

Statistics in Brief

PhD students in federal scientific institutions:
A contribution to training scientists

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Highlights

- Between 2016 and 2020, 312 PhD students worked towards their degree with at least one (co-)supervisor connected to an FSI.
- The FSI's international reach is illustrated by the 53 different nationalities of these students, the variety in the 61 different funding mechanisms/organisations for their research, and the collaborations with 51 universities both in and outside of the EU.
- The success rate of these students is very high, with only 3% known to have given up.

PhD students in federal scientific institutions: A contribution to training scientists

Introduction

In hosting and supporting PhD students, FSI contribute to the training of young scientists. This publication offers a description of the scope, advantages and challenges of this undertaking for all parties (students, universities, FSI).

The data used concern all PhD students with at least one (co-)supervisor connected to an FSI, in the time period 2016-2020. They do not take into account situations where an FSI scientist acts as juror, as chairperson of the jury or as a member of the doctoral committee, because not all FSI have data available on these students¹. Nor do we take into account PhD students asking FSI personnel for information and/or guidance on an ad hoc basis or using collections or databases for their research without a formal link to the FSI.

Nine out of 10 FSI responded to the survey. They will be referred to by acronyms:

ARCH: State archives

ICH: Royal institute for cultural heritage

BISA: Royal Belgian institute for space aeronomy

RBINS: Royal Belgian institute for natural sciences

RL: Royal library

RMAH: Royal museums of art and history

RMCA: Royal museum for central Africa

RMI: Royal meteorological institute

OBS: Royal observatory

Following the survey, three in depth interviews were conducted with BISA, RMCA, and RBINS, to further clarify and contextualise the survey response.

Respondents to the survey as well as interviewees emphasised that there is no general policy concerning PhD students, resulting in very different situations in different FSI or even in various departments within the same FSI.

The first part of this publication describes the PhD students, while the second part focuses on the role FSI play in (co-)supervising their research and the added value FSI offer at the start of a scientific career.

¹ RMAH does keep those data and gave a list of 14 PhD degrees awarded in the 2016-2020 period with scientific staff as member of doctoral advisory

committees and/or juror or jury president, but not as (co-)supervisor and consequently not included in the 10 PhD students integrated in this study.

2. PhD students

a. The PhD students in the FSI

Table 1

Total PhD students	312
women	110
men	202
<i>employed by FSI</i>	93
women	39
men	54
<i>Enrolled at a university, but with a prior, formal and/or administrative link to the FSI</i>	106
women	30
men	76
<i>Enrolled at a university, no prior link with the FSI</i>	113
women	41
men	72

A total of 312 PhD students had an official supervisor and/or co-supervisor at the FSI responding to the survey. To contextualise this: an estimated total of 27.000 PhD students are working towards a doctoral degree every year in Belgium.

64% of those 312 students have prior links with the FSI: 30% by being actually employed at the FSI, while another 34% is enrolled at a university, but with a previous, formal and/or administrative link to the FSI (for example, an internship). The number of actual FSI

personnel working towards a PhD includes both FSI personnel writing a PhD to advance their scientific career based on the research work they're doing anyway, and PhD students who were hired by the FSI for the duration of a specific research project, for which funding has already been found. Doctoral students at universities and at FSI show the same distribution over age groups, with about 80% under 30 years of age.

These PhD students are unevenly distributed over FSI (average 35, median 20):

Table 2:

2020	Researchers (HC)	Research intensity (Researchers/total personnel) (%)	R&D expenditure (million €)	PhDstudents (2016-2020)
RL	35	13%	less than 5	4
RMAH	67	28%	less than 5	10
ICH	73	52%	less than 5	3
BISA	80	48%	10 to 14	20
RMI	89	48%	5 to 9	35
ARCH	90	34%	5 to 9	2
RMCA	90	34%	10 to 14	104
OBS	118	66%	10 to 14	43
RBINS	176	45%	20 to 24	91

RBINS is by far the largest institution when looking at number of researchers, followed by the Observatory. All other FSI have less than 100 researchers, with ARCH, RMCA and BISA closely together at about 90 researchers. Research intensity reflects how important research is in the activities of the FSI, by defining the number of researchers as a percentage of all personnel. This shows for example that in RBINS, although it has the most researchers in absolute number, researchers don't make up half of all personnel. The only FSI with a research intensity of over 50% are OBS and ICH, although BISA and RMI come close. The number of researchers nor research expenditure nor research intensity are good predictors for the number of PhD students, however.

