



## RltrainPlus

### Deliverable 2.1. Identifying and Updating Training Needs in European Research Infrastructures and Core Facilities

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## Index

1. List of authors
2. Executive Summary
3. Contents

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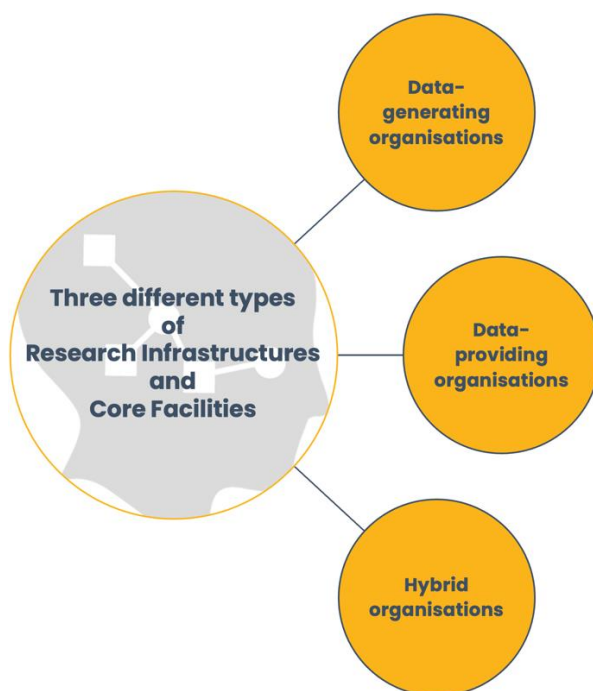
# Executive Summary

The aim of RI:TRAIN Plus is to “create a foundation for the long-term provision of highly qualified personnel for managing Research Infrastructures, Core Facilities and other complex scientific operations in academia and industry” (RI:TRAIN Plus, 2022). In order to achieve this, specific curricula are to be developed and a European School for Research Infrastructure (RI) Management is to be established in the near future. An integrative mixed-method approach was developed and implemented to offer evidence-based proposals. It consists of an online survey among 330 members of RIs and Core Facilities (CFs) and a qualitative expert survey among (17) heads and managers of selected RIs and CFs in structurally selected countries.



**Figure 1 – Three overarching categories of competencies required for heads and managers.**

The evaluation of both part-studies gives insights into which skills and qualifications good heads and managers in RIs and CFs should have which, consequently, need to be developed and deepened in the corresponding modules of the curriculum: “communication and engagement”, “leadership and staff management” and “positioning in the scientific community” (quantitative results); “academic excellence and broad and deep academic understanding of the field”, “project management and organisation management”, “deeper knowledge about the field of science and research in Europe” and “communication skills on different levels” (qualitative results). The results of both sub-studies, quantitative and qualitative, can be grouped into three overarching categories of the competencies required: “communication skills on different levels”, “organisational leadership and staff management” and “academic excellence and a deeper knowledge of the respective field of science” (see Figure 1). Correspondingly, there are also statements on which skills and qualifications the employees in RIs and CFs should have, which must also be developed and deepened in the corresponding modules of a curriculum: “academic excellence – based on academic education and professional experiences”, “flexibility and curiosity”, “interdisciplinarity”, “communication skills on different levels” and “service orientation and support”.



**Figure 2 – Three different types of Research Infrastructures (RIs) and Core Facilities (CFs).**

Furthermore, the results of the evaluation underline that the orientation and diversity of RIs and CFs must be considered even more than before for the development of future policy strategies and funding programmes. This includes not only the different academic disciplines but also the specific character of the respective RIs and CFs – both shape their needs. We can deduce three different types: “data-generating organisations”, “data-providing organisations” and “hybrid organisations” (see Figure 2).

# Table of Contents

INDEX.....	2
DOCUMENT HISTORY .....	2
LIST OF AUTHORS IN ALPHABETICAL ORDER.....	3
EXECUTIVE SUMMARY .....	4
TABLE OF CONTENTS.....	6
<b>1. INTRODUCTION .....</b>	<b>8</b>
1.1. A MIXED-METHODS APPROACH TO CREATE AN EVIDENCE-BASED DATA BASIS .....	8
1.2. BACKGROUND TO THE SURVEY AND THEORETICAL ASSUMPTIONS .....	9
1.3. FUNDAMENTAL CHALLENGES OF THE SURVEYS .....	10
<b>2. QUANTITATIVE STUDY .....</b>	<b>11</b>
2.1. AIMS AND SCOPE – PLANNING AND FIELD PERIOD .....	11
2.2. TECHNICAL SET-UP, ACCESS TO DATA AND GDPR COMPLIANCE .....	12
2.3. DEVELOPMENT OF THE QUESTIONNAIRE AND MODULES .....	12
2.4. OVERVIEW CONCERNING THE SOCIO-DEMOGRAPHIC AND STRUCTURAL DATA .....	13
2.5. ACTUAL TASKS AND THEIR DESIRABILITY .....	21
2.6. DRAWING CONCLUSIONS .....	25
<b>3. QUALITATIVE STUDY .....</b>	<b>28</b>
3.1. AIMS OF THE STUDY .....	28
3.2. PRINCIPALS AND STRUCTURAL DESIGN .....	28
3.2.1. <i>Selection of Countries</i> .....	29
3.2.2. <i>Core and Satellite Countries</i> .....	30
3.2.3. <i>Data Collection, Interviewer Training and GDPR Regulations</i> .....	30
3.2.4. <i>Data Processing, Data Analysis and Preliminary Dataset</i> .....	30
3.3. SELECTED RESULTS ON THE CHARACTER OF RESEARCH INFRASTRUCTURES AND CORE FACILITIES .....	31
3.4. FURTHER ANALYSIS CONCERNING THE NEED FOR RI:TRAIN PLUS CURRICULA AND CONTENTS DESIRED .....	34
3.4.1. <i>Should There Be a RI:TRAIN Plus Curriculum for Heads and Managers?</i> .....	34
3.4.2. <i>Summary</i> .....	37
3.4.3. <i>Should There Be a RI:TRAIN Plus Curriculum for Staff Members?</i> .....	38
3.4.4. <i>Summary</i> .....	40
<b>4. REFLEXION ON THE RESULTS - GROUP DISCUSSION.....</b>	<b>41</b>
4.1. SUMMARY OF THE DISCUSSION .....	41
4.2. CONCLUSION OF THE DISCUSSION .....	42
<b>5. CONCLUSION .....</b>	<b>43</b>
<b>6. REFERENCES.....</b>	<b>47</b>
<b>7. LIST OF TABLES .....</b>	<b>49</b>

8.	LIST OF FIGURES.....	49
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# 1. Introduction

Research Infrastructures (RIs) and their services are a vital element for the realisation of the European Union as a knowledge-based society. Together with Core Facilities (CFs), existing in many universities, academic research centres and national nodes of decentralised RIs, RIs are standing pillars for excellence in science.

The RIs and CFs are also at the core of the development of the open science and open innovation strategy, and a major factor regarding whether those should succeed. Therefore, their establishment and ongoing work is a significant achievement for the European research landscape, developing initiatives, practices, shared facilities, common guidelines and standards that make it possible for European research to thrive. However, the interrelationships between RIs and CFs in the same science domain and across domains, as well as the need to align to and contribute to the findability, accessibility, interoperability and reuse of digital assets (FAIR) approach, the European Open Science Cloud (EOSC), equal opportunities (including gender balance and diversity) and the open science policy, make a diverse skill set necessary to manage a RI or CF. Consequently, it is becoming increasingly relevant to acquire data on the skills needed in RIs and CFs to set up a proper and sustainable training programme for the staff involved.

## 1.1. A Mixed-methods Approach to Create an Evidence-based Data Basis

The aim of RI:TRAIN Plus is to “create a foundation for the long-term provision of highly qualified personnel for managing Research Infrastructures, Core Facilities and other complex scientific operations in academia and industry” (RI:TRAIN Plus, 2022). This should finally lead to the establishment of a European School for RI Management: “The idea is to give students the opportunity to broaden their existing study programs in order to prepare them for different managerial tasks in Research Infrastructures. The ultimate goal is to set up a European School for RI management” (Lavitano, 2022).

