be done through specific calls, by inviting applicants to reshape applications with an increased opportunity for debate and dialogue and/or through awareness-raising during networking events.
- Actively encourage more high quality applications from engineering-related projects, especially in areas where there is a national skills shortage such as information technology and computing. For example, this could be done via joint initiatives with Engineers Ireland and/or by improving links with industry.
- Be clearer about priority audiences and why it is important to put additional effort into targeting their engagement. SFI has not been sufficiently forceful in ensuring

equity of access to STEM, not just for the groups currently identified but for older adults, people with disabilities and ethnic minority groups. This may also need to extend to other groups such as first language Irish speakers (see also recommendation under funding below).

Funding process

- Offer more pre-application promotion and support to Institutes of Technology. Institutes of Technology have the potential to increase reach into underserved areas but are currently underrepresented in the funding.
- Strengthen the mechanisms for funding projects aimed at priority audiences. Reflect on the rationale for wanting to put additional efforts into engaging with each of these audiences and the nature of the effort required. Where increased engagement with an audience is of high importance, consider what level of additional resource would be appropriate to support engagement effectively and what new mechanisms may be necessary. One option may be to target additional pre-application support towards organisations that are well positioned to fill some of the gaps in the present portfolio and enable them to submit high quality applications that will score well in peer review. Another could be an additional strand of the Discover Programme specifically for projects that work with these audiences. (The Royal Astronomical Society's RAS200 funding programme had some success using these types of approaches[4]).
- Consider the role of volunteer time vs paid time. In order for engagement to take root as part of regular business in higher education, it needs to be recognised as an important activity. Appropriate remuneration contributes to this. Volunteer activity is also important and valuable, so the relative importance of each needs to be weighed up and taken into account.
- Improve end of grant reporting. Current report formats ask for information that is not necessarily useful either for grant holders or for SFI. For example, the detailed financial reporting requested seems to create considerable confusion. Furthermore, SFI have little capacity to look at reports in detail. Consult with other EPE funders (e.g. Royal Academy of Engineering) and grant recipients (especially those with experience of multiple funders) to work out what is useful to both sides. An example end of grant report template has been provided separately to SFI.

Supporting funded projects

- Ensure there is follow-through on any requirements or changes put in place prior to the grant agreement. Some grants are offered on condition of making certain adjustments to the project, but these are not always strictly enforced. Grant holders need to be clear about what is expected and required to demonstrate that they have acted upon requirements.
- Offer improved support for evaluation. It is particularly important that there is good alignment between objectives and evaluation metrics and that there is some

[4] See https://www.ras.org.uk/200/2454-ras200-intro for project background and ras200.org for information about the funded projects. (NB ras.org.uk is the old RAS website. The new website, launched June 2018, does not have background information about the scheme.)

consideration of intended impacts. Currently, fund-holders are not clear what is required and are disappointed by the lack of feedback. The lack of evaluation evidence makes it difficult to understand the quality and impact of projects and identify ways to improve. Support in this area could be improved by offering increased training (e.g. via compulsory webinars or evaluation planning workshops for all funded projects) and clarification of expectations. In particular, it might be beneficial to support applicants to work through a logic-model that focuses them on the intended outcomes and impacts of their project and how these can be measured rather than limiting their evaluation to delivery metrics. However, this evaluation approach is unlikely to be appropriate for all projects.

- See projects in action. Grant holders would really value visits from the funders.

Networking

- Offer more networking opportunities. Past and present fund holders really appreciate the national networking opportunities but would like more of them to take place outside of Dublin.
- Create more strategic links with industry. There is little representation from industry in Discover grants. Improving links with industry is not an easy task, but SFI is relatively well positioned to do this. There may also be opportunities to leverage connections made via funded projects.
- Offer more networking opportunities between funded projects and formal education including teachers, teacher trainers and educational researchers. This will help to understand what teachers want and improve links to best practice pedagogy.
- Improve connections to community organisations. Community organisations have the potential to reach into underserved groups and offer innovative and relevant approaches to STEM engagement – some independent educational organisations could act as a bridge.
- Disseminate the latest theories and knowledge base, for example through webinars or during networking meetings.

Joining up with other strategic initiatives

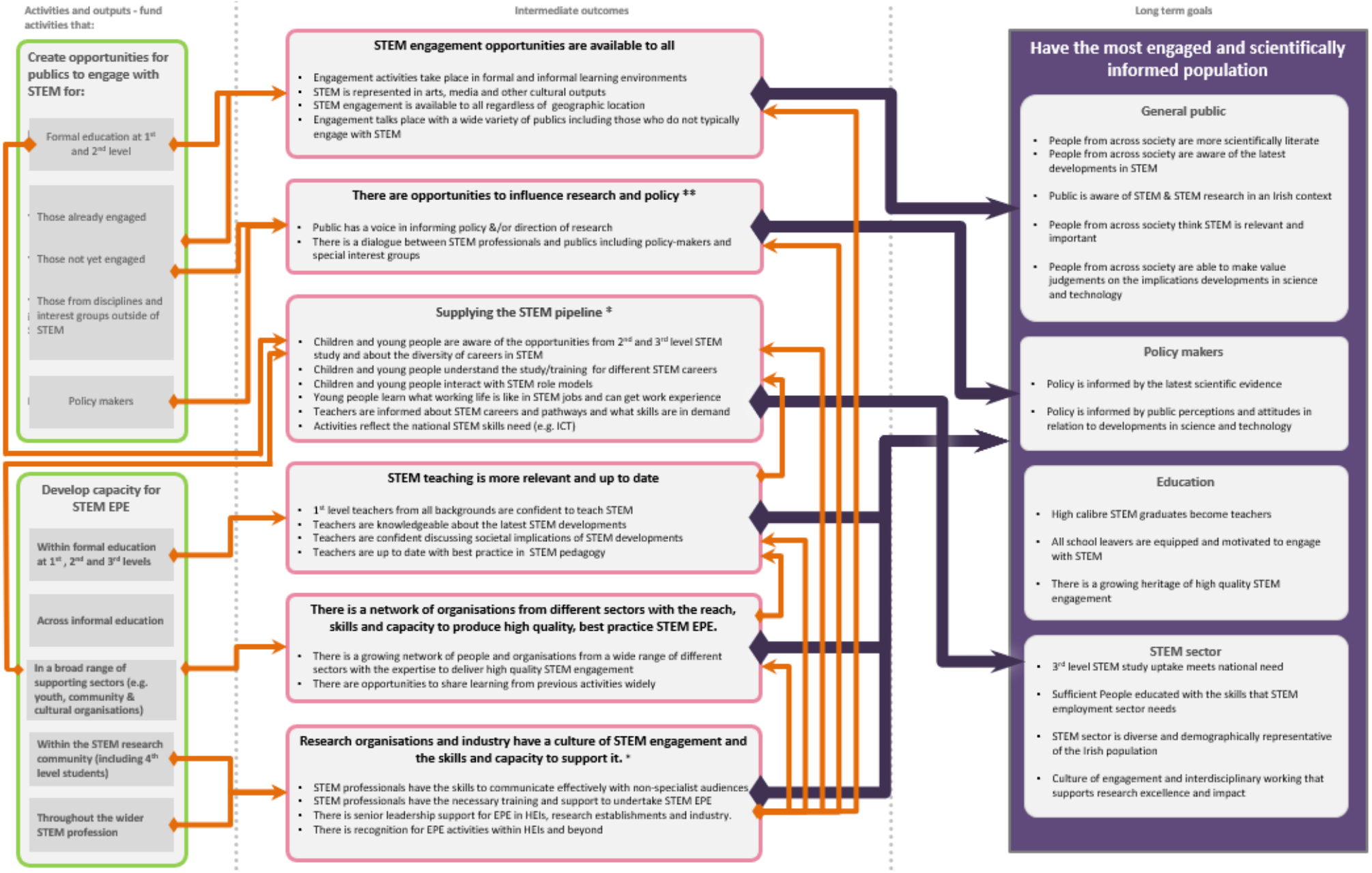
- Join up with other organisations' strategic initiatives with a view to coordinating some support. SFI Discover's aims intersect with a number of other strategic initiatives. These include responsible research and innovation, engaged research, impact, widening access to higher education, researcher development, maintaining the STEM pipeline and civic engagement. While these initiatives have their own specific aims, the synergies and overlaps offer opportunities for cooperation that could add value for all parties. For example, communication and engagement training for scientists is relevant to Discover aims and also to Campus Engage strategies.
- Consider how to reward and recognise the best projects, especially for HEIs. This will help to showcase outstanding engagement and demonstrate that engagement is valued and important.