ARCH, ICH, RL and RMAH only have between 2 and 10 PhD students; BISA, RMI and OBS between 20 and 43. RBINS more than doubles this with 91, and RMCA with 104 even has more PhD students than researchers at the institution.

There are several possible reasons for these discrepancies, as indicated in the interviews:

First, natural sciences have an easier access to research funding than humanities. Natural

sciences and engineering together counted for a stable 53% of R&D expenditure over the past 5 years in the Belgian higher education sector and public research centres. Social sciences are at 11% for 2020 and 2021, down from 12% the years before that, and humanities stand at 6%.

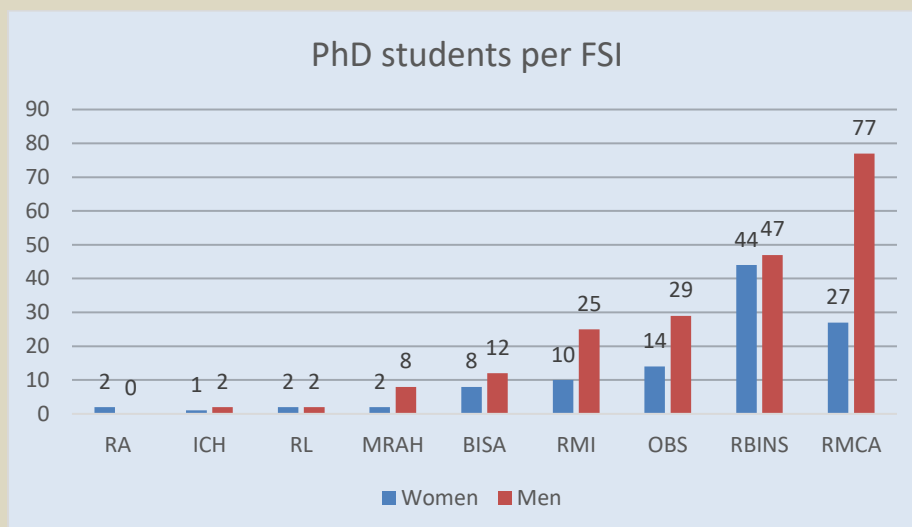
Second, the public is probably more aware of the existence and activities of RMI, RMCA, and RBINS, compared to other FSI such as BISA.

Third, the internationally known museums/collections provide extra visibility for RMCA, RBINS and RMAH, although this last FSI is less research intensive than the other two and has a lower number of PhD students: RMAH has no natural science research in addition to its sole focus on heritage and museum related studies.

A fourth reason might be that some research areas are more flexible than others, allowing for a broader range of possible PhD subjects. For certain specific research niches in the FSI, finding relevant PhD topics could be challenging. Moreover, those would not always be of interest to a university supervisor.

Finally, especially RMCA, but also RBINS, have programmes supporting capacity building, which also serve as a framework for training young researchers.

Figure 1: PhD students per FSI



Of the 312 PhD students, about 1 in 3 (35%) are women. This is below the EU-28 average of 48% female PhD students (She Figures 2018). The FSI taking part in the interviews did not, at this point in time², have specific gender balance policies in place, preferring to work with the most competent/promising/motivated PhD student, no matter which gender.