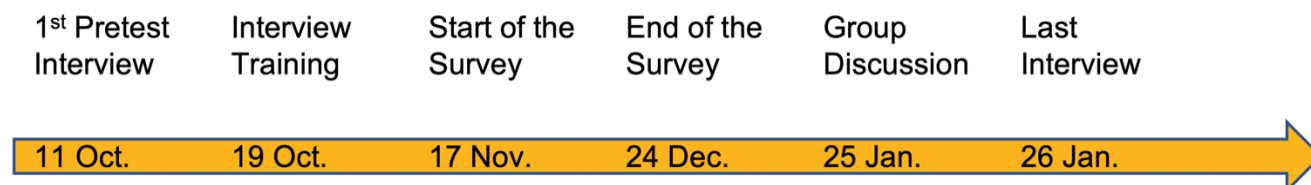


Figure 3 – Project timeline.

We developed and implemented a mixed-methods approach to create an evidence-based data basis for this. This combines a qualitative guideline survey among heads and managers of RIs and CFs utilising a quantitative online questionnaire, which is also addressed to all employees of these institutions.

- Our qualitative interview study identified key stakeholders in the European research landscape and discussed with them how they evaluate the situation and what they identify as core needs against their not only individual but also professional background. This includes the state of research in Europe as a whole, the situation and future prospects of RIs and CFs, and the needs and demands of their own organisation. Furthermore, we asked them about their opinion on the implementation of curricula and on the important skills of managers and staff in our specific environment. This will help us to gain an understanding of the challenges found in the field and overview of the major tasks that need to be completed to make high-level research possible.
- In addition to this, the quantitative study is dedicated to the expectations of all those who work in European RIs and CFs. The aim of the survey is to define an understanding about what makes these institutions a success and what is important to their members with diverse backgrounds, tasks, interests and needs: Who are they and what is it like to work in a European RI or CF? What challenges and demands do those who support the first pillar of scientific excellence encounter day after day? Which skills do they need to fulfil their tasks? What type of training or support do they need to make it work? The quantitative questionnaire deals with these questions and helps to create the structure and content of the future curricula.
- Finally, the validation of the results was done in the form of a group discussion with the members of the RI:TRAIN Plus WP2 consortium.



## 1.2. Background to the Survey and Theoretical Assumptions

Both the field and the concrete object of research are characterised by diversity to a high degree. The European Union is a union of states, but not a national or federal state. “Promoting peace and security and respecting fundamental rights and freedoms are just some of the European Union’s aims and values” (European Union, 2022a). These principles are based on “human dignity”, “freedom”, “democracy”, “equality”, “the rule of law” and “human rights” (Lisbon Treaty, 2016, Art. 2). These principles are supported by both the institutions of the European Union and the Member States. What they have in common is the striving for close co-operation, but the Member States are also characterised by their national autonomy. These include, among other things, specific national contexts, historically shaped ways of working and traditions, and perspectives and goals. Consequently, “United in Diversity” or “In Varietate Concordia” is the official motto of the European Union (2022b). Therefore, when conducting a pan-European study, we need to take into account national contexts and specificities. In this case, this concerns not only the 27 Member States of the European Union but also other states outside the Union, such as Israel, Norway, Switzerland, or the United Kingdom, which are also integral parts of the system of RIs and CFs (European Commission, 2021; ESFRI, 2018; 2021). In particular, different traditions include the individual development of the national science systems of the national states and their traditions and perspectives, as well as specific theoretical approaches and methodological orientations. This is the connecting link between the research field and the object of research. After all, the various scientific disciplines, both nationally and internationally, have different traditions and approaches. This diversity should be preserved. Nevertheless, it is the goal of the European Union to strengthen co-operation and increase the common impact under the motto “Excellent Science”: “Activities under this pillar aim to reinforce and extend the excellence of the Union’s science base and to consolidate the European Research Area in order to make the Union’s research and innovation system more competitive on a global scale” (European Commission, 2021). Regarding RIs and CFs, this means to “foster their innovation potential and human capital, and complement this with the related Union policy and international co-operation” (ibid.) Research institutions are typically classified according to scientific disciplines or they are assigned to superordinate categories, such as natural sciences, social sciences or humanities. This is particularly true of RIs and CFs, which are increasingly diverse. According to their thematic orientation, they are assigned to the six categories of DIGIT, ENERGY, ENVIRONMENT, HEALTH & FOOD, PHYSICAL SCIENCES & ENGINEERING, and SOCIAL & CULTURAL INNOVATION (ESFRI, 2021, p. 18). This is associated with different needs in terms of technical equipment and personnel, skills and competencies, processed data, accessibility, infrastructure and much more – according to their thematic orientation (see Chapter 3.3). People are at the heart of both the values of the European Union and the goals for “Excellent Science”; “Human capital” (European Commission, 2021) is the most valuable resource we have. Therefore, in order to develop goal-oriented curricula that are also accepted by the people, it is essential to learn more about who the staff in RIs and CFs are, what their backgrounds and fields of activity are, and what their needs are. This is the core of the present study and, again, it is closely linked to diversity.

Against this background, we have built the theoretical foundation of the study on two pillars that complement and support each other. The first approach is dedicated to the outlined diversity in Europe. For this purpose, we draw on the considerations of Melvin Kohn (1989) concerning “cross-national research”. In this context, the countries surveyed and selected do not only function as an “*object of study*”, but also as a “*context of study*” and a “*unit of analysis*” (ibid., pp. 20-22; emphasis in the original). These perspectives allow the focus to wander analytically and make it possible to take a comparative look at different aspects of the object of research. This includes not only aspects such as “comparing particular institutions in these countries” and national “systems”, “the contexts in which social institutions operate” and “certain aspects of social structure”, but also what “classifies countries along one or more dimensions” (ibid., pp. 21-22). A last focus mentioned by Kohn (1989, p. 23) deals with “studies that treat nations as components of larger international systems” – such as the European Union and the network of RIs and CFs that extends beyond. The second approach focuses on the people investigated. As mentioned previously, the staff in RIs and CFs, and, thus, their positions, needs, views and opinions, are at the heart of the present study. Consequently, their “Doings” and “Sayings” (Schatzki, 2002, p. 73) are of the greatest interest. This concerns their personal perspectives and ways of working, embedded in the structures of the respective institutions and national and international structures. In this context, personal backgrounds, such as educational pathways and biographies, and the influence of systems and people, gain central importance. In order to deal with this complex mix, we are guided by Bourdieu’s Theory of Practice (1977), which is dedicated to available resources that enable and constrain action, patterns of action in specific contexts and practices applied in everyday life. Furthermore, this approach makes it possible to capture not only the “social space” or spaces in which individuals and groups must move and orient themselves but also the “symbolic power” that is available or must be invested for this purpose (Bourdieu, 1989, p. 14).

### 1.3. Fundamental Challenges of the Surveys

A typical challenge of empirical research is identifying suitable subjects and recruiting available subjects – especially under the conditions of the COVID-19 pandemic. This is especially true when people need to be reached throughout Europe and beyond (quantitative study), as well as in numerous selected countries (qualitative study). In the absence of an overview of all those responsible in the RIs and CFs (both nationally and internationally), a correspondingly robust database firstly had to be compiled at great expense. This project was made very difficult in part, and in some cases impossible, by the very different homepages and contact options of the institutions covered. Numerous RIs and CFs work very transparently and facilitate contact. In these cases, there are clear lists of the people nationally and internationally responsible as well as direct contact options (e-mail, telephone). However, one often encounters the opposite, and a great deal of effort must be expended to identify those relevant via external searches. In many cases, no contact options are offered, or only contact forms for general inquiries and non-personalised e-mails are provided. In addition to outdated data, very high-ranking people are often given as contacts, such as ministers, who typically cannot be contacted or can only be contacted at great expense. In some cases, there is also a lack of information about which institutions and, subsequently, which people are involved at the national level. This again requires time-consuming searches via numerous other portals to obtain satisfactory results. In extreme cases, homepages have, so far, served more to prevent contact than to establish it. This makes empirical work very difficult. In particular, it also proves to be extremely problematic, since RIs and CFs also function as service providers in science, so they should be as accessible as possible for scientists. This leads to the urgent recommendation for all RIs and CFs to critically review their own homepages and contact options and, if necessary, to update them as soon as possible.