Appendix 1 - repeat funded projects

Project title	Organisation	Times funded	Years funded
FameLab	British Council Ireland	5	2013, 2014, 2015, 2016, 2017
I'm a Scientist/ Engineer	Gallomanor Communications	5	2013, 2014, 2015, 2016, 2017
SFI Discover zone at St Patrick's Day Festival	St Patrick's Festival	5	2013, 2014, 2015, 2016, 2017
Dublin/Ireland Maker	NUI Maynooth	4	2013, 2015, 2016, 2017
Physics Busking	Dublin City University	4	2013, 2015, 2016, 2017
Science Hub Limerick	Learning Hub Limerick	4	2014, 2015, 2016, 2017
Calmast STEM Outreach Hub	Calmast, Waterford Institute of Technology	3	2015, 2016, 2017
Cell Explorers	NUI Galway	3	2013, 2014, 2016
Curiosity Studio	The Festival of Curiosity	3	2015, 2016, 2017
Maths Sparks	University College Dublin	3	2015, 2016, 2017
Music and Science: Quavers to quadratics	National Concert Hall	3	2015, 2016, 2017
RDS Primary Science Fair	Royal Dublin Society	3	2015, 2016, 2017
Tech Week	ICS Skills	3	2013, 2014, 2016
Thesis in 3	University College Dublin	3	2013, 2014, 2015
Apps4Gaps	Insight Centre for Data Analytics, NUIG	2	2014, 2015
Bealtaine Festival	Waterford Institute of Technology	2	2013, 2014
Bright Club	Trinity College Dublin, NUI Galway	2	2015 (TCD), 2016 (NUIG)
CoderDojo	CoderDojo Ireland Foundation	2	2014, 2017
Curiosity Lab	The Festival of Curiosity	2	2013, 2014
Debating Science Issues	University College Cork, Royal College of Surgeons	2	2013 (UCC), 2014 (RCS)
ELI Afterschool coding club	National College of Ireland	2	2016, 2017
Engineers Ireland STEPS programme	Institution of Engineers of Ireland	2	2015, 2017

Expansion of Spectroscopy in a suitcase	Royal Society of Chemistry	2	2015, 2016
Festival of Curiosity	The Festival of Curiosity	2	2015, 2017
I Wish	I Wish STEM	2	2015, 2016
INSIDERS	Stop.watch Television Ltd	2	2014, 2016
Letter of 1916: Community Engagement	NUI Maynooth	2	2014, 2015
MakerDojo	Tyndall National Institute, UCC	2	2014, 2016
Maths Week Ireland	Waterford Institute of Technology	2	2015, 2017
ReelLIFE SCIENCE video competition	NUI Galway	2	2016, 2017
Science LIVE!	AMBER, CRANN Institute	2	2014, 2015
Science on Stage	Science on Stage in Ireland-Dublin City University	2	2014, 2016
SciFest	SciFest Ltd	2	2015, 2017
Suite Science	University College Dublin	2	2016, 2017
VEX IQ Junior Robotics	Lifetime Lab	2	2013, 2015

Appendix 2 – logic model and narrative



* - Areas where Discover funds projects but that are not apparent from its aims and objectives (supporting the STEM pipeline; developing researcher capacity for EPE)
** - Area where Discover funds very little. Support is implied in its aims and objectives ("debate" and "new ways of thinking about STEM" and in the idea of "the most engaged public")

Logic model narrative

1) Introduction

This document describes a theory of change logic model for the SFI Discover Programme. It is intended for use as a working document that can be clarified and refined over time in response to improving understanding of the relationship between the programmes actions and outcomes and any strategic changes in the programme's goals and framing.

The purpose of a theory of change is to describe the routes between an activity and its desired goal, ensure that actions and goals align and understand, test and clarify any underlying assumptions.

This theory of change outlines education and public engagement (EPE) actions that can contribute to Science Foundation Ireland's long term strategic goal of having "the most engaged and scientifically informed public which are achievable and measurable within the scope of the Discover Programme.

It attempts to encompass all approaches that the Discover Programme and the projects it funds could take to meet the programme's aims. Individual projects will not and should not try to cover all of these approaches. However, any project that does not fit at least one area within the theory of change should be outside the scope of the funding.

Our Discover Programme theory of change is informed by the following elements:

- The Discover Programme aims and objectives (Appendix 2b)
- A systematic analysis of projects that have received grant funding to date
- Unpacking the meaning of the goal to "Have the most engaged and scientifically informed public" based on our own knowledge of STEM engagement (Appendix 2c)
- Background knowledge of the contexts driving STEM education and public engagement in Ireland and elsewhere

Assumptions and enablers relating to each aspect of the theory are detailed in pink beneath their corresponding section. Please note that these are not necessarily a comprehensive list and should be clarified and developed in line with the Theory of Change itself.

2) Activities and outputs

We have identified two subsections of activities funded by the programme.

1. Activities that provide opportunities for publics to engage with STEM
2. Activities that develop capacity for STEM EPE.

2.1) Activities that provide opportunities for publics to engage with STEM

2.1.1.) Who are publics the Discover Programme wishes to engage?

- Formal education at 1st and 2nd Level
- The wider public, including young people outside of formal education

  - People who are already engaged with STEM
  - People who are not yet engaged with STEM
  - Those from disciplines and interest groups outside of STEM
- Policy makers

Why engage with formal education?

There are many reasons for targeting formal education.

- Young people are developing their view of the world; it is therefore possible to make a substantial difference to young person's interests and aspirations that could continue into adult life.
- Almost all children can be reached through schools, giving an opportunity to influence the whole of society
- Extending what schools can offer through external influence and expertise can enrich formal education through bringing the latest ideas, different approaches to teaching, role models etc.

Enablers and assumptions:

- Schools have the capacity to engage both in terms of time and the associated costs in relation to transport, professional fees and staff cover charges.
- Activities are age appropriate, support the curriculum and are timed to fit the pattern of the school year
- Participation in activities is associated with increased attainment
- Activities are available to young people regardless of ability
- Teachers are able to provide linked follow-on conversations and activities
- Both short-term and longer-term interventions have lasting positive impacts on participants

Why engage with the wider public?

The wider public is a necessary target for engagement opportunities in order to support the long-term goal of having the most engaged public. The target needs to include everyone but the same approaches to engagement will not be suitable for everyone.

Here, the wider public is segmented into three groups: those already engaged in STEM; those not currently engaged with STEM; and those from disciplines and interest groups outside of STEM. This is a relatively coarse-grained approach to encapsulating the whole population, but does allow for some focus on different types of audiences.

Why engage with policy- makers?

Engagement with policy makers is important to instigate change and create a scientifically informed public. Full engagement requires that different types of people have a voice in policy decisions at all scales.

Where publics engage with policy in collaboration with experts such as STEM professionals, policy at all levels can be informed by what non-experts think is acceptable and/or important as well as what experts say can/should be done. This can have impacts at many levels from individual to institutional to national.

Where STEM experts use their knowledge to engage with policy-makers, policy-makers will be better informed by current developments in science and technology and this will have an impact on policy.

The relationship between publics and policy in relation to STEM is important if through-and-through public engagement with STEM is required. Opportunities for increased public ownership of STEM-related policy are essential to create an engaged public.

2.1.2) What are the intermediate outcomes?

STEM engagement opportunities are available to all

- There are relevant, appropriate and accessible opportunities to engage with up to date STEM for everyone regardless of age, interest, geographic location or socioeconomic status.
- STEM engagement opportunities can be found in all types of cultural venues and outlets including those not typically associated with STEM.

Enablers and assumptions:

- There are no cost barriers to access for participants
- There are no geographic or other logistical barriers to access for participants
- There are no psychosocial barriers to access
- There are effective mechanisms to reach and engage with those who are not currently engaged.
- Approaches that are indirectly about STEM are effective in highlighting the role of STEM in society and translate into more direct STEM engagement.
- Access to STEM engagement opportunities is equitable and understands the needs of its intended audience.
- There is sufficient insight and resource within the engagement sector to reach the least engaged.
- Non-STEM specialist groups see the relevance and value of STEM engagement
- The high visibility of STEM contributes to a culture where STEM is seen as integral to the functioning of society.

There are opportunities to influence research and policy

- The public has a voice in informing policy and/or the direction of research
- There is formal and informal dialogue between STEM professionals and publics, including policy-makers and special interest groups.

Enablers and assumptions:

- Publics feel their views are valued and listened to.
- Those responsible for policy are willing and able to take public views into account.
- Public input into policy decisions is visible to those who contributed.

Without these factors, trust will be lost and people will become disengaged.

The Discover Programme currently funds little in this area. It has funded projects which engage with policy-makers and projects that encourage debate about science. However, it has not yet funded projects where publics can discuss issues around science with policy-makers or participate in ways that could alter policy or research priorities.

There is a sufficient supply of new talent to the STEM pipeline

An engaged population must have the capacity to sustain and renew the expertise required for STEM research and development without undue reliance on other countries to provide the brightest and best.

Children and young people therefore need to be aware of the career opportunities related to STEM and the educational and vocational pathways to achieve them.

They also need more tangible, affective experiences to inspire them and raise aspirations, for example through interactions with role models and mentors, or work experience.

Teachers need to be sources of knowledge and inspiration about STEM careers.

- Children and young people are aware of the opportunities from 2nd and 3rd level STEM study and about the diversity of careers in STEM
- Children and young people understand the study/training for different STEM careers
- Children and young people interact with STEM role models
- Young people learn what working life is like in STEM jobs and can get work experience
- Young people are aware of the areas with the greatest employment prospects/skills need
- Teachers are informed about STEM careers and pathways
- Teachers are aware of areas of greatest national skills need

Enablers and assumptions:

Promotion of STEM careers and STEM study do not feature in the Discover Programme's aims and supplying the STEM pipeline does not readily fit into the aspiration of "having the most engaged and scientifically informed **public**" - in this context, those with STEM expertise would not be expected to count as "the public".

However, the programme regularly supports projects in this area and at least one call has invited applicants to address the STEM pipeline.

Furthermore, experience in other countries would suggest that a programme of this sort would generally include STEM careers and aspiration-raising aims. Adjusting SFI's long term goal to read "having the most engaged and scientifically informed **population**" would address this.

- Activities take place at the right stage in a young person's development and decision-making to have an impact
- Activities break down rather than reinforcing negative perceptions regarding STEM
- Fun and excitement translates into increased aspiration and feelings that STEM is for "people like me"
- Young people's choices represent not only their own interests, but relate to areas where there is the greatest skills need

2.2) Activities that develop capacity for STEM EPE

To meet the goal of having the most engaged and scientifically informed public, it is essential to develop capacity for STEM education and public engagement.