This imbalance seems to be connected to the fields of research: in natural sciences research in the public and higher education sectors in Belgium, there is a one third women, two thirds men split (MERI data, 2019). Especially Earth sciences attract more male students and this imbalance will continue into post graduate work. A research proposal call by the RMCA where only a few of the respondents are women, is no exception. Moreover, a PhD requiring the student to relocate to another continent for 6 months or more, as is often the case for African students collaborating with the RMCA, can present more of an obstacle to women students. Although the data concerning gender equality in young

researchers' mobility are promising (She Figures 2015), they also show that women researchers don't go as far from their country of residence as male researchers, and that they tend to leave for shorter periods of time. The DGD (Directie-Generaal Ontwikkelingssamenwerking en Humanitaire Hulp/Direction générale Coopération au développement et Aide humanitaire), which funds almost 1 in 5 PhD students at the RMCA, also monitors these numbers, but the main criterium for receiving funding remains, for both the DGD and the RMCA, a student's abilities. However, the RMCA interviewee does see a trend towards more women students and PhD candidates in natural sciences too. RBINS however, while also focusing on natural sciences, surprisingly has an almost gender balanced PhD student group. Leaving aside the 5 researchers in humanities and 1 in engineering & technology, there are still 39 female and 46 male PhD students in natural sciences, or a 46/54% split.

² The interviews took place before the FSI and BELSPO developed Gender Equality Plans, which is

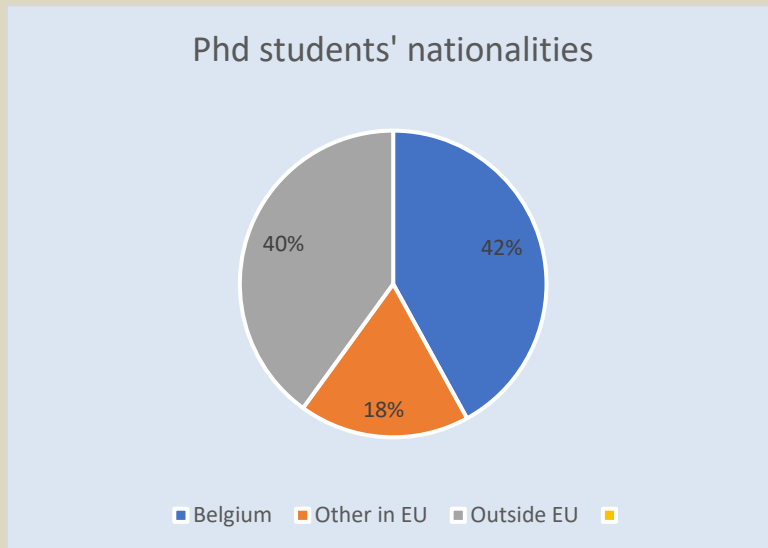
now a prerequisite for access to funding at EU level.

b. The FSIs international appeal

FSI have an obvious international reach, with 53 different nationalities among the PhD students. Excluding Belgium for a moment,

there are over twice as many students from outside the EU as from other EU countries³:

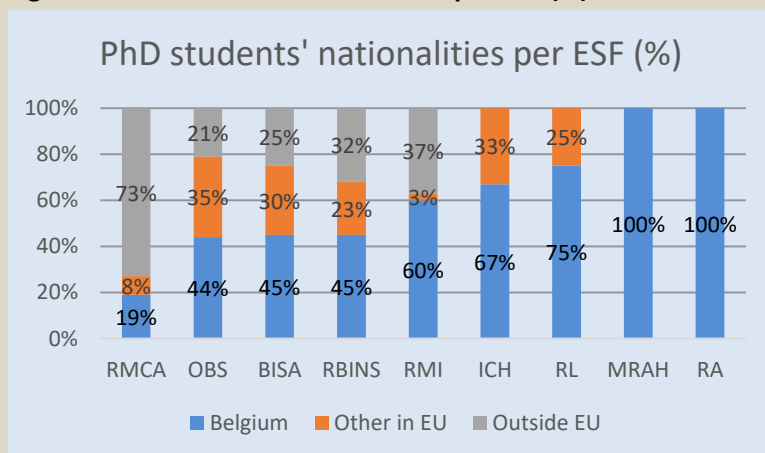
Figure 2: PhD students' nationalities



Outside of the EU, 58% of PhD students come to the FSI from the African continent. The RMCA plays an important role in this geographical distribution, with only 19% of

PhD students with Belgian nationality, but BISA, RBINS and OBS also have a majority of non-Belgian PhD students (55%):

Figure 3: PhD students' nationalities per ESF (%)



³ The information used was available for 293 of the 312 PhD students.