Finally, a list of 493 entries was generated, which served as a starting point for recruitment in the quantitative study and for the selection of interviewees in the qualitative study. Participation in a qualitative study particularly requires a high degree of time resources on the part of the interviewees. In this context, it should be emphasised that all the interviewees involved were very supportive of the RI:TRAIN Plus project and took a lot of time for the interviews. They deserve our greatest thanks for this, as they were the ones who made the project possible in the first place. On the other hand, some individuals selected could not be won over for the study. This must be expected, and there were several substitute candidates for each of the persons selected. Nevertheless, it was ultimately not possible to conduct all the interviews planned in each of the countries (however, additional countries were able to fill these gaps). In this context, it should be mentioned as very regrettable that numerous colleagues did not respond to inquiries at all for several months and that even repeated friendly inquiries were ignored. This is not a sign of collegial support and makes it very difficult to conduct such pan-European studies, which are intended to serve the scientific community on a whole. We hope to see an even stronger commitment here for future survey waves.

## 2. Quantitative Study

The quantitative study is dedicated to the expectations of all those who work in European RIs and CFs. The aim of the survey is to define an understanding about what makes these institutions a success and what is important to their members with diverse backgrounds, tasks, interests and needs: Who are they and what is it like to work in a European RI or CF? What challenges and demands do those who support the first pillar of scientific excellence encounter day after day? Which skills do they need to fulfil their tasks? What type of training or support do they need to make it work? The quantitative questionnaire deals with these questions and helps to create the structure and contents of the future curricula.

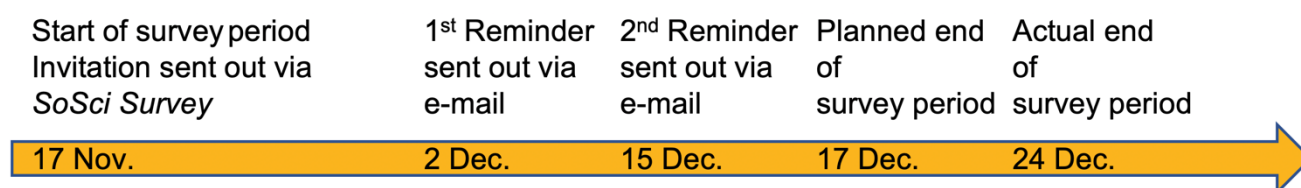


Figure 4 – Timeline of the RI:TRAIN Plus Survey.

### 2.1. Aims and Scope – Planning and Field Period

Accordingly, a quantitative online survey was fielded between November 17 and December 24, 2021, resulting in a field period of 37 days. The field phase was originally planned to last for 30 days, however, based on feedback during this time, we extended the time provided to complete the survey. The target population was defined as employees who work in European RI, particularly the ESFRI landmarks and projects, and in the CFs connected. The complete list contains 493 entries and can be found in the ANNEX. Similar to within the RI:TRAIN Plus project group, it was agreed upon that not only top level managers who lead European or national initiatives but also sites (e.g. subnational or national nodes) should be addressed. The questionnaire had to be inclusive for a wide range of individuals coming from different cultural and national backgrounds, scientific disciplines, and especially institutions that were made up by heterogenous and often highly specific structures.

A multi-step procedure was used to contact the individuals. Firstly, all the landmarks defined were contacted on November 17 via e-mail, sent from the online-survey platform *SoSci Survey*; two reminder waves, distributed directly via e-mail sent from the personal account of a researcher involved followed between December 2 and 15 (in accordance with 'individual out of office' notes). Christmas greetings were sent to all contacts on December 20, together with a 'thank you' for their active participation and a final reminder that the questionnaire would be online until December 24. Additionally, the co-ordinators of RI:TRAIN Plus spread the information that the survey was online (see Figure 5). The population could be defined and strategically contacted via both of these. However, an exact number of individuals in this population cannot be provided because the specific number of members and staff in individual RIs and their representatives in particular regions and countries were hard to define. This situation has to be highlighted, as it makes it evident that an adequate sampling frame for the whole population was missing and, consequently, completing a full probability sample was not possible. While this limits the potential for drawing conclusions based on interference via model building (see Cornesse et al., 2020), it enables us to research a otherwise hard to access population and research in other fields shows that the data quality – if controlled and argued for – is sound enough for descriptive and strictly theory-based models (Quatember, 2019; Prandner & Weichbold, 2019). These limitations have to be considered and results have to be read accordingly.

However, the approach made it possible to track and cover those who accessed the questionnaire, the completion rate and potential methodological issues. There have been no issues that could be identified. The questionnaire was accessed 1584 times over the course of the field period and 330 useable datasets were generated. Accordingly, we have an efficient translation rate of interview attempt to interview of 21 %. Of those 330, more than 70 % (235) had no missing values; the rest of the participants skipped some questions, but provided enough data to be included in the analysis.

These values can be seen as very good for the mode of an open online survey that targets a highly specialised group, without any incentives or other motivators. However, it has to be stressed that self-selection may be a potential issue, as it is for all kinds of online surveys. To account for this, constant data and plausibility were conducted during and after the field phase. Those showed some with misleading information (e.g. the year of birth was stated to be in the 2070s); such cases very evaluated in a more comprehensive way. If cases were deemed unfit for use after this evaluation (e.g. a simple typo could be ruled out), the respondent was deleted from the dataset.

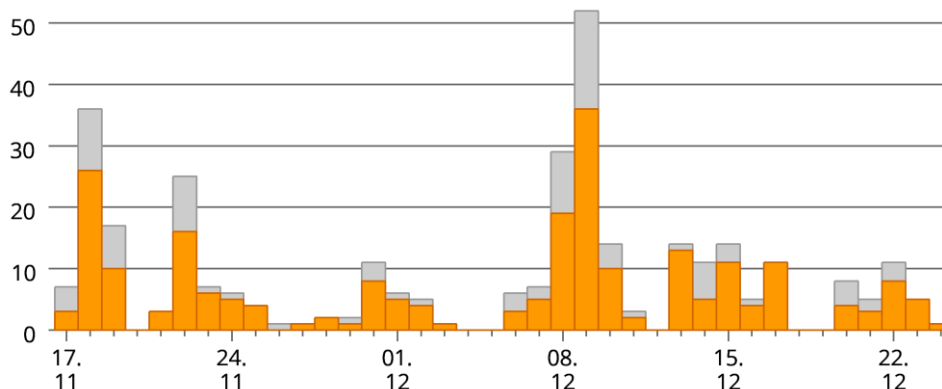


Figure 5 – Response to the survey during the field phase (orange bars: complete datasets, grey bars: additional useable datasets).

## 2.2. Technical Set-up, Access to Data and GDPR Compliance

As highlighted previously, the survey was conducted via an online questionnaire hosted by the German online survey provider *SoSci Survey* ([www.sosicisurvey.de](http://www.sosicisurvey.de)). The server hosts the data for a period of six months after completion of the data collection and is physically set up in Munich, Germany. Access to the survey platform and the raw data collected was only provided to three researchers involved: Dimitri Prandner and Philip Sinner, the principal researchers, and Katrin Hasengruber, who helped with technical issues and programming. Furthermore, the raw dataset was made available to AUSSDA – the Austrian Social Science Data Archive – data manager Nikolai Soran. All of those individuals worked at the Johannes Kepler University (JKU) at the time of data collection and processing and processed the data in compliance with EU General Data Protection Regulations (GDPR). In addition to the server of *SoSci Survey*, the dataset is only saved on local hard drives and JKU servers.

The data are highly sensitive as they contain information on country of residence and origin, age, sex, career-track and affiliation to specific RIs and CFs, and the raw dataset had to be converted into a scientific use file that matches GDPR regulations. This dataset will subsequently be available via AUSSDA in long-term storage formats, useable with open source and commercial statistics software.