This capacity needs to include a full breadth of community, civic and cultural organisations as well as throughout formal education at all levels and within industry.

Networks and sharing mechanisms that will increase capacity and enable best practice to be understood, developed and shared need to be developed and cover the whole country.

Teachers need to be kept up to date with the latest ideas from research both in terms of the content and practice of their teaching. Teachers with weaker STEM backgrounds need to build confidence in teaching STEM subjects.

Scientists need to be competent and confident it communicating and collaborating with non-specialist audiences.

Industry needs to be involved in the networks, training and delivery of STEM EPE.

2.2.1) Where could the Discover Programme contribute to capacity development?

- Within formal education at first, second and third levels
- Across informal education
- In a broad range of supporting sectors – e.g. youth, community and cultural organisations
- Within the STEM research community including 4th level students
- Throughout the wider STEM profession including industry

Enablers and assumptions:

- First and second level teachers have the capacity to engage with STEM CPD opportunities
- Offering training for STEM researchers translates into more, higher quality STEM engagement by STEM professionals
- Value of public engagement is understood in the STEM professions beyond academia
- Youth, community and cultural organisations see the value and relevance of working with STEM
- STEM undergraduate programmes value engagement skills and practice and are willing to formally embed engagement
- There are opportunities to build and develop formal links with industry in relation to EPE.
- There is evidence of the value of public engagement to practitioners as well as their audiences/collaborators
- Increased support and opportunities for STEM engagement help to establish a culture where public engagement is seen as a part of a researchers' normal business

2.2.2) What are the intermediate outcomes?

STEM teaching is more relevant and up to date

- 1st level teachers from all backgrounds are confident to teach STEM
- Teachers are knowledgeable about the latest STEM developments
- Teachers are confident discussing societal implications of STEM developments
- Teachers are up to date with best practice in STEM pedagogy

There is a network of organisations from different sectors with the reach, skills and capacity to produce high quality, best practice STEM EPE.

- There is a growing network of people and organisations from a wide range of different sectors with the expertise to deliver high quality STEM engagement
- There are opportunities to share learning from previous activities widely

Research organisations and industry have a culture of STEM engagement and the skills and capacity to support it.

- STEM professionals have the skills to communicate effectively with non-specialist audiences
- STEM professionals have the necessary training and support to undertake STEM EPE
- There is senior leadership support for EPE in HEIs, research establishments and industry.
- There is recognition for EPE activities within HEIs and beyond

Enablers and assumptions:

- There is a culture of STEM EPE involvement among STEM professionals which includes formal recognition
- HEIs see EPE as part of their everyday business
- There is alignment between different policies and agendas relating to EPE (e.g. Responsible Research and Innovation, Corporate Social Responsibility, Civic engagement, recruitment to the STEM pipeline, engaged research, research impact)
- There is alignment and interconnection between Discover and other SFI EPE programmes
- Policies are updated to reflect a commitment to EPE
- Industry sees the value of EPE and how it relates to their corporate social responsibility

Appendix 2b - SFI Discover Programme aims and objectives

The mission of the SFI education and public engagement programme is to catalyse, inspire and guide the best in STEM education and public engagement. In support of this mission the purpose of the SFI Discover Programme Call is to support and develop the STEM education and public engagement sector in Ireland by:

- Investing in developing and extending capacity in this area
- Exploring and encouraging novel means of public engagement and communications

The objectives of the SFI Discover Programme call are to:

- Stimulate interest, excitement and debate about STEM through various methods
- Support formal and informal learning within STEM
- Promote awareness and understanding of the importance and relevance of STEM to everyday life, reaching new audiences not normally engaged with STEM, as well as continuing to target existing audiences
- Encourage new ways of thinking about STEM
- Encourage high quality inter-disciplinary practice and collaborative partnerships
- Investigate and test new methods of engagement, participation and education
- Leverage, support and broaden, where possible, existing programmes

Appendix 2c - unpacking "Have the most engaged and scientifically informed public"

We have unpacked the statement "have the most engaged and scientifically informed public" in relation to SFI EPE and Discover Programme aims and objectives, the portfolio of Discover Programme funded projects, documentation regarding engagement in the Irish context and our own expertise in engagement.

What is meant by public:

- Children/young people in formal educational settings
- Teachers
- Children/young people in informal educational settings
- Families
- Adults
- Older people
- People of all educational backgrounds
- People from all socioeconomic demographics
- Special interest groups (e.g. patients, religious groups, policy makers, artists and makers)
- People who are not normally engaged with STEM
- People from all geographic areas of Ireland

What is meant by informed:

- Scientifically literate
    - Have a good understanding of basic science
    - Understand the scientific process
    - Can use their knowledge to judge whether or not information is scientifically valid and to evaluate competing claims
- Aware of the latest developments in STEM
- Aware of the societal implications of developments in STEM
- Able to form their own value judgements about these implications based on a good understanding of the science

What is meant by engaged:

- Personal level engagement
    - Interested in fundamental science and its underlying concepts
    - Want to be aware of the latest developments in science and technology
    - Have developed their own views regarding the societal implications of developments in science and technology
    - Are aware of the value of STEM to the Irish economy
- Societal /civic level engagement
    - Have opportunities to input their views into policies regarding science and technology
    - Have opportunities to input in ways that inform the direction of scientific research

Appendix 3 - international reports

Appendix 3a.

Maria Xanthoudaki- Italy

1. Context, in general

The SFI Programme should be considered in the context of an increasing general sensibility towards, and action in, science communication and Public Engagement. From the EU with the RRI framework and related investments, to national initiatives or programmes (in which museums and science centres have an important role), there seems to be an ever-wider acknowledgement of the need and importance to create a direct and active relationship between science and society.

Worth mentioning here are the following cases:

a) The Horizon 2020 Programme of the European Union not only encourages Public Engagement but has created a shift in the way science communication has been regarded so far. Horizon 2020 places the need for opportunities for dialogue and engagement among the responsibilities of the scientific community as much as of the science communication experts, with several often complex implications. https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation
b) The initiative OpenUp Science is a responsible research and innovation project created in collaboration among the major European science museums, that is, Science Museum London, Deutsches Museum, Universcience with Fonds de Dotation Universcience Partenairs, Museum National d'Histoire Naturelle, Museo Nazionale della Scienza e della Tecnologia Leonardo da Vinci. This initiative wanted to take a step further in what we regard as citizen engagement for, it seems, most of the existing initiatives are still very much deficit based. For this reason, the museums came together to reflect on what it means and what it takes to 'close the feedback loop', that is, to ensure public action that is the result of evidence-based and up-to-date information and that the citizens' input reaches the scientists – therefore, that research benefits from well-constructed evidence from society.
(no website, paper volume available).

2. The Italian context

With particular reference to the Italian context, there are, in this case too, numerous and increasing initiatives of science communication, ranging from science festivals, education projects for teachers and students, online tools, etc., developed and run by museums, science centres, associations, research institutions, and funded by public or private bodies. Although the number of initiatives around the country is high, we cannot argue

that Public Engagement represents a priority of the government (as research does not either), while the private funding bodies supporting such efforts are indeed very few.

In detail:

- The law '6/2000 for the dissemination of scientific culture' of the Ministry of Education, University and Research is the main channel for funding this kind of projects and programmes and is mainly aimed at museums, education or science communication agents. The annual calls fund either 3-year collaborative projects at national level or smaller 1-year projects, all aiming to reach schools and young generations and with them teachers and families. Average annual total funding is around €8.000.000.

- The National Council of Research (CNR) is another public body does at times fund science communication initiatives mostly with the aim to make their research known to the public and with particular focus on young generations. In this case, funding is specific, going to individual initiatives. Similar funding is given by the Italian Space Agency, in this case for education projects that introduce Space as topic for STEM education and carrier orientation.

- The Cariplo Foundation (linked to an important north-Italy bank institution) is maybe the only private body (if not the only, certainly among the very few at national level) that shows a structured awareness of the importance of Public Engagement. In line with the EU policy, Cariplo has adopted the RRI-oriented values and explicitly requires for specific Public Engagement actions in all its research funding calls.

- In parallel to the funding opportunities, there are several initiatives promoting Public Engagement but with no funding. For example, STEM in the City is the recent initiative of the City of Milano gathering already-existing or made ad hoc activities into one single programme with the aim to attract citizens towards, and stimulate dialogue on, STEM topics https://www.steminthecity.eu. Or, the 'STEAMiamoci' initiative of the Association of Industrialists of North Italy which has a similar character and goals and mainly addresses schools http://www.assolombarda.it/steamiamoci.

- Higher education has been attributed the 'third mission', that is, the task to reach the wider public through a range of outreach and public understanding of science initiatives. See for example the Art&Science Programme of the Politecnico di Milano https://www.eventi.polimi.it/rassegna-evento/arte-e-scienza-dialoghi/ or the Festival of Sustainable Development https://www.polimi.it/tutte-le-news/dettaglio-news/article/10/al-via-il-festival-dello-sviluppo-sostenibile-5610/. Here, we should also mention the main Public Engagement initiative attributed principally to higher education institutions: the European Researchers' Night mainly funded by a specific bi-annual EU call.

- Science festivals have always been present in Italy – first of all the Science Festival in Genoa City since 2003 and BergamoScienza since 2005 – but in the recent years there seems to be an incredible boost of the number and types of festivals across the country: From the Festival of Sustainable Development mentioned above, to

> the Festival of the Brain, the Festival of the Ideas, as well as the Festival of Beauty or the Festivals of Economy or Philosophy, these are organised by newspapers, scientific journals, ad-hoc associations, city administrations and funded by private sponsors, foundations and other organisations sensitive to the cause. This kind of organisation seems to be taking the attention of the public that looks to be involved in something out of the ordinary, to meet often famous personalities or raise their questions directly. The question remains: what is the impact of the festivals on the people – but, more than that, I would say on the scientific community involved as speakers and experts in the various fields. I am not aware of any efforts to look into this issue.