This is not entirely reflected in the students' affiliation with 51 universities in 28 countries⁴, although here too, a predominance of non-EU countries and universities is apparent once

affiliations in Belgium (with all 11 universities) are excluded: 15 universities in 7 other EU-countries, and 25 universities in 19 non-EU countries.

Figure 4: Worldwide location of PhD students



251 PhD students, or 81%, will earn their PhD from a university in Belgium, with all 11 universities in Belgium involved. Almost half of these 210 students are enrolled in the UGent (65) or the KUL (59), the two largest universities, followed by the ULiège (31) and the ULB (28), together home to another fourth of the PhD students.

A further 7%, or 21 PhD students is enrolled in a university elsewhere in the EU, and 12% or 39 students in a university outside of the EU. The FSI collaborate in total with 25 universities in 8 different EU countries (including Belgium) and with 26 universities in 20 other countries (including 11 African countries and 4 Asian). The RMCA has the most diverse affiliations with PhD students in 27 different universities, closely followed by the RBINS with 26.

Response to the second part of the survey indicates that none of the FSI actively look for PhD students on a continuous basis, with only

RMCA and RBINS indicating that their institute is "often" actively looking for PhD students. RMCA and RBINS also specify that finding PhD students is "often" encouraged by the FSI, while all the others opt for "sometimes", both for finding PhD students and being encouraged in this by the FSI.

The interviews show that mostly, for both BISA and RMCA, the majority of PhD students are found through universities and similar institutions in the context of a specific research project developed by the FSI. It also happens - but less often - that universities contact RMCA or BISA because of specific expertise they offer. All 3 FSI interviewed mention PhD students coming to them first with a research topic, sometimes without a university connection as yet, which is then found through the FSI. For RBINS, an estimated half of PhD students come to the FSI first, which explains the many (52%) PhD students without a prior link to the FSI, and the variation in nationalities and university

⁴ This information was available for 311 of the 312 PhD students.

affiliations. The other half are already connected to a university, with RBINS involvement sought because of its specific expertise. For BISA however, it is almost always the FSI which proposes a topic.

All 3 interviewed FSI have long standing contacts at universities. The interviews show that FSI personnel from all 3 FSI also teach at universities as (paid or unpaid) guest lecturer or similar: for BISA, 6 scientists do this, and for RBINS an estimated one third. For RMCA, 6 scientists have guest lecturer status, 3 are

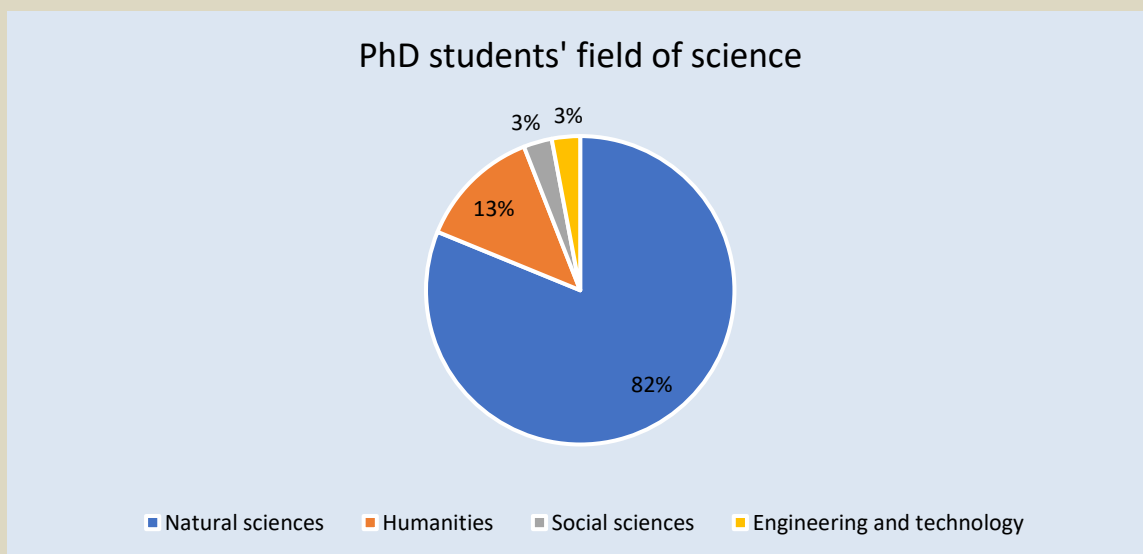
appointed as professors, and several more are occasionally invited to give ad hoc lectures.