Most of the data is collected in a numeric format, while some fill-in questions contain strings. All data processing is handled with IBM SPSS 27 or 28.

## 2.3. Development of the Questionnaire and Modules

The questionnaire was developed in a multistage process, as the methodological and structural limitations became known. After an initial meetings in July with the WP2 team of RI:TRAIN Plus, several smaller meetings with a core group to exchange ideas and concepts for the questionnaire were shared. As highlighted in the first section, one of the main issues was tied to the fact that the project aims to address a highly heterogeneous community, which comes from service providers that are far removed from scientific practices, at the one end, and highly competitive scientists at the top of their corresponding disciplines, at the other. Furthermore, language barriers had to be considered and specific vocabulary used in different organisational and national contexts (Dillman et al., 2014, p. 463). Such problems often stress the reliability and validity of results when not considered adequately (for a starting point of the discussion concerning the associated problems, see Verba, 1973)

This necessitated structuring the questionnaire in such a way that it was both accessible and in depth enough to understand the context of each and every respondent (see Creswell & Creswell, 2018). Consequently, the decision was made to also cover structural information about the work context of the researcher population and how they perceive their situation, as it was expected that the circumstances experienced may not match available data on the set up of RIs and CFs.

Accordingly, we were interested in not only demographic data but also the professional socialisation of the individuals (studies, stays abroad, changes of positions) and their current situation (type of contract, number of RI or CF employees at the site, potential leadership role, amount of RI- or CF-relevant work in comparison to the general workload).

Additionally, several modules from surveys coming from studies in the field of the sociology of professions were used to get a general understanding of the tasks that both managers and staff have to do, their wishes if they want to do less or more of them, and more specific questions on the role of their RI or CF in the context of scientific work. This was seen mostly in the context of which services they provide for whom, what kind of materials or data they handle as well as their scope. Especially previous research done by the members of RI:TRAIN Plus proved to be valuable here in order to contextualise the situation. This was further contextualised with questions on satisfaction, work environment, career drivers and professional roles, which were meant to give insights into what kinds of skills or backgrounds led individuals to progress and succeed in the field.

Driven by the literature and previous studies, these questions were the foundation for the questionnaire, that was in the next step pretested by the RI:TRAIN Plus WP2 team and discussed. The first round of feedback identified that the questionnaire was too long to meet the targeted 15-minute survey time and was adjusted accordingly. In order to reduce the load on the participants, it was decided to cut parts of the more in-depth socialisation questions and questions on professional roles. In a second round of pretests, the staff of AUSSDA and personnel from medical and life sciences were included to do both a functional and content-based pretest. Several items were added to the questionnaire during this round that address the situation in the medical field more comprehensively and the wording was adjusted to be more inclusive for people outside of the academic context.

A final round of pretests was done subsequently, again with the group of WP2, and the questionnaire was finalised. A total of 56 pretests were conducted by 33 individuals, 16 of whom did more than one round of pretesting. However, there were specific remarks from the Consortium of European Science Data Archives (CESSDA) that the questionnaire may not address all of their members. While the project team discussed those issues both with the team of WP2 and CESSDA, certain aspects could only be acknowledged, as the aim was to generate an inclusive questionnaire that could cover a large number of RIs and CFs. This limitation has to be considered when reading the results and planning further projects that may focus in more depth on specific disciplines or institutions and may have different requirements. However, we used the tailored design method to create a broad survey that is able to reflect the whole situation at hand (Dillman et al., 2014; Creswell & Creswell, 2018)

## 2.4. Overview Concerning the Socio-demographic and Structural Data

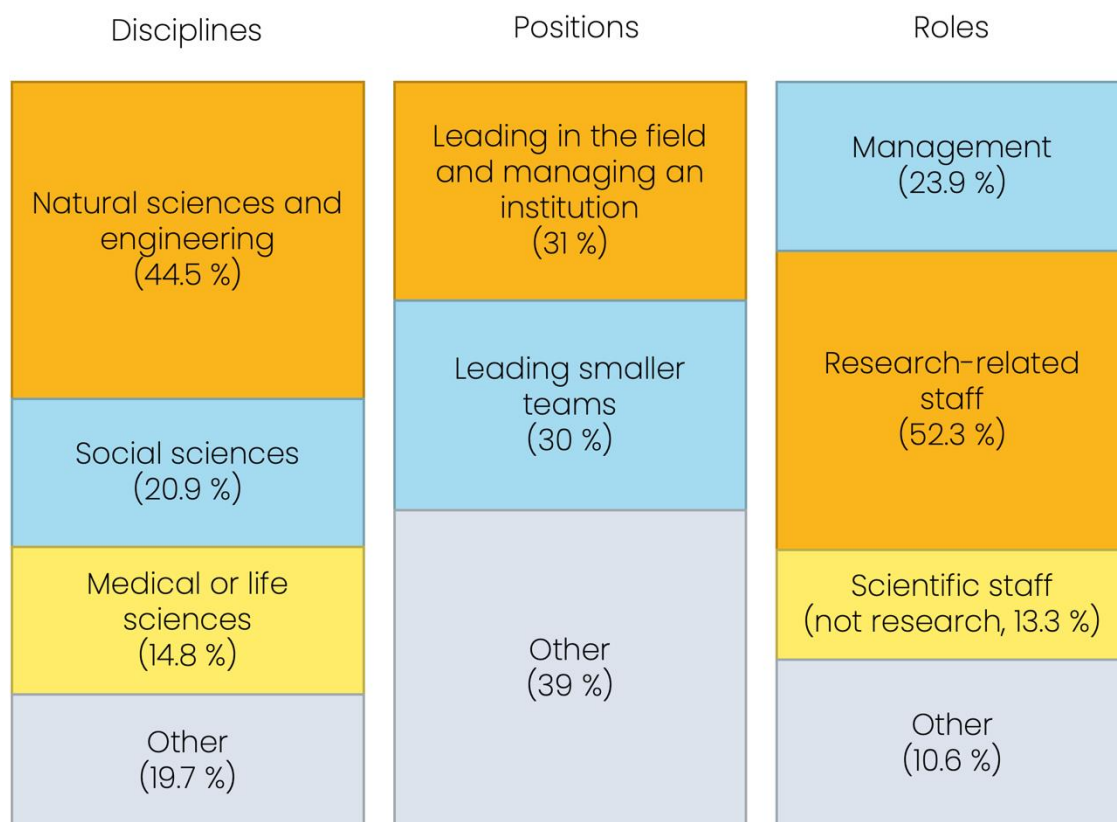
As stated during in previous section, 330 individuals responded to the survey: 44.5 % are currently working in the field of natural sciences or engineering, 20.9 % come from the social sciences or humanities, and 14.8% are in field of medical or life sciences. The rest (19.7 %) are not affiliating in their job with a specific scientific discipline. Looking at the professional experience of the individuals surveyed, it can be stated that at least half of the respondents have at least 11 years of professional experience at RIs or CFs. More than 10 % of the individuals surveyed have spent 25 years or more in the domain. This is also reflected in the professional status of the respondents; 31 % of them state that they are leading in their field, responsible for managing a RI, CF or other institute. Another 30 % are leading at least smaller teams and projects, while the rest are either junior staff or not interested in taking or qualified to take over leadership roles (see Figure 6).

The data also highlights that approximately half of the respondents were scientific staff who are doing research-related tasks (52.3 %), while about another quarter (23.9 %) are handling management and business operations. Scientific staff who does not conduct research (13.3 %) and technical (6.1 %), administrative (3.0 %) and other (1.5 %) staff make up the rest of the participants. Slightly less than two-thirds of the staff have completed a PhD (60.3 %) and another 4.5 % aim to do so; 26.4 % do not plan or do not see the need to acquire a doctorate. Additionally, 8.8 % preferred not to state whether they have completed such a degree (see Table 1).

Accordingly, it can be assumed that the dataset collected is useful to gain insights into the demands that high-level staff of RIs and CFs are facing on a daily basis and what they expect other leaders in the field to be able to do. What is of interest in this regard is that of those who provide information on their educational background, more than a quarter of the individuals in management and business operations have not completed a PhD (27.4 %). In addition, more than a third (37.1 %) of scientific staff not involved in research have either not completed or are not planning to do a PhD (see Table 1 for details on this).