Based on this question, I would argue that if we wanted to take one step further and look into the engagement methods adopted by the majority of the above initiatives – that is, those that foster an authentic Public Engagement of citizens/learners therefore, as the OpenUp Science initiative suggests, help develop an active role for citizens – then we end up with only a small number of examples across Italy. The reason, in my view, appears to be the limited, still, recognition of the need for real dialogue between the scientific community and citizens; we are still in the era of the public understanding of science, we are still working on the scientific community getting out of the ivory tower and into the public square. But this is a very important step. It means that we are making an effort to understand what it means to reach the public, to create the conditions for a direct relationship, even if there are still not many opportunities for 'closing the loop'. To do this, we need to understand not that much the need to educate society, as the importance of society in the scientific debate – something that not everybody necessarily feels the need for.

3. Examples of best practice

As mentioned above, there are several quality cases of Public Engagement in Italy, several important efforts to create a context for a direct relationship between science and society. But there is still a lot to be done regarding what we really mean with the term 'engagement'. I would mention two examples from the experience of the National Museum of Science and Technology Leonardo da Vinci (MUST) taking them as a stimulus to discuss the steps that still need to be taken (in general, but maybe also in the context of the SFI Programme):

a) The need to train researchers in Public Engagement

One of the first things we should address is the *nature* of the relationship that needs to be built between researchers/scientists and citizens. MUST, based on a series of opportunities of direct work with the scientific community, reflects on what dialogue and engagement really mean in terms of roles, identities, values - and stereotypes. If we aspire to have a role in developing what RRI calls for – "working together" and "mutual responsibility" – we do need to invest in a shared agenda between researchers, citizens, and museums. Training here seems to be the key.

In this respect, our most recent experience in training researchers emerged after an explicit invitation from the Cariplo Foundation. Cariplo, in line with Horizon 2020 and RRI, recognises the centrality of the citizen in the debate about science and technology and considers communication as one of the compulsory requisites for a fundable research proposal. In this context, the Foundation asked the Museum to structure a training programme for researchers that would address the lack of participatory approaches in the communication plans of (funded) research proposals, and help research institutions to improve their Public Engagement strategy. The training is aimed at a total of 50 researchers from 16 different institutions mainly, but not only, from the Region of Lombardy, with research projects on biomedical research, industrial biotechnologies and water resource management. All of them have been funded through the Cariplo research calls in 2015.

The goal in this case was not that much to create experts in science communication, but rather to build researchers' awareness of the need to communicate science, of the reasons why we need to put citizens at the centre of the learning experience and engagement processes, and to build a context of mutual understanding and respect. However, this has been a particularly taxing task. It is not only the fact that we addressed (high-level) professionals who, though, do a different job and are suddenly called to see themselves as communicators away from their labs and scientific publishing; it is also the fact that the noble mission of a researcher does not often see an ally in what Irwin calls "third order thinking in science communication", that is, that "different forms of expertise, practice and understanding represent an important resource for change rather than an impediment or burden". Nevertheless, this experience has strengthened even more the need to create training opportunities for researchers if and when we are asking them to take up the role of a communicator with people that are not part of their usual context of discourse. And I think this should represent an important field of continuous investment and action.

b) The approach to Public Engagement programmes

'Science and Society', as a field of action and as a methodology for engagement with science and research put its first roots down at MUST about 10 years ago with a programme called "Make up your mind". The programme combined experimental activities in the Museum's interactive labs with informal meetings between adult visitors and researchers. Lab activities aimed to stimulate reflection and discussion on current research topics while the meetings aimed to bring citizens and experts together in debate. The sequence of the two moments was deliberate; experiments came first and were purposefully designed to engage visitors in first-hand experience in science, raise interest and questions, and build a context of ease and trust even in the cases of new, difficult or controversial topics. Then came the debate, which built on the visitors' concrete experience in the lab and on their questions to move on to an exchange of views between the different participants.

"Make up your mind" inspired more similar projects creating a continuity in methodology and practice. It offered us the opportunity to reflect on the ways to engage citizens in discussing contemporary research, and the opportunity to build a close relationship between the research community and the Museum. Ever since, our goal has been that the Museum becomes the place where citizens choose to go, to seek more information, to contribute their own views and to discuss issues at the forefront of the scientific debate – a place in which all people, researchers and non-specialists, have a role in building a shared knowledge.

Without knowing it back then, "Make up your mind" also anticipated what Responsible Research and Innovation today calls for, that is:

- a citizen at the centre of the debate with a strategic role in the process of reflecting how science and technology can contribute to the future we all want
- an open discussion based on the views of different stakeholders;
- knowledge shared and accessible to all.

This experience has stimulated important reflections that, in my view, go beyond the specific case of MUST. We increasingly see that the distance between producers and receivers is blurring: scientists and lay people are actively involved as information brokers and content providers and cannot longer be considered as mere audiences. This implies the need for new models of communication and engagement built on a deep understanding of learning and the role of the learner, and on dialogical, participatory approaches.

4. Comments on the SFI Programme

From what I can understand by reading the evaluation report of the SFI Programme, I see no substantial differences from other funded (or not) Public Engagement initiatives such as the ones presented at the beginning.

There is a clear width and breadth in the Programme covering a wide range of audiences and types of action. What, in my view, can make the difference is there: the key target groups, young generations, teachers, girls, as well as the strategic goals, capacity building and CPD. There is also a clear sensibility towards innovative approaches, that is, the will to embrace new ways of Public Engagement, i.e. Famelab or STEM clubs, and a good balance between high quantity impact actions and smaller more in-depth types of work.

If I would compare this programme with Italy, I would say that it resembles the '6/2000 law for the dissemination of scientific culture' of the Italian Ministry of Education, University and Research. My comment on this would be however that the SFI Programme seems to be a stable, permanent funding opportunity for the country, while the 6/2000 law is unfortunately very often subject to political turbulences or bureaucratic delays that prevent it from being the lasting and strategic funding tool that in principal it is meant to be.

In the SFI Programme, working with students, teachers and researchers is somehow a guarantee of impact, as opportunities for capacity building or the development of an inquiry-based approach contribute to the creation of an attitude more than a temporary interest. Science festivals are important and should keep on being and being funded as their extra-ordinary nature is decisive for citizens' awareness, however investment in what can put the seeds of a sustainable scientific citizenship should remain a priority.

To the above I would add the need to look more into the possibility to create opportunities that 'close the feedback loop'. This means, first of all, the need to understand, in a structured way, the methodological approaches adopted in the funded initiatives and the degree in which they consider and help build an active role for citizens/learners; and, consequently, the need to create (more) opportunities that authentically engage citizens/learners (but also civil society organisations where needed) into a process that *affects change*. This means, for example, opportunities:

- in which researchers and citizens engage in meaningful dialogue
- with clear mechanisms through which the civil society influences the innovation process
- that move from promoting debate to ensuring impact.

This is not an easy task. Across Europe we still find very few situations, if any, in which this takes place really and authentically. But it seems that after Public Understanding of Science and Public Engagement with Science, it is the next step that needs to be taken to ensure and maintain an aware, stance-taking and democratic society.

ONE LAST COMMENT:

The funding schemes from the Italian Ministry of Education, University and Research, National Research Council or the Italian Space Agency are mainly meant for science education programmes rather than Public Engagement ones. With regards to the SFI Programme, for example, activities for students including visits or STEM clubs are in my view science education initiatives while science festivals, citizen science programmes or the 'holistic' engagement projects mentioned can be considered as Public Engagement.

The boundaries of what is defined as science education or Public Engagement are fine, however the time is mature for a distinction that would clarify better identity and goals of each as well as the differences among the two. But this is not the aim of the present report.

Appendix 3b.

Didier Laval- France

Public engagement funding in France

The SFI Discover Programme is significantly different from the Public Engagement funding landscape in France. In France, the main funder for public engagement at national level is the state itself. The French state invests around 250 million euros in public engagement, mostly through grants for its main state institutions based in Paris, such as Universcience or the Museum d'Histoire Naturelle. National research bodies can also fund some public engagement projects, and although such actions can be embedded with research, there is no obligation to add public engagement to research grants. Thus, the funding for research and the funding for public engagement are very often distinct, although the Stratégie Nationale pour la Culture Scientifique,

Technique et Industrielle, a report released in 2017, aims to articulate them. Outside Paris, the budget for public engagement is delegated to each region (3,6 million euro in total), in a decentralised process.

There is thus a great difference between the amount benefitting to Paris and the Ile-de-France region of the capital city and the amount for the other regions. A study led by the AMCSTI and the OCIM identified that in 2015, four organisations (Universcience, Museum d'Histoire Naturelle, and Conservatoire National des Arts et Métiers in Paris, Musée des Confluences in Lyon) received 187 million euros in grants, while the remaining 83 organisations received 22 million euros.

The Ministry in charge of Research and Higher Education also holds a 800 000€ budget for the regions to organise the Fête de la Science, a week long event quite similar to the Science Week. A similar amount is used to fund specific projects from scientific culture actors or to lead national actions – such as the one implemented during COP21.