All FSI indicate their specific scientific expertise, often not found at universities or only to a limited extent, as essential for attracting young researchers passionate about a specific topic, for finding suitable PhD candidates at universities and MSc programmes, and for being actively sought out by universities to assist with PhD (co-)supervision, juries or doctoral committees.

c. Fields of research

Considering which FSI have the largest numbers of PhD students, it's not surprising

that 4/5 of those PhD students are researchers in natural sciences:



d. Sources of research funding

While BISA, OBS, RMCA and RBINS indicate on a 5 point scale they 'often' help PhD students finding funding, this is only 'rarely' or 'sometimes' the case for the other 5 respondents.

The respondents list in total 61 different sources of PhD funding. The following classification of domestic, foreign and international funding actors shows how many PhD students are funded by each:

	PhD students	
Belgian sources	195,5	77%
FSI	33	13%
Universities	34	13%
FNRS/FWO	60,5	23%
BELSPO research programmes	43	17%
Government	25	10%
Other countries	22	9%
Foundations	1	0%
Universities	6	2%
Research programmes	6	2%
Governments	9	4%
International sources	26,5	11%
Foundations	3	1%
Research programmes	2	1%
International organisations	4	2%
EU	17,5	7%
Self funded	8	3%
Total	252	100%

Leaving out the 60 PhD students for whom the funding source is unknown or 'other', we conclude that 77% of PhD students is funded by sources in Belgium, 9% by other countries, 11% by international funders and 3% is self-funded.

Focusing on the type of funder and ignoring geography, we see that 40% of PhD students receives funding from universities, FWO and FNRS; 17% from BELSPO research programmes

(mostly BRAIN); 13% from national or regional governments; 13% from one or more FSI; 7% from the EU (mainly FP7, H2020, ERC and MSCA grants) and a further 9% from international organisations and programmes. For EU funded research, and possibly international programmes' as well, experienced, postdoctoral researchers are often preferred over a less experienced PhD student.

3. The FSI

We outlined the FSI's role in training young researchers by way of 5 point ordinal scales (either *very important - important - moderately important - slightly important - unimportant* or

always - often - sometimes - rarely - never), further explained by and illustrated with information from the interviews.

a. The FSI's role

Of all the suggested roles for the FSI, 'co-supervisor', 'co-author' and 'co-researcher' are most frequently indicated. Only universities can officially supervise a PhD and award a doctoral degree, and there seems to be an

unwritten policy in some FSI to not combine an official, paid university position with being employed by the FSI. Therefore, the FSI's role mostly remains one of co-supervising and assisting.

Different reactions to this are possible. On the one hand, FSI take on an important part of what can be seen as essentially a university's role, often without getting recognition for it: the doctoral degree will have a university's name on it, no matter how much time and effort the FSI put into supervising the PhD. On the other hand, even though the degree will be the university's, the FSI does get a share of the visibility: the PhD student will attend conferences and collaborate with other actors, which opens perspectives for further collaboration for the FSI itself as well. RMCA for example will also insist on having its logo on the PhD manuscript. If the PhD topic was developed by the museum and the PhD is funded by or through the museum (for

example by way of the BRAIN programme), the FSI supervisor will also be the lead on publication of the research results.