The survey showed that the individuals responding work an average of 38.2 hours per week (Std. Dev.: 7.7 h; n = 246), with more than 75 % of them spending most of their time on tasks related to the RI or CF with which they are affiliated. On the flipside, this means that about 25 % of the individuals are only able to allot a minor part of their working time towards an RI.

The relative majority of the respondents were male (45 %), while 38 % were female. The rest – approximately 16 % – did not declare their gender. Two individuals stated that they were non-binary. Regarding the age, it could be seen that (mean and median) the respondents were 48 years old (Std. Dev.: 10.5 years) on average (21 to 74 years old).



**Figure 6 – Overview of the dataset: discipline, positions and roles (n = 330 each).**

Role	Completed PhD	Currently working on a PhD	Planned to work on a PhD in the future	PhD is not planned
Management and business operations (n = 62)	69.4 %	1.6 %	1.6 %	27.4 %
Scientific staff, research-related (n = 137)	86.9 %	4.4 %	0.0 %	8.8 %
Scientific staff, not research-related (n = 35)	62.9 %	11.4 %	5.7 %	20.0 %
Non-scientific, non-technical staff (n = 4)	25.0 %	0.0 %	0.0 %	75.0 %
Technician (n = 16)	68.8 %	6.3 %	0.0 %	25.0 %
Administrative staff (n = 8)	25.0 %	0.0 %	0.0 %	75.0 %

**Table 1 – Role in RI/CF and PhD.**



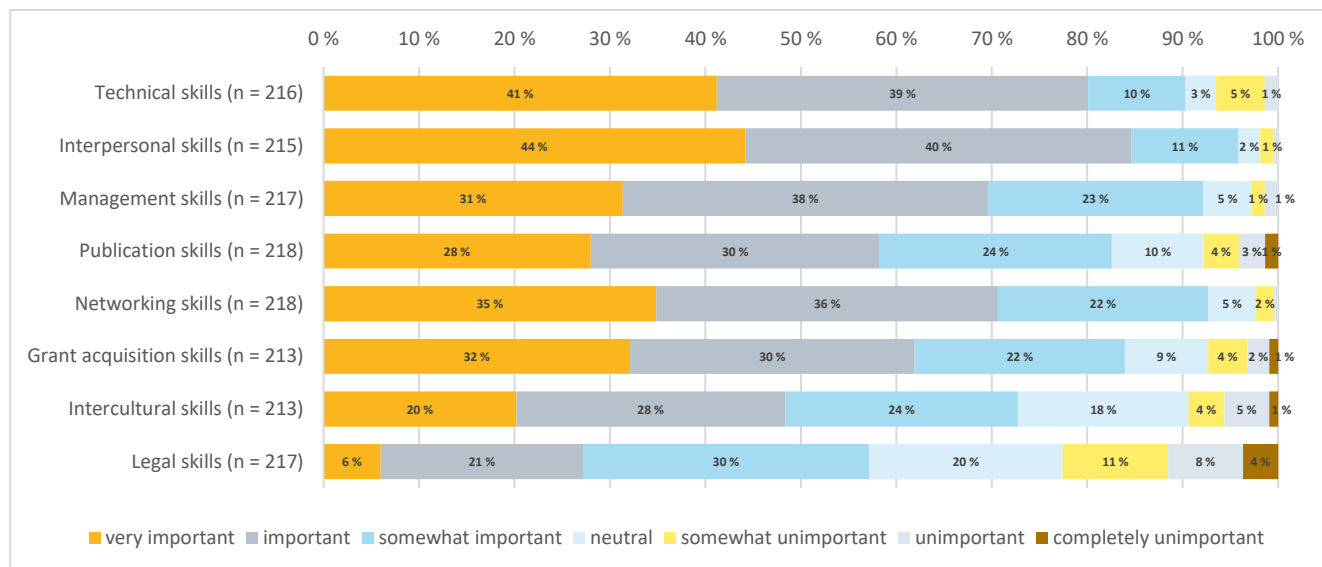
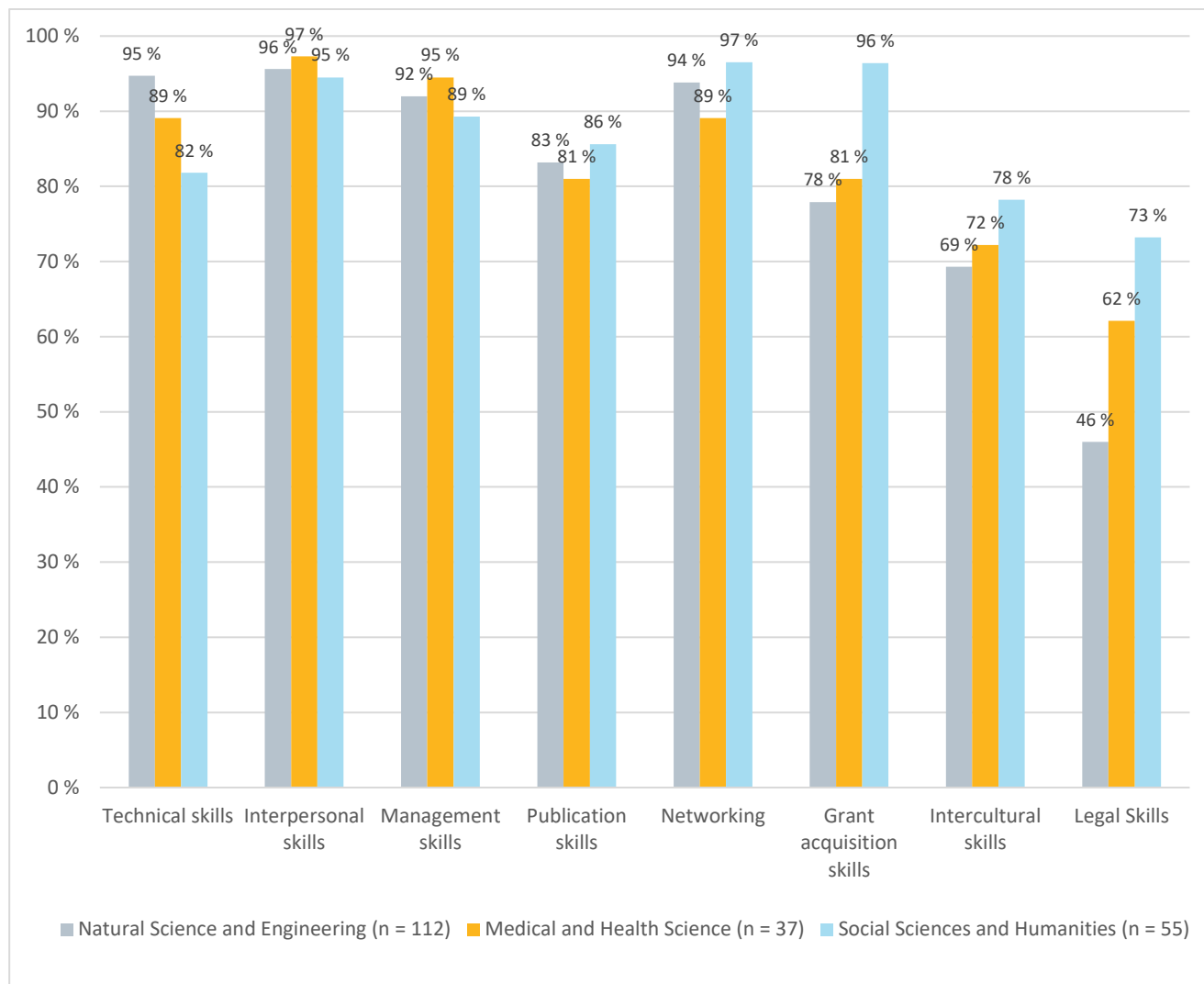


Figure 7 – Skills needed to lead an RI or CF.