The first main difference between the French funding and the SFI fund is the decentralisation that is characteristic in France. Previous attempts to centralise the funding of public engagement in the country (the last one in 2012) has failed for various reasons. Today, the strategy is built at national level, the state setting the main priorities, but the application of these are led at regional level, taking in account the specificities of the various territories. Regional councils are re-distributing the budget, and often delegating the coordination of the main public engagement actions – such as the Fête de la Science – to Centres of Scientific, Technical, and Industrial Culture, which may be science centres, science museums or dominant regional associations dedicated to public engagement.

SFI Discover Programme objectives and approaches

Globally, the objectives are quite broad, and do not define any primary main outcome. The scope of projects, the change they are seeking or their impact on the long term is not set by the framework. I am surprised that special target groups are only used as a secondary criteria, if applications have scored similarly during the peer-reviewed process. This is a very soft incentive, while public engagement is often benefitting to the same population groups.

I am wondering what is the relationship between the SFI Discover Programme and digital practices or new technologies. Obviously, applied research in STEM will be extremely linked to new technologies of information and communication, but there is no mention in the programme of any focus on education or engagement about digital technologies, or about reducing inequalities regarding access or use of digital technologies.

The very small focus on debate and critical dialogue related to STEM is also a weak point, not only in terms of variety of actions but also in terms of engagement and audiences. On controversial or debated issues, dialogue is a much more efficient approach than mere information or promotion of science.

As an example, after the GMO-related crisis in Europe, the European Commission has funded a lot of discussion and debate-oriented activities, such as:

• FUND, which enabled the translation of the discussion game DEMOCS to scientific topics, resulting in the PlayDecide game.

• Xplore Health, which funded discussion games about genetic diseases.

• Other discussion games and debate formats appeared in NanOpinion (about nanotechnologies),

SYNENERGENE (on synthetic biology) and other projects.

The applied sciences are the ones that are the closest to society, as they can have a direct economic, social or legal impact. Thus, they are also the ones that may raise important ethical questions. Social rejection of the applications could be mitigated by dialogue activities and ways for citizens to express their views or even influence the outputs.

I would expect that the engagement programme of the SFI to comprise a strong focus on:

• Dialogue on ethical, legal and social consequences of the research: fostering critical thinking,

articulating opinions and choices, enabling dialogue about the research.

• Feeding citizens' view into the research to ensure that applied research is in line with public views, and to unveil new research ideas from public groups and communities.

• Co-creation, co-design or collaborative research, which may open new applications, new products and services, and create a mutual influence between researchers and public groups.

This type of activities would be particularly relevant for the strategic topics of the SFI. Manufacturing includes products that could change the use, habits and life of many public groups (e.g. internet of things), and Health is a vastly interdisciplinary topic, where ethical questions and societal choices play a crucial role.

Organisations funded

French Universities do not have a specific fund for engaged research, so they usually rely on their own budget for public engagement and on specific partnerships with science centres or other organisations. The downside is that engaged research in France is much less present than in Ireland or in the United Kingdom. However, it fosters collaborations between researchers and public engagement professionals, which are mutually beneficial, tend to guarantee a good level of quality, and quickens the adoption by researchers of new engagement practices, such as participatory approaches.

It is noticeable that most of the SFI Discover funding goes to Higher Education Institutions and other educational organisation, with the exclusion of science centres or science-related museums – as these also function as visitors attractions. It is in complete opposition with the French national funding for scientific culture and public engagement, which goes mainly to large and small science centres, natural history museums and technical museums. The French system tends to support these institutions as they offer a whole new environment for learning, an on-site attractive live experience, and a link with culture as a whole. One other reason is that public engagement is not yet considered in France as an integral part of a researchers' job – so most of the funding often goes to major visitor attractions as science centres and museums who define public engagement as their core business. Focusing on Higher Education Institutions (HEI) has a double-side effect:

on the one side, it fosters engaged research as a common practice for researchers, favours institutional change and builds capacities within universities and other HEIs. On the other side, it may miss the opportunity to support visitor attractions and some informal learning actors, or to trigger partnership between visitor attractions and HEIs. Indeed, in terms of scale, visitor attractions often situate between HEIs and film producers. These institutions usually reach much more people than HEIs, including groups who would never feel legitimate to engage in a programme led by a HEI. However, their reach – even for large exhibitions – remain much lower than mass media in terms of number.

Funding HEIs and current researchers offers valuable opportunities to create involvement in on-going research. The small presence of citizen science projects or co-creation and living lab approaches is surprising, as it would be beneficial to all parties. In 2015, the French programme for the Researchers' Night led a call to project for a Grande Experience Participative (Big Participatory Experiment). This experiment was a way to involve all

citizens participating to the Researchers' Night in all French regions in a wide experiment on STEM or social sciences. After the successful attempt of 2015, the principle have been reiterated. As SFI is focusing on applied research, much more public engagement involving citizens in live experiments or measurements, in the co-design of solutions, in exploring themselves possible applications or in testing prototypes would enable them to become actors of current Irish research.

Types of activities

The variety of the programme is good, as the SFI Discover Programmes funds festivals and fairs, scientists talks and short presentation or science busking, as well as collaboration between scientists, artists and public groups. Online activities and programmes on existing portals and platforms (e.g. YouTube videos) seem underrepresented. If this was the case, it would be a missed opportunity to engage absolutely new groups with a very large reach. YouTube scientific video channels, for example, has proven to engage people who would never step in a science centre or watch a mainstream documentary.

As the French equivalent of the Science Week, the Fête de la Science is held during a whole week in October. In 2017, it offered 6000 free animations in France, 150 science villages and the involvement of 2500 places of public engagement. One million visitors participated, including 300 000 school visitors. As stated above, the regions are coordinated each regional Fête de la Science, and the state holds a 800 000€ budget for them. A call to projects is launched each year by a regional coordinator for actors to get involved in the programme. Non-public bodies can also be funded for their Fête de la Science project through this call.

A striking feature of the SFI Discover Programme is the impact the programme has on formal education. The prominence of schools involvement, as well as the importance of teacher CPD – which is much weaker in France -are indicators that an implicit goal of the activities is to influence the formal education system. The excellent point is that it means that current research is constantly influencing what happens in the classroom – the weakness might be, once again, the lack of use of informal learning environments.

The SFI partnership with the national broadcaster appears as a very important element. In France, there is no national partnership to support STEM-related documentaires. However, STEM-related films can be part of a regional Festival of Scientific Film to get attention and recognition. The funding part related to broadcast is particularly interesting – there is no equivalent in France. The reach of such projects is very big, and goes way beyond school students. Moreover, it foster the development of scientific documentaries film-makers, which is an almost non-existing career in many countries, and may result in better quality documentaries on the long term.

The small focus on engineering is also noticeable, as applied research often involves a lot of engineering tasks. This may be a hint showing that the public engagement still mainly focuses on the theoretical background rather than on the applied research itself. It may also indicate that the projects focus on the benefits of the research, with a promotional

approach, rather than tackling also the challenges of "making it real" – which is often the core of applied research. In short, focusing genuinely on applied research could open lots of innovations in public engagement that still seem to be missing in the current programme.

Career awareness is more present than in France. Although several projects focus on them and on the interaction with real scientists (in particular the Fête de la Science), the focus on careers is much lighter in the French landscape. This appears as a strength of the SFI Discover Programme, as it has many other side effects – such as creating connections with real researchers or raising awareness of the research jobs, organisations and process. Beyond the STEM pipeline perspective, all of these contribute to build a public understanding of research, to build science capital and to decrease the gap between the scientific community and society as a whole.

Value for Money

The value for money is something quite difficult to comment upon, as the value cannot only be measured by the number of people reached – but needs to comprise the impact as a whole and the types of audience engaged. If we exclude the 16 projects that have a much higher cost, a median cost of 18.93€ offers a rather good value for money. This cost is higher than large projects focusing or raising awareness of a very large audience (such as the Researchers' Night), but also reflects the fact that more qualitative activities are held. The 16 more costly projects are very expensive though. Budgeting close to 2000€ per person is high – even for a professional training. The actual impact of such projects should be carefully examined. For example, CPD may enable trained teachers to train other teachers using a cascading effect, or may impact the students of each trained teacher – if the CPD materials and approaches are effectively and regularly used in the classroom. For these projects, ensuring that a proper impact evaluation is being held may be necessary.

Appendix 3c.

Ana Godinho- Portugal

The context in which the programme sits - what is the funding landscape is your country, and what are the political and strategic drivers for this? What is funded, by who, and why? What are the typical amounts of funding available?

In Portugal there is currently no equivalent scheme to SFI's Discover Programme. In fact, there is no sustained funding scheme for public engagement in STEM. In the past, either the national funding agency for science and technology (FCT – Fundação para a Ciência e a Tecnologia) or the national agency for the promotion of scientific culture (Ciência Viva) have occasionally opened calls for public engagement/science communication projects.

Grant values typically range from a few thousand euro, to €50,000 (exceptionally).

The main sources of funding for public engagement in science in Portugal are the European Commission, local councils and foundations (namely the Calouste Gulbenkian Foundation).

Some form of public engagement in science is incorporated into FCT-funded social science research projects, namely those that investigate the social, ethical or economic impact of science and research on different social groups.

The breadth of the programme - the variety of projects covered. Would you expect to see anything that is not there?

A large proportion of projects (40%) have schools as their target audience; many have an explicit goal of inspiring, promoting awareness and interest in STEM, often associated to the teaching of skills associated to research and engineering.

As stated in the interim report, few projects encourage a critical engagement with STEM. Furthermore, many are one-way, and do not create space for dialogue, debate and deliberation. Of the projects developed for schools, few adopt an enquiry-based learning approach.

There could be more projects targeted at audiences with disabilities (such as developing exhibition content for the visually impaired, for the deaf or hard of hearing) and those in disadvantaged areas.