For RBINS, the role the FSI will play in the process of co-supervising the student is also determined by another factor: when a student connected to a university arrives, she or he will mostly have a research topic defined and will mainly need access to collections. However, when a student comes to the FSI first with a research idea, or if the PhD student already works at the FSI in some capacity, the FSI's role will be a more active one, contributing also ideas. These research results will be more aligned with the FSI's in house research activities and interests.

b. The FSI's services

Of the services potentially offered by the FSI, 'expertise' is considered by all to be 'very important'. All 3 interviewed FSI emphasise how unique their expertise is in its field, and how this is a recognised fact by the scientific community in Belgium as well as internationally. Second, those among the respondents with collections and/or a museum function also consider those as 'important' or 'very important'. Third, scientific equipment and field work are also seen as contributing significantly to the PhD student's research.

'Publications', 'contribution to the FSI's activities' and 'new data sets' seem to always be among the direct results of the collaboration between the FSI and the PhD student. 'Contribution to FSI's activities' is considered by the survey respondents as 'always' (4 times), 'often' (4 times) and 'sometimes' (once) present. The FSI indicating 'always' are the ones mostly outlining research projects and then looking for suitable candidates. Among the possible indirect results, 'new methods' and 'new implicit knowledge' score highest.

c. Continuation of the collaboration

Concerning the possible continuation of the collaboration, 'working together on a new research proposal' earns mostly 'sometimes', while the more general options of 'continued collaborative research' and 'continued collaborative publications' receive a combination of 'sometimes' and 'often'. Actual

employment in an FSI happens rarely. Among the interviewed FSI, both BISA and RMCA most emphasised the investment in a PhD student as an investment in a longer term collaboration, even after the PhD is finished, with both the young researcher and her/his present and future affiliations.

d. Success rates

Of all 312 PhD students, 116 have earned their doctorate, 162 are still working towards it, and only 10 have given up⁵. This proportion of 3% unsuccessful PhDs is significantly lower than the general rate of about 30% PhD students not receiving their doctoral degree within 6 years (Ecoom Brief 33, December 2020⁶), even if there should be others among the 162

currently still ongoing PhDs who will not be awarded a degree. All 3 FSI mention in interviews, when illustrating their unique expertise, applications from PhD students or other researchers mentioning very specific topics of personal interest: this level of motivation could contribute to an elevated success rate for these PhD students.

e. Advantages and challenges of the collaboration between FSI and PhD students

In the interviews, we asked what the FSI's considered to be the most important challenges and advantages of the

collaboration, for the person (PhD student/FSI scientist) as well as for the institution (university/FSI).

e.1. For FSI scientists and FSI:

A short term advantage for the person co-supervising as well as for the FSI is the contribution of a promising PhD student to the scientist's and the FSI's research, because most of the PhD students are engaged to work on specific projects initiated by the FSI. Moreover, capable PhD students can expose the FSI to new ideas, perspectives and interactions, and help the FSI to form or strengthen further collaborations. The FSI also gains visibility when the PhD student enters into collaborations with other organisations or attends conferences.

likely to lead to results which are interesting to the international community, and to new data the PhD student can continue working on. Research is not an easy career choice and finding a permanent position is difficult. Keeping young researchers motivated is important and the FSI supervisor can play an important role here.

An important challenge for the FSI is finding interesting research topics a PhD student can build a career on: they have to be relevant,

Although this (co-)supervising can be a time-consuming task for the FSI, depending on the capabilities of the PhD student in question, it is also seen as a longer term investment in future collaboration: often, the PhD students work at the FSI for 4 or more years until the PhD is finished, and continue to work at or with them afterwards.

e.2. For PhD students and universities:

Mostly, universities or individual students ask an FSI to be involved because of its expertise, which both the individual student and the university benefit from.

Another advantage for the PhD student's research, and consequently the university, is the access to FSI collections, equipment and infrastructures.

⁵ Situation in December 2022

⁶ ECOOM finds a difference in success ratios depending on the PhD's field of science: in medical, exact and applied sciences, 70% obtains a

doctoral degree within 6 years, but this number is lower for both social sciences (61%) and humanities (57%) (ECOOM Brief 33, 2020).