Looking at the skills that are needed from the perspective of the respondents, it becomes clear that most of them see a highly demanding field, with a heterogenous structure (see Figure 7). Regarding the standardised items on which we collected data, interpersonal, networking and management skills were the ones that were seen as central pillars for managing an RI or CF. This sentiment is also reiterated in the fill-in answers, where most comments state that interacting and communication are the central pillars for leaders. An additional point that was raised was the fact that leadership demands highly developed writing skills, going beyond proposals for grants and scientific publications, which were not seen as essential. Interestingly enough, the legal and intercultural skills were not as much in demand as the others. However, it must be stressed that legal skills – Key word: GDPR – is something that was seen as more important by individuals affiliated with the social sciences and humanities and those who are not working in a particular field.





**Figure 8 – Skills per discipline.**

Furthermore, the key areas differentiate (see Figure 8). Technical skills are most in demand by respondents coming from the natural sciences and engineering, while representatives from medical and health science RIs and CFs have the highest demands of interpersonal and management skills. Social scientists and humanities have the highest scores for publication, networking, grant acquisition, intercultural and legal skills. However, when it comes to the last two domains, it must be stated that those are less in demand than the others. Additionally, several fill-in answers included legal aspects (e.g. data protection, intellectual property rights) which should be considered important in some domains because they were part of the skills highlighted by some of the respondents. Finally, teaching and training skills – going deeper than interpersonal and management – were also stated several times in the fill-in answers.

	Technical skills	Inter-personal skills	Management skills	Publication skills	Networking	Grant acquisition skills	Intercultural skills	Legal skills
No team to lead (n = 109)	89 %	97 %	90 %	82 %	91 %	79 %	76 %	57 %
Small team, with up to 5 individuals (n = 67)	94 %	93 %	93 %	81 %	93 %	88 %	71 %	55 %
Medium team, with 6 to 10 individuals (n = 16)	81 %	100 %	94 %	94 %	100 %	88 %	50 %	56 %
Medium team, with 11 to 20 individuals (n = 14)	93 %	100 %	100 %	80 %	93 %	93 %	86 %	53 %
Large team, with more than 20 individuals (n = 9)	89 %	89 %	100 %	89 %	100 %	89 %	67 %	78 %
Overall (n = 215)	90 %	96 %	92 %	83 %	93 %	84 %	73 %	57 %

**Table 2 – Skills that are (very/somewhat) important when working for/leading an RI, by team size.**

When it comes to the team size a respondent leads, there are not too many differences that can be identified (see Table 2). Those that have no leadership roles, value grant acquisition less than those who have teams to manage. Those who manage larger teams with more than 20 members more often see a value in legal skills. Other differences seem negligible, because the number of respondents that lead teams with 6 or more members are not enough to make strong claims.

This assumption about the skills needed also matches the tasks are described by the respondents very well. Communication and training are also the most relevant aspects here, next to scientific work. As expected, both the disciplines and the role someone takes in an institution are of importance regarding the time spent. Those who are especially already in management positions spent significantly more time (Kruskal Wallis Test,  $p < 0.05$ ) on grant preparation, administrative and intuitional tasks then other groups.

It also becomes possible via exploratory factor analysis (KMO: 0.74 / sig.:  $p < 0.001$ ; extraction: 59 % via principal component analysis) to identify that those tasks are generally divided into scientific and administrative ones that are disconnected from each other and represent different aspects of the work conducted in an RIs or CFs (for factor association, see the following table, elimination of variables based on extraction, factor association and task-related assumptions, e.g. specific tasks are only relevant for a few of the participants). See Table 3 for details, beginning on the following page. This approach also highlights the differences in the job duties that various individuals face in RIs and CFs and that those jobs and demands are not comparable in all instances.

	<i>I do not spend time on this task at all</i>	<i>I spend only (very) little time on this task</i>	<i>I spend some time on this task</i>	<i>I spend a lot of time on this task</i>	<i>Factor</i>
<i>Work for the scientific profile / community (e.g. reviewing, participating at conferences, writing papers / books / chapters / research reports) (n = 237)</i>	14 %	32 %	38 %	16 %	Sci
<i>Conducting empirical work (e.g. lab work, survey or interview work, expeditions, data analysis) (n = 235)</i>	19 %	25 %	27 %	29 %	Sci
<i>Developing and acquiring new methods and technologies (n = 234)</i>	18 %	29 %	43 %	10 %	Sci
<i>Preparing and acquiring grants (n = 236)</i>	21 %	30 %	36 %	13 %	Admin
<i>Maintaining infrastructure and equipment (n = 236)</i>	26 %	22 %	33 %	19 %	Dropped
<i>Working with patients (clinical work) (n = 232)</i>	97 %	1 %	1 %	1 %	Dropped
<i>Teaching students (n = 233)</i>	32 %	31 %	26 %	12 %	Dropped
<i>Training colleagues or stakeholders in my services and consultancy (n = 234)</i>	15 %	35 %	41 %	9 %	Dropped
<i>Communicating with users / stakeholders (e.g. universities, laboratories, research institutes, scientists) (n = 233)</i>	3 %	22 %	46 %	28 %	Dropped
<i>External communication and outreach (e.g. media, political stakeholders on a national and international level) (n = 236)</i>	19 %	39 %	30 %	12 %	Admin
<i>Institutional management (e.g. representation, high-level meetings) (n = 237)</i>	20 %	34 %	30 %	16 %	Admin
<i>Administrative management (e.g. regulations, compliancy, GDPR, safety) (n = 236)</i>	20 %	32 %	36 %	11 %	Admin
<i>Human resources-related management (e.g. recruitment, staff development, organisational culture) (n = 237)</i>	27 %	36 %	29 %	8 %	Admin

**Table 3 – Exploratory factor analysis, type of work x time spent on this task.**

DV (ascending – higher means important)	M1 – Administrative Duties and Tasks		M2 – Scientific Duties and Tasks	
	Std. Beta	p-Value	Std. Beta	p-Value
Age in Years	<b>0.170</b>	<b>0.020</b>	0.095	0.240
Women (Ref: non-female)	0.084	0.230	-0.015	0.839
No PhD	REF	-	REF	-
PhD	-0.072	0.341	<b>0.224</b>	<b>0.008</b>
PhD planned / in progress	-0.070	0.345	<b>0.186</b>	<b>0.023</b>
Staff size on site	-0.001	0.988	-0.077	0.316
RI Work is a priority (50 % or more of workload)	-0.096	0.165	-0.019	0.799
No team	REF		REF	-
Small team (up to 5)	<b>0.188</b>	<b>0.013</b>	0.061	0.465
Small / Medium team (up to 10)	<b>0.197</b>	<b>0.005</b>	-0.035	0.644
Larger / Medium team (up to 20)	<b>0.350</b>	<b>0.000</b>	0.095	0.235
Large team (20 or more)	<b>0.250</b>	<b>0.001</b>	-0.128	0.105
No specific scientific orientation	REF	-	REF	-
Natural sciences and engineering	<b>0.370</b>	<b>0.038</b>	<b>0.522</b>	<b>0.008</b>
Medical and life sciences	0.224	0.131	<b>0.341</b>	<b>0.038</b>
Social sciences and humanities	<b>0.477</b>	<b>0.003</b>	<b>0.371</b>	<b>0.038</b>
Model Indicators:				
Intercept	-1.637		-1.674	
adj. R <sup>2</sup>	0.26		0.10	
sig.	<0.001		0.004	
n=	168		168	

**Table 4 – Linear regression model explaining what leads to an orientation towards administrative (Model M1) or scientific (Model M2) tasks. Significant Effects in the models are in bold**

Using this simple division as a base for a linear regression model (following social science paradigms, we use a  $p < 0.05$  as an alpha error threshold for significant influence and are more interested in  $\beta$  interactions than a good model fit with a high  $R^2$  value to estimate  $\gamma$ ), with the extracted factor variables as dependent ones, it becomes evident that there are specific demands involved. The older the participants, the more they spend time on aspects that are tied to administrative issues. This is also true for those that lead teams. Teams of each and every size have a considerable impact on the number of administrative duties. Additionally, those who work in the natural sciences and engineering or social sciences and humanities have considerably more administrative duties than those who do not have a scientific specialisation. Those in the medical or life sciences field do not differentiate from those without specialisation.