What would be your intended impact expectations for a programme such as this?

The Discover Programme's objectives are quite broad, encompassing both outcome-focused goals (stimulate interest in STEM, promote awareness and understanding of the importance of STEM, support formal and informal learning within STEM), to methodological goals (encourage high quality inter-disciplinary practice and collaboration, investigate new methods of engagement).

The impact of the former is difficult to assess, due to the difficulty in controlling for the effect of other engagement and education in science initiatives in Ireland and internationally.

Regarding the latter (methodological) goals, the expectation would be to see an increase in the number of inter-disciplinary projects and in those that propose new methods of engagement, both at the level of applications and funded projects.

The programme could thus be a real stimulus for innovative approaches to public engagement in STEM.

Your comments on the innovation and types of projects funded

Reading through the funded project in 2017, they include the now traditional approaches of interactive activities, festivals, training for scientists, and collaborative work with artists.

The projects that include "maker" and "hackathon" components (such as the Teen Entrepreneur STEM Camp) feed into the more recent maker movement. An innovate component could be the application of the hackathon concept to the resolution of socially relevant problems, that is the application of scientific and technological skills to problems in fields of environmental impact, humanitarian causes and healthcare.

Your comments regarding best practice in your own country and how this compares. Do you have any outstanding examples?

As mentioned above, in Portugal there are, unfortunately, no programmes similar to the Discover Programme.

Are there any significant differences between this programme and ones you are familiar with? Any gaps? Any cultural differences in approach?

This programme seems very similar to the Promoting Science to the Public (PSP) programme of the Luxembourg National Research Fund, specifically the PSP-Classic strand.

The PSP programme has another strand – PSP-Flagship (for which I was a reviewer in the 2017 call). The PSP Flagship aims to set up long-term (3-year) engagement in science

projects, with high impact. Funding is higher (€350,000 - €400,000), and on average two projects are selected in each call.

What are your thoughts on the value for money of the programme?

The Discover Programme contributions are overall lower than the average total cost per person (27% to 60%), thus it would seem that the value for money is positive.

Any comments on the sustainability of funded projects

A strand similar to the above-mentioned PSP-Flagship programme could be considered for the higher impact projects, to ensure their medium to long-term duration.

Appendix 3d.

Angela Monasor- Spain

1. **The context in which the programme sits- what is the funding landscape is your country, and what are the political and strategic drivers for this? What is funded, by who, and why? What are the typical amounts of funding available?**

The main public funding agency for science communication activities in Spain is FECYT (Fundacion Española para la ciencia y la tecnología, Spanish Foundation for Science and Technology), which is part of the Ministry of Economy, Industry and Competitiveness.*

FECYT official objectives are:

- Driving science communication and increasing science culture among society
- Fostering social participation in and for science
- Analyzing and disseminating Spain's science and innovation indicators
- Supporting the internationalization of Spanish science
- Supporting and monitoring Spanish science, technology and innovation policies.

Approximately once a year**, there is a call for projects that promote science, technology and innovation culture.

Calls usually have 3 main lines of funding:

Line of funding	**Global funding (€) 2017 call**
1) Promoting science, technology and innovation	1570000
2) Promoting science education and science capital among students	980000
3) Science & innovation communication networks - only public institutions such as universities and museums can apply	700000
TOTAL	3250000

Each project can only apply to up to 60% of the total costs of the project, so there will always be a need of match funding.

It is very rare to see projects funded with over 100000€ from FECYT. **The average funding per project must be of around 20.000 €.**

There are also a handful of private institutions which fund science communication in Spain, but they don't do it through public calls, but rather private agreements. The main funder probably is Fundación "la Caixa", but others such as Fundación Telefónica, or Fundación BBVA also contribute to certain projects.

* There is no Ministry of Science in Spain since 2011.

** Example of 2017 call calendar (calls for projects to be developed Jan 2018- June 2019):

- Nov 2017: application deadline
- March 2018: provisional resolution
- June 2018: final resolution

2. The breadth of the programme- the variety of projects covered. Would you expect to see anything that is not there?

Among SFI Discover Programme 2017 Funded Projects, there seems to be a **great emphasis on young audiences**, but not so much in other sectors of the public, with the exception of The Festival of Curiosity and Irish Micro Plastic Awareness and Coastal Threats, Big Life fix, Famelab or Bright Club. Moreover, most of these examples are aimed at adults who already have an interest in science. Likewise, The IGGIES project aims to develop STEM concepts with 7-10-year-old girls, but I haven't found any projects aimed at **increasing awareness of promoting the role of women in science and technology.**

I would recommend **funding more projects aimed at difficult to reach audiences including the elderly, people living in underserved or isolated areas, those with special needs**, or even **groups of adults joined by a variety of common interests** such as parenting, knitting, music, art, food, agriculture or any other that might come to mind.

Even though a great amount of funding is awarded to a TV programme, I miss funding of other **audiovisual formats, such us documentaries, radio shows, or even podcasts, video games, apps, or YouTube videos**. As a matter of fact, there seem to be not so many funded projects involving **social media** in their core strategy.

I've also failed to find any **citizen science projects**. In future calls, I'd recommend a more active involvement of citizens in some of the funded projects.

It is also attention calling that all funded projects are run by established organisations. I wonder if it would be useful to provide some funding for pilot projects run by individuals, in order to foster innovation in the sector.

FECYT call covers pretty much all kind of projects. Its limitation does not lie on the type of proposals covered, but rather on the funding model. Only projects with matched funding can apply to this call, which leaves behind innovative pilots from small companies or individuals (they can apply, but their projects aren't usually funded).

Another drawback for projects coming from small organisations, or even individuals, is the high level of bureaucracy of the application and economic justification process. This is even more complex for those who ask for an advance of funding, which can only be up to 60% of the awarded grant; 36% of the total project funding.

Finally, I think it is very positive that organisations can apply to 2 years of funding in Discover, which is not possible in FECYT grant application programme.

3. **What would be your intended impact expectations for a programme such as this?**

- Increasing societal science and technology awareness, and knowledge.
- Disseminating of the results of public funded research.
- Promoting science education among school students.
- Fostering the active participation of society in science communication and research (citizen science, open science).
- Funding pilot, innovative science communication projects.
- Reaching different sectors of the public including: school students, adults, the elderly, people with special needs, people from underserved backgrounds and areas, BME, girls and women…
- Using a variety of media: life (shows, workshops, fairs, exhibitions), online (social media, websites), audiovisual, written (books, comics, magazines)…

4. **Your comments on the innovation and types of projects funded**

I think most of the projects deserve the funding, but it would be interesting to add alternative branch of funding for new, pilot projects, aimed at everyone, including small organisations and individuals.

These could be smaller projects (up to 20000€/year), but they'd need to be brand new, innovative and/or aiming to difficult to reach audiences.

5. **Your comments regarding best practice in your own country and how this compares. Do you have any outstanding examples?**

Some examples of innovative projects aimed at underserved audiences:

- PDICiencia: YouTube channel in which people with mental disabilities present science news, interview famous scientists and science communicators, and explain basic science concepts.
- Catastrofe Ultravioleta: Science podcast with outstanding storytelling and sound production.
- Ciudad Ciencia: Science bus which travels to small towns around the country to showcase (with exhibitions, talks, shows, workshops…) the research performed at the Spanish Science Council.
- Saca la Lengua: a citizen's science project that aims to study the mouth's microbiome and its possible relationship with our environmental characteristics and lifestyle.

- 11defebrero: group of female scientists, engineers and technologists who get together create awareness and promote the role of women in science and technology through a variety of activities (talks, shows, workshops, school and research centre visits, exhibitions…) all around the country.
- Astrochat game: video game and social media strategy aimed at increasing awareness educating about space travel and the women involved in it.
- Principia magazine: science magazine and blog (adult and children edition) with a great emphasis on art and illustration. They also sell cards and decorative posters, and they organise workshops and exhibitions.

6. **Are there any significant differences between this programme and ones you are familiar with? Any gaps? Any cultural differences in approach?**

See point 2 for main funding differences.

I cannot think of any important cultural differences in approach.

7. **What are your thoughts on the value for money of the programme?**

I'd need more information about this, but the first thing that comes to mind is that there is a great difference in the costs depending on the project. For example, Music and Science workshops are more than twice as expensive as Maths Sparks ones. However, I don't know if this is due to the nature of the workshop, the amount or type of public reached, the venue used, the type or value of each interaction…

In any case, I don't see any example that looks extraordinary expensive.

8. **Any comments on the sustainability of funded projects**

Sustainability of science communication activities tends to be an issue, especially for projects aimed at underserved audiences, which usually cannot/will not pay to take part. I don't think the funded projects are more or less sustainable than the average science communication activity. However, here are some factors I think should be taken into account:

- **Cost per participant**: if high, justify why- For instance, reaching certain audiences could be more expensive than others, but it should be justified.
- Annual **progression of costs**: if the project is not new, costs should not increase (the costs per participant should be lower) over the years, as the process should be getting more and more efficient.

- **Innovation costs**: introducing an innovation might increase the costs in the first year, but this expense should be recovered in future editions.

In order the guarantee the sustainability of certain projects, it would be interesting to **offer funding guidance and contacts to the awarded project**s. It would be very interesting if SFI could develop **links with the science and engineering companies, and all sorts of private organisations interested in funding science communication** activities in order to build links between them and Discover projects.

Appendix 3e.

Jean S Fleming- New Zealand

The context in which the programme sits - what is the funding landscape in New Zealand, and what are the political and strategic drivers around public engagement? What is funded, by who, and why? What are the typical amounts of funding available?