Because these students can be more adequately supervised through a collaboration between a university and an FSI, where the FSI takes a more substantive supervising role, an advantage for the university is being able to leave this often time-consuming role to the FSI and focusing more on specifically academic aspects such as timely publications.

The student potentially benefits too from a different working environment than they have known at the university, where individual achievements, leading to publications and funding, is encouraged. To a large extent, FSI

have a different vision and strategy, and a different way of working involving collaborations with diverse partners. Research teams in FSI will be more varied in terms of age, career stage, background, ... than the standard university structure of an (older) professor and their (young) research group. Because a research topic developed by an FSI can be of interest to several departments or research groups at the FSI, the PhD student can interact with different experienced researchers. The FSI can offer a broader perspective, an awareness of the wider context of the research.

f. Should working with PhD students be structurally encouraged for FSI?

Most FSI prefer to employ more experienced researchers who have proven themselves than PhD students, who are just starting out in their research careers. However, supervising PhD

students can be rewarding because most PhD students are enthusiastic about their research topic and eager to learn, and still contribute significantly to the FSI's research.

f.1. Doctoral schools

PhD (co-)supervising is in fact a university's task FSI help out with. Even if the FSI invests resources in the form of its scientists' time and expertise, its collections and infrastructure, it will still be the university who awards the student a PhD. In that sense, the return on

investment of collaboration with/hiring of postdoctoral researchers can be considered greater for the FSI. The creation of doctoral schools at the federal level would reward FSI for their contribution to the education of young scientists.

f.2. PhD funding

When an FSI has a research topic and funding, a PhD student is easy to find. Without funding, however, even with a good research topic (which is not necessarily of interest to a university), the FSI often has a problem. When no BELSPO funding can be secured, the possibilities for finding funding in Belgium are often limited. While universities can apply for both FWO/FNRS funding and BELSPO

programme funding, an FSI needs the support of a university in order to secure FWO/FNRS funding. This support is not always available, because the research interests of a university and an FSI are not necessarily aligned and it happens that no university promotor is willing to support the application, as this reduces the likelihood of their own students receiving this competitive funding.

4. Conclusion

Between 2016 and 2020, 312 PhD students worked towards their degree with at least one (co-)supervisor connected to an FSI.

PhD students are distributed unevenly over different FSI, with RMCA (co-)supervising 104 and the ARCH 2. Possible explanations are the public's awareness of an FSI and its activities; internationally known collections/museums; fields of study which accommodate more easily than others different PhD topics and for which funding is relatively easier to acquire; and the emphasis on capacity building which is very important to especially RMCA and RBINS.

The success rate of these students is very high, with only 3% known to have given up.

The FSI's international reach is illustrated by the 53 different nationalities of these students, the variety in the 61 different funding mechanisms/organisations for their research, and the collaborations with 51 universities both in and outside of the EU.

All FSI indicate their specific scientific expertise, often found only to a limited extent or not at all at universities, is essential for attracting young researchers passionate about a specific topic; for finding suitable PhD candidates at universities and MSC programmes for the FSI's own research projects; and for being actively sought out by universities to assist with PhD (co-)supervision, juries or doctoral committees.

FSI see definite advantages in (co-)supervising PhDs: PhD students contribute to the FSI's research, increase visibility and collaborations for the FSI, and often become long term collaborators. FSI offer PhD students (and by extension universities) access to expertise, collections and equipment; and a diverse

research environment which values collaboration.

FSI also note that these (co-)supervising tasks are often time- and resource-intensive.

When asked if working with PhD students should be more structurally encouraged, all interviewees assented. They see value in both a specific PhD funding programme (where applications wouldn't need to name a candidate), and in broader funding such as the one offered by the BRAIN bottom up calls (ideally with a lesser administrative burden), where different kinds of collaborators can be involved.

Statistics in Brief aims at presenting relevant data to inform a broad audience, including policy makers.

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- general information: www.belspo.be
- general online statistics: www.innovationdata.be or <http://www.stis.belspo.be/en/statistics>Welcome.asp>