On the other hand, those that spend a lot of time on scientific duties are those with PhDs or planning to acquire them. Additionally, people who have a particular scientific orientation are more likely to also spend time on scientific work, however, this is not a particular surprise. People who are associated with a specific scientific domain are more likely to work in this field than generalists without specialisation.

When it comes to drivers for success, it can be stated that the most important aspects are tied to the support of the local instructions and the ones where the RI and CF are hosted. National structures are also seen as central. After this, the quality and number of publications and the publication of data, the work in the international community and grant acquisition are seen as important drivers. Outreach and teaching are not seen as central in the community. This structure is seen mostly as homogeneous across the disciplines. However, there are some key differences. While the work in people's own institutions and the national context is comparatively more relevant for medical and health science, social sciences and humanities, outreach activities are not seen as a driver for success in the natural sciences, engineering, and medical and health sciences (see Figure 9).

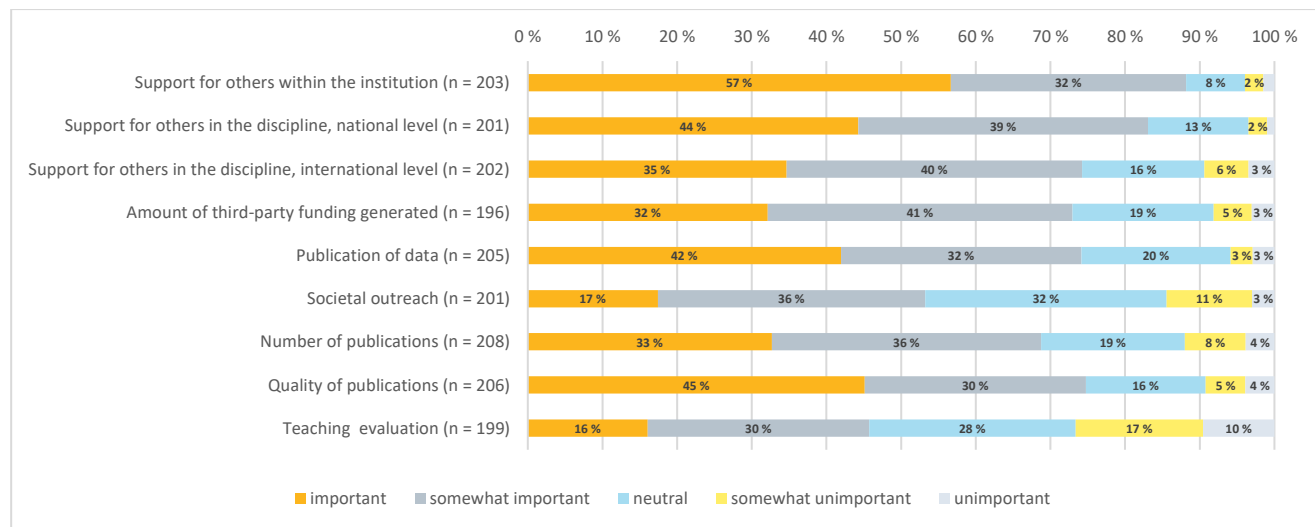


Figure 9 – Drivers for success.

	Support for others within the institution (e.g. university, research centre)	Support at the national level	Support at the international level	Publication of data	Grant acquisition	Outreach	Number of publications	Quality of publications	Teaching evaluation
No specific discipline (n = 12)	78 %	78 %	67 %	78 %	67 %	78 %	78 %	78 %	44 %
Natural science and engineering (n = 112)	87 %	84 %	77 %	71 %	73 %	43 %	69 %	77 %	43 %
Medical and health science (n = 37)	91 %	77 %	71 %	71 %	74 %	49 %	63 %	71 %	49 %
Social sciences and humanities (n = 55)	90 %	86 %	71 %	78 %	77 %	73 %	70 %	72 %	50 %
Overall (n = 216)	88 %	83 %	74 %	73 %	74 %	53 %	69 %	75 %	46 %

Table 5 – Drivers of success by discipline.

	<i>Support for others within the institution (e.g. university, research centre)</i>	<i>Support at the national level</i>	<i>Support at the international level</i>	<i>Publication of data</i>	<i>Grant acquisition</i>	<i>Outreach</i>	<i>Number of publications</i>	<i>Quality of publications</i>	<i>Teaching evaluation</i>
<i>No team to lead (n = 109)</i>	91 %	86 %	75 %	74 %	76 %	59 %	70 %	75 %	17 %
<i>Small team, with up to 5 individuals (n = 67)</i>	84 %	81 %	72 %	77 %	69 %	49 %	75 %	75 %	18 %
<i>Medium team, with 6 to 10 individuals (n = 16)</i>	93 %	87 %	73 %	73 %	72 %	40 %	53 %	64 %	8 %
<i>Medium team, with 11 to 20 individuals (n = 14)</i>	87 %	80 %	73 %	67 %	64 %	47 %	60 %	73 %	14 %
<i>Large team, with more than 20 individuals (n = 9)</i>	78 %	67 %	89 %	67 %	89 %	56 %	56 %	89 %	11 %
<i>Overall (n=215)</i>	88 %	83 %	74 %	74 %	73 %	53 %	69 %	75 %	16 %

**Table 6 – Drivers of success by team size.**

## 2.5. Actual Tasks and Their Desirability

The following section provides further tables and information to get a deeper insight into the dataset. These provide an overview of the responses regarding current activities and time spent on them, the importance of services offered by the respective RI or CF, specific career drivers, and the desired qualifications of managers and employees in RIs and CFs – these aspects will then be taken up in the next section. The distribution of time spent on the areas of activity surveyed is comparatively homogeneous. Exceptions are, for example, the very specialised work with patients (clinical work). The field of communication with users is very strongly represented; communication with external partners somewhat less so.

Looking at the time spent on different tasks (see Table 7), it turns out that the answers are very balanced. Only a few tasks and time spans reach very high or very low values. However, there are some exceptions. As an example, the questionnaire was obviously only completed by a very small number of medical professionals who do both clinical and scientific work. This is also due to the special working conditions in this field. In addition, regarding the time used, communication proves to be a central object. Only 3 % say they never deal with it at all. By contrast, “I spend some time on this task” reaches the highest value with 46 % and another 28 % state “I spend a lot of time on this task”. The important aspect of “human resources-related management” should also be emphasised: 8 % spend a lot of time on this – a typical task in high-level management – and 29 % spend some time on this task. But there is a majority of 63 % that do not spend any or only a little time involved in this task.

Regarding the qualifications desired for managers (see Table 8), it can be seen that the response options from “neutral” to “very unimportant” were only selected to a very limited extent. This indicates that employees expect their managers to have numerous competencies at different levels. Most areas of activity are considered “very important” and “important” by the vast majority. Once again, communication is at the top of the list, with a total of 87 %, closely followed by management (85 %), providing service (71 %) and aspects of research and innovation (70 %).

	<i>I do not spend time on this task at all</i>	<i>I spend only (very) little time on this task</i>	<i>I spend some time on this task</i>	<i>I spend a lot of time on this task</i>
Work for the scientific profile / community (e.g. reviewing, participating at conferences, writing papers / books / chapters / research reports) (n = 237)	14 %	32 %	38 %	17 %
Conducting empirical work (lab work, survey or interview work, expeditions, data analysis) (n = 235)	19 %	25 %	27 %	29 %
<i>Developing and acquiring new methods and technologies</i> (n = 234)	18 %	30 %	43 %	10 %
<i>Preparing and acquiring grants</i> (n = 236)	21 %	30 %	36 %	13 %
Maintaining infrastructure and equipment (n = 236)	26 %	22 %	33 %	19 %
Working with patients (clinical work) (n = 234)	97 %	1 %	1 %	1 %
Teaching students (n = 230)	32 %	31 %	26 %	12 %
Training colleagues or stakeholders in my services and consultancy (n = 234)	15 %	35 %	41 %	9 %
Communicating with users / stakeholders (e.g. universities, laboratories, research institutes, scientists) (n = 233)	3 %	22 %	46 %	28 %
External communication and outreach (e.g. media, political stakeholders on a national and international level) (n = 236)	20 %	39 %	30 %	12 %
Institutional management (e.g. representation, high-level meetings) (n = 237)	20 %	34 %	30 %	16 %
Administrative management (e.g. regulations, compliancy, GDPR, safety) (n = 236)	20 %	32 %	36 %	11 %
Human resources-related management (recruitment, staff development, organisational culture) (n = 237)	27 %	36 %	29 %	8 %