A strong programme of science communication and public engagement with science has emerged over the past decade. The longer-term history of science communication in New Zealand has been described recently [Fleming & Star 2017]. The original political drivers were to improve science literacy and awareness of the public in the importance of innovation and research. More recently there has been a push for the majority of scientists to be able to communicate their work, with a number of new prizes for science communication, the requirement of communication of results in funding applications, as well as specific funding for programmes involving public engagement.

Universities have long held outreach programmes to increase science literacy and attract high calibre students [Fleming et al. 2017]. Long-term initiatives in public engagement include the International Science Festival (www.scifest.org.nz/), held in Dunedin biannually since 1998, the Sir Paul Callaghan Eureka! Awards (www.eureka.org.nz/eureka-awards/), the Science Learning Hub (www.sciencelearn.org.nz/) and the University of Otago Marine Metre Squared programme (www.mm2.net.nz/).

The previous government (2008-2017) set up a panel of people, from university students to business leaders, to develop a set of ten National Science Challenges designed to take a more strategic approach to the government's science investment, by targeting a series of goals, which, if achieved, would have major and enduring benefits for New Zealand. Underlying all of the Challenges was the need for public communication. Eventually an eleventh Challenge was funded, called "Creating a Nation of Curious Minds" (https://www.curiousminds.nz/). There are currently three funded Participatory Science Platforms under Curious Minds, in Auckland, Taranaki and Otago. Funding is available up to NZ$20,000. Earlier projects at a regional level attracted a larger amount of funding, up to NZ$150,000.

The Prime Minister's Prizes were established to stimulate interest in STEM careers and celebrate stars in STEM in New Zealand (www.pmscienceprizes.org.nz/about-the-prizes/). While the Science Prize is a substantial $500,000 and that for an Emerging Scientist is $200,000, the Science Communication Prize is still a valuable $100,000. The awardees often have a substantial impact on the community and become valuable role models in STEM. Nanogirl Michelle Dickinson (www.medickinson.com/) and microbiologist and radio science commentator Siouxsie Wiles (siouxsiew.blogspot.co.nz/) are two prize-winners who have become household names in New Zealand.

The breadth of the programme- the variety of projects covered. Would you expect to see anything that is not there?

The diversity of the projects currently funded in New Zealand is good and similar in scope to the ROI. The Citizen Science Project "Flip the Fleet" (flipthefleet.org) aims to get more electric vehicles onto our roads and provides EV owners with a comparison with others' vehicles. Other projects that spring to mind include Ahi Pepe MothNet (www.landcareresearch.co.nz/information-for/citizen-science/mothnet), notable for its Māori perspective, and the Festival for the Future (https://www.festivalforthefuture.org.nz/), finding innovative solutions and young entrepreneurs.

Community engagement is one of eight principles in The New Zealand Educational Curriculum that provide a foundation for schools' decision making. Many of the community science projects funded in New Zealand involve school students. There are few engineering and maths programmes, although the Science Learning Hub does provide some engineering, physics, astronomy and maths resources for schools.

The New Zealand Predator Free 2050 programme has stimulated an increasing interest in trapping introduced predators (stoats, weasels, possums, feral cats and rodents) by voluntary groups. There are now many New Zealanders involved in habitat restoration and predator control. The number of schools involved in habitat restoration is also increasing. I suspect this is a major difference from ROI, in that removing introduced pests and restoring native habitats has become a major focus of community engagement in New Zealand.

What would be the impact expectations for a programme such as this?

The recent focus on environmental projects has certainly had more impact in the community than the older "celebrating STEM" projects such as the International Science Festival or the Eureka! Awards. However festivals, science fairs and hands-on science events remain popular. The University of Otago has now widened its Hands-on Science summer camp to become a Hands-on Otago event [Fleming et al. 2017]. The new Labour-Green coalition government has moved the older emphasis on university education more towards development of trade skills and innovation entrepreneurship. It is too soon to see the effect this may have on the science communication landscape.

Any comments on innovation and types of projects funded

Gender Balance: The low numbers of senior women scientists in New Zealand is still an issue, despite the formation of an Association for Women in the Sciences (http://www.awis.org.nz/) in the 1980s. There are still regular AWIS meetings and conferences and a recent book highlighted the problem [Gaston 2015], but the issue may be seen as a wider workforce problem by the new Government, which is trying to deal with pay equity issues in many areas, including nursing and education

(https://www.nzno.org.nz/about_us/media_releases/articletype/articleview/articleid/2673/pay-equity-recommendations-to-cabinet).

Broadcast: The TV programmes funded in the ROI do not have an equivalent in New Zealand. The Centre for Science Communication in Dunedin trains filmmakers, who produce a 24-minute documentary at the end of their MSciComm. The best films are shown in an annual celebration for the public of Dunedin. Some of these are award winning and are shown on national television. However, most are not of good enough quality. In New Zealand there is a strong presence of science communication on Radio New Zealand National, the free-to-air broadcaster, with interviews and analysis on a daily basis [Fleming & Star 2017].

Art-science collaborations: There have been many major art-science collaborations in New Zealand, on topics as diverse as chemistry, Antarctica or sleep biology, as described [Fleming & Star 2017].

Many of the ROI's funded projects have their equivalents in New Zealand. For example "Spectroscopy in a Suitcase" could be compared with the "Lab in a Box" project, funded by "Curious Minds", which is a container that expands into a working science laboratory, complete with microscopes and molecular biology tools. Bright Club and Fame Lab might be compared with The Eureka! Awards, or Otago University's Advanced School Sciences Academy [Fleming et al. 2017].

Your comments regarding best practice in your own country and, where possible, how this compares. Do you have any outstanding examples?

It is hard for me to determine best practice in New Zealand, now I am no longer working in the field. However several projects stand out for me.

The Kāpiti Biodiversity Project: This restoration project was funded (approx. NZ$290,000 over three years 2015-2018) by the Ministry for the Environment. The project was run by a collaboration of four small, local environmental groups, who worked together and recruited volunteers to run a number of projects. There was (is) a large programme of pest eradication over a large area of the Kāpiti Coast and groups worked on stream riparian planting, native flora seed collection, propagation and planting, monitoring of bird species and numbers, monitoring of weta (a large indigenous insect) numbers in "weta motels" established across a variety of habitats, monitoring of lizard numbers and creation of "lizard gardens" to protect lizards and encourage their survival. I was involved in this project. For me, the most impressive aspect involved the recruitment of volunteers, who continue to monitor and report despite the end of the funding [Fleming 2017].

Ahi Pepe MothNet: This programme, funded through Curious Minds is notable for its young Māori participants and the use of Te Reo (the Māori language). Ahi Pepe (www.landcareresearch.co.nz/information-for/citizen-science/mothnet) "engages teachers, students and whānau (family) with moths, and through moths with nature and science". The programme seems to be always oversubscribed by schools. Several new

moth species have been uncovered and the students are rewriting the distribution and prevalence of moths in New Zealand. Ahi Pepe runs out of the Crown Research Institute Landcare and involves entomologists and ecologists as experts.

Project Hotspot is a collection of environmental citizen science projects, based in the Taranaki region (https://www.hotspot.org.nz/). Project Hotspot is driven by the Nga Motu Marine Reserve Society and funded by the Curious Minds initiative. Volunteers record sightings of orca, kororā (little penguin), reef heron and NZ fur seal sightings around the Taranaki Coastline. The programme is run through schools, but sightings of wildlife are recorded by everyone. Students learn to handle data and work with scientists, then feed the results back to the community. As an example of the impact this programme has had on the environment, surveys of coastal rubbish revealed many plastic shotgun wads found washed up on the beach. After discussions with Fish & Game NZ, most shotgun wads sold in Taranaki are apparently now made out of biodegradable fibre.

Are there any significant differences between this programme and ones you are familiar with? Any gaps? Any cultural differences in approach?

The projects described above are primarily environmental or conservation related, but not solely. Many include awareness of and response to climate change as a secondary objective. The ROI programme has a similar aim to New Zealand. The NZ Government's Strategic Direction of Science in Society ensures ownership by taxpayers.

These citizen science/community engagement programmes evolved from the likes of science fairs and festivals. The successful ones enable and empower those less likely to be doing science (e.g. young Māori). The ROI programme appears to have less emphasis on response to climate change, such as rising sea levels, ocean acidification or slowing of the Gulf Stream.

The Ahi Pepe project is strongly Māori, empowering those less likely to take up a scientific career to engage with environmental science.

What are your thoughts on the value for money of the programme?

> More funding for community engagement seems to be offered in ROI than NZ, but there is a cost of living difference too. Volunteers offer very high value for money! They tend to keep working, long after the original funding has dried up. More funding and organisation will be available in NZ for volunteers to help with climate change mitigation (http://www.mfe.govt.nz/climate-change/what-government-doing/new-zealands-climate-change-programme), tree planting (https://www.mpi.govt.nz/funding-and-programmes/forestry/planting-one-billion-trees/) and pest control (https://predatorfreenz.org/about-us/pf-2050/) in coming months, as the New Zealand coalition government begins new policies.

Any comments on the sustainability of funded projects

> The past five years has seen an emergence of a demand, in primary and secondary schools, for all sort of STEM engagement, but particularly environmental projects.

> Currently there are not enough projects to fill demand on the Kāpiti Coast, where I live. The change of Government and the move of emphasis to predator control and habitat restoration, makes New Zealand projects more sustainable, especially if citizens become engaged as volunteers.

Another thing worth noting, which is probably particularly relevant to a New Zealand comparison, is that the field is generally very well networked, especially within academia, but also beyond this. The networking is both formal and informal and has allowed relatively good connections to develop between projects compared to what we generally see in the UK. However, our interviewees have still tended to report this as something that could be done better.

> The ivory tower is also a bit of a problem in New Zealand, but the projects listed above work best when local and citizens are empowered by the work they do. We have now got a Citizen Science network as well as SCANZ (Science Communicators' Association NZ). A directory of citizen science projects and a network of emails has been established - contact monica.a.peters@gmail.com. Our small population tends to help with networking, but the longitudinal nature of the geography tends to isolate Auckland people from those in Dunedin. A recent Citizen Science Symposium held in Wellington, brought people together from all over the country. This will continue and grow. Training in Science Communication skills is well-established and producing results [Fleming & Star 2017].

Fleming, J. and Star, J. (2017). The emergence of science communication in Aotearoa New Zealand. *Jcom-Journal of Science Communication*, 16 (3).

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Fleming, J. S., Broni, B., Copeland, S., Hunt, D. and Newburn, R. (2017). Thirty years of science outreach at the University of Otago. *New Zealand Science Review*, (in press).

Gaston, N. (2015). Why Science is Sexist, Wellington, New Zealand, Bridget Williams Books.

Appendix 3f.

Ben Johnson- UK

The context in which the programme sits - what is the funding landscape is your country, and what are the political and strategic drivers for this? What is funded, by who, and why? What are the typical amounts of funding available?

The funding landscape in the UK is very much more complicated than that in Ireland. Government funding is channelled primarily through UKRI which has many superficial similarities to SFI. UKRI is responsible for distributing the UK's research budget, not just for STEM, but also in Social Sciences, Arts and Humanities. Rather than support PE through a dedicated funding stream such as Discover, however, PE is funded as an additional (and optional) component of research grants. In part this may be due to the previous structure for funding i.e. seven separate and autonomous funding bodies defined by disciplines. With the merger of these (and other) bodies into UKRI there is the possibility of launching a Discover-like programme in the UK in the future.

Government support is also delivered by BEIS (Dept for Business, Energy and Industrial; Strategy) funded programmes such as:

- STEM Ambassadors - a national volunteering programme for STEM professionals wishing to support formal and informal learning around STEM in schools and other youth focused settings.
- British Science Week - a national festival of STEM, primarily, but not exclusively aimed at schools.
- The British Science Association - a national umbrella body for STEM engagement working with a large volunteer body across the UK and across a number of fronts, including formal education (CREST Awards), informal and community engagement (British Science Festival) and political engagement on behalf of STEM (e.g. the newly launched All Party Parliamentary Group for Diversity and Inclusion in STEM).
- The National Coordinating Centre for Public Engagement - a small dedicated centre supporting HEIs across the UK to develop and embed best practice in PE across the whole of Higher Education. Many of the NCCPE's activities are similar to the work of Campus Engage Ireland.

BEIS is also a supporter of the Sciencewise programme, which aims to support policy makers across Govt to identify STEM related issues within their portfolios and to then develop deliberative consultative processes for future policy development.

There is also significant support for Public Engagement within the Research Excellence Framework, which distributes core funding to HEIs. One of the core criteria for assessment of HEIs is their broadly defined impact on society and there is significant scope

for HEIs to be rewarded for their PE through core funding following a successful REF submission.

Any international comparison of the UK will inevitably be skewed by the presence of the Wellcome Trust; an independent body with a research and engagement spend that bears comparison with many governments (approx. £750 million per annum). Wellcome has used its financial muscle to influence the prevailing culture of PE throughout the UK HE sector, not just in the areas of bio-medical research it supports. WT has made substantial investments in PE infrastructure, including professional PE support staff in centres of research, and support for festivals, visitor attractions and a series of one off national programmes. WT also invests in a pedagogic and social science derived evidence base for improving practice in PE with STEM subjects. Historically WT has used its independence from share-holders and tax payers to nudge the PE community and its Govt supporters towards a more ambitious, critically informed and socially inclusive model of PE. WT is the only funder large enough to leverage significant additional funding from BEIS, such as the current Inspiring Science Fund, a £30M renewal fund for science centres co-funded 50:50 by WT and BEIS.

Smaller funding programmes are run by a number of other bodies, particularly learned societies, and other programmes of support are offered by the Royal Institution, and the national academies (particularly the Royal Society of London and the Royal Academy of Engineering, but also the Royal Academy of Medical Sciences, Royal Society of Edinburgh and the British Academy). Individual HEIs will sometimes run their own small scale competitive grant schemes for PE.

One significant difference is the attention paid to Engineering in the UK. The RAEng. referred to above runs a grant scheme called ingenious that supports programmes to promote engineering, and particularly to build capacity for engagement among engineers by developing training, resources etc. Engineering UK is a large and effective agency coordinating engagement with engineering across many professional bodies and managing (among many things the huge annual Big Bang Fair and a large number of smaller regional BBF events. In contract there seems to be very little engagement with Engineering in the Discovery programme of work.

Overall, the amounts of funding and the costs of other support are relatively generous in the UK. The Wellcome Trust has no upper limit on grants and has funded up to £500,000 in the past. PE additions to research grants from UKRI are small compared to total grant awarded, but significant in terms of PE spend and are typically tens of thousands of pounds. REF funding is worth many millions of pounds, but there is no specified contribution to an HEI's PE activities.

Private sector support is limited to programmes delivered by major brands such as the Science Museum Group or non-financial support for major programmes like STEM Ambassadors.

The breadth of the programme - the variety of projects covered. Would you expect to see anything that is not there?

As in Ireland the UK is home to a significant push towards working with schools and enhancing young people's experience of the curriculum. However, the diversity of funding sources gives rise to a number of quite different agendas. As a crude approximation, it might be said that there is significant political support from HM Treasury for programmes that improve educational attainment in STEM subjects and so contribute to the national skills base and thus to future prosperity; in this regard social inclusion is seen as a key factor in maximising the return on human resources and BEIS is tasked with delivering on these aspirations.

On the other hand many in the field (and with support from the Wellcome Trust) have developed a model of engagement that is more reflective and critical and is concerned with the relationship of citizens with science outside the context of professional skills or employment. This social justice model is a work in progress, but has great traction with many funders and thought leading bodies as well as with many researchers in HEIs (although there are important disciplinary differences here as well).

Elements of both of these approaches can be seen in the recent work around Science Capital; an attempt to understand the relationship between citizens and science in a way that maximises benefit to both parties, reducing inequality while increasing productivity. It should be noted that support for this work has come not only from long established STEM players referred to previously, but also from industry (BP).

The relatively generous support for PE in the UK has made space for innovation and created safe spaces for experimentation and failure, especially in the area of Art/Science collaborations, that have influenced practice in many areas.

Science Capital is rapidly becoming a major feature of funded work in the UK and represents an opportunity to diversify and deepen PE practice in Ireland. While none of the work funded by Discover would look out of place in the UK, there is a shortage of these more reflective, dialogue-based opportunities for citizens to consider STEM and to articulate their own aspirations for the future.

What would be your intended impact expectations for a programme such as this?

The stated objectives of the Discover Programme are very wide ranging, and are not amenable to simple metrics of impact. It is important that SFI is perceived both by Irish citizens and by the Irish research community as both a supporter and champion of PE with STEM in Ireland. One of the major impacts of a programme like Discover is the normalisation of PE within a researcher's portfolio of professional activities; for the benefit of both civil society and the researcher in question.

Direct impact on society is very difficult to quantify when there are so many variables to control for; but it is worth noting the amount of effort, investment and the level of innovation other similar countries are mobilising in this area. At the very least Discover should be able to demonstrate parity of excellence in its work with international competitors.

This also applies to arguments about value for money. Looking around the UK and beyond, it is clear that PE has a real cost; however, discussions around value for money generally reveal more about the priorities of the interlocutor than the value of the project. If PE with STEM is important to the future of research in Ireland it has to be funded.

Another important question in this regard is the extent to which activities deemed to be effective in one society are equally effective in another. While many of the imported activities are strong projects with a good evidence base for claims of success, I would like to see SFI give more support to domestic solutions that might be more sensitive to cultural differences between Ireland and the rest of the world, even the Anglophones.

Your comments on the innovation and types of projects funded

Innovation is often budget dependant, especially if the funder is a risk averse public body. However, even in relatively under resourced activities in the UK one might expect to see more innovative approaches on display, or at least a greater cognisance of trends of thought within the global STEM PE community than is seen in the Discover portfolio.

Your comments regarding best practice in your own country and how this compares. Do you have any outstanding examples?

The Wellcome Trust have recently reconfigured their grant schemes for PE into a single open call with remarkably few restrictions. Most reviewers (and applicants) can point to the mangled re-versioning of great ideas to make them fit the arbitrary criteria of funding schemes.

In the past the Engineering and Physical Science Research Council (now part of UKRI) employed a college of mentors, who were assigned to grant holders to support their work. This was remarkably successful and very popular with grant holders, but adds a significant cost.

Any comments on the sustainability of funded projects

Sustainability will always be fraught with difficulty. By their nature many of the most effective programmes will address subjects and communities that will rule out simple

mechanisms for monetisation of their outputs. In such cases a form of public subsidy is essential to their continuation.

On the other hand, in an economy the size of Ireland's SFI is likely to be the only real player in town for the foreseeable future. Great care should be taken not to be drawn into lengthy relationships based on perceptions of "worthiness" or simple repeat business. It is essential that competitive funding should be genuinely competitive. Perhaps more thought can be given to putting other structures in place (e.g. within HEIs) that can support PE activity of proven value in future, by reprioritising other budgets. HEIs already receive considerable public support; perhaps they can shoulder some of this burden and help to build ever stronger ties between themselves and the rest of civil society?