**Table 7 – Time spent on different tasks.**



	Very important	Important	Somewhat important	Neutral	Somewhat unimportant	Unimportant	Very unimportant
Research and innovation (e.g. developing tools, writing papers) (n = 212)	33 %	37 %	20 %	5 %	4 %	1 %	1 %
Provide services (e.g. consultancy, trainings, or creating service documents/data) (n = 212)	33 %	38 %	19 %	7 %	2 %	0 %	1 %
Education and training of students (e.g. giving lectures) (n = 212)	16 %	31 %	28 %	14 %	6 %	3 %	2 %
Management (e.g. stakeholder interaction, budgeting, acquiring, funding) (n = 212)	55 %	30 %	11 %	4 %	0 %	0 %	0 %
Communication (e.g. to different stakeholders, internal and external) (n = 212)	52 %	35 %	6 %	8 %	0 %	0 %	0 %

**Table 8 – Qualifications desired for managers of RIs and CFs.**

	Very important	Important	Somewhat important	Neutral	Somewhat unimportant	Unimportant	Very unimportant
Research and innovation (e.g. developing tools, writing papers) (n = 212)	56 %	32 %	9 %	2 %	0 %	0 %	0 %
Provide services (e.g. consultancy, trainings, or creating service documents/data) (n = 212)	39 %	38 %	16 %	6 %	1 %	0 %	0 %
Education and training of students (e.g. giving lectures) (n = 212)	26 %	40 %	18 %	12 %	1 %	2 %	0 %
Management (e.g. stakeholder interaction, budgeting, acquiring, funding) (n = 212)	14 %	23 %	28 %	23 %	7 %	4 %	1 %
Communication (e.g. to different stakeholders, internal and external) (n = 212)	21 %	39 %	25 %	12 %	2 %	1 %	0 %

**Table 9 – Qualifications desired for scientific staff members of RIs and CFs.**

The answers are very similar regarding the areas of activity of the employees (see Table 9). Only management achieved a comparatively high value of 23 % for the option "neutral". However, there are shifts at the top, corresponding to the different requirements for managers and scientific staff: Here, the area research and innovation is considered by 88 % to be that in which scientific staff need to be most competent. In line with the character of RIs and CFs, however, service provision also achieves a high value of 77 %. This often overlaps with student support, which also achieves a high value of 66 %. At the level of academic staff, communication is also "very important" or "important" with 60 %. Only the aspect of management takes a slightly back seat here but is still an activity that is considered "very important" or "important" by 37 % of the respondents. The responses to the question "How important is it for your type of RI or CF to provide the following services?" underline the importance of RIs and CFs as providers of services that enable excellent research (see Table 10). However, the wide spread of responses to the options "somewhat important" to "completely unimportant" also shows that overall, there are numerous RIs and CFs in which services play only a subordinate role. Later, the results of the qualitative study also offer additional insights into this aspect of the character of RIs and CFs: there are also RIs and CFs that are strongly involved in their own independent research.

Finally, the focus is on the importance of various aspects for a successful academic career in RIs and CFs (see Table 11). Some differences regarding the conditions in universities become apparent here but also many similarities. Almost all areas of activity are only very occasionally classified as "somewhat unimportant" or "unimportant". One exception is evaluation by students, which receives comparatively high values of 17 % and 10 % here. However, this can be explained by the fact that academic teaching, and, thus, its evaluation, plays only a very minor role in RIs and CFs. Compared to other questions, the answer option "neutral" is often chosen in this area, but most aspects of scientific work are also considered "somewhat important" or "important" in RIs and CFs.

	Very important	Important	Somewhat important	Neutral	Somewhat unimportant	Unimportant	Completely unimportant
Providing (high-performance) computing services (e.g. CPU, GPU, AI) (n = 210)	20 %	21 %	15 %	11 %	4 %	11 %	16 %
Providing long-term data repositories/archives for data/material (n = 210)	53 %	23 %	10 %	6 %	3 %	2 %	4 %
Providing short and mid-term storage for data/material (n = 210)	44 %	32 %	11 %	7 %	2 %	2 %	1 %

**Table 10 – Importance of services provided.**

	Important	Somewhat important	Neutral	Somewhat unimportant	Unimportant
Support for others within the institution (e.g. university, research centre) (n = 213)	57 %	32 %	8 %	3 %	2 %
Support for others in the discipline on a national level (n = 213)	44 %	39 %	13 %	3 %	1 %
Support for others in the discipline on an international level (n = 213)	35 %	40 %	16 %	6 %	4 %
Amount of third-party funding generated (n = 213)	32 %	41 %	19 %	5 %	3 %
Publication of data (n = 213)	42 %	32 %	20 %	3 %	3 %
Societal outreach (n = 213)	17 %	36 %	32 %	11 %	3 %
Number of publications (n = 213)	33 %	36 %	19 %	8 %	4 %
Quality of publications (n = 213)	45 %	30 %	16 %	5 %	4 %
Good teaching evaluation (n = 213)	16 %	30 %	28 %	17 %	10 %

**Table 11 – Importance of career drivers.**

This also applies particularly to the publication of data (74 %), the number of publications (69 %) and their quality (75 %). Although RIs and CFs have other funding options than purely university research institutes, very high importance is, nevertheless, attached to acquiring third-party funding (73 %) in order to advance one's career. "Societal outreach", which is strongly demanded at many universities in the sense of public science with low-threshold offers, is, on the other hand, assigned a high significance by only 53 % of the respondents. Most important, however, is "support for others within the institution", which is "important" or "somewhat important" for 89 % of respondents. This suggests a very strong local anchoring of RIs and CFs, which are, however, basically intended to support scientists in Europe and beyond. In this context, it is also noticeable that "support for others in the discipline on a national level", with a total of 83 % of respondents, is more often considered "important" or "somewhat important" for a career in an RI or CF than is the case for "support for others in the discipline on an international level" (75 %). (See Table 11 on the previous page)

## 2.6. Drawing conclusions

The structure identified hints at the following for RI:TRAIN Plus: it is of uttermost importance when developing courses and classes to reflect who the target group is meant to be. Those who lead larger teams and are active on an international level have other demands than those who manage smaller teams and may be tied to more local or national structures.

However the general necessity to master communication with external and internal partners and manage the institution and staff (leadership) are central for the success in the field and, therefore, should be top priorities for courses in a RI:TRAIN Plus curriculum.

Furthermore, the legal and administrative framework is of importance and was highlighted in several datapoints; even if the overall assessment was not so strong that it could be seen as a key aspect for all involved, it is much more specific to certain demands. The higher demand from the social sciences can be seen as a consequence of the advanced GDPR guidelines in some instances, but this may not be the sole factor.

Additionally, the skill of writing – both for scientific publications and grant acquisitions – is seen as a key competency. Therefore, it should be reflected on by the individuals involved in RI:TRAIN Plus. If the curriculum saw academic writing and publishing as key skills, this would foster the competencies of those employees involved.

Overall, the quantitative dataset hints at the need for the following key competencies:

- **Communication and engagement:** How to talk and communicate with different groups.
- **Leadership and staff management:** Develop and manage structures for leading teams and what is necessary to do in a strong and decisive way. Regional and organisational structures need to be reflected on here.
- **Positioning in the scientific community:** How to write and prepare communications for the scientific communities, in the form of both publications and grant proposals.

In order to not only broaden the view and improve the evidence base, but also ensure a link with the qualitative survey, we also gave participants the opportunity to provide open answers regarding the skills and qualifications of good heads and managers. Therefore, we added the open question "Please specify in which other sections managers of RIs or CFs should be trained" to the quantitative survey (see Figure 10). The overview intentionally shows the spellings and combinations from the survey, which also explains the repetition of aspects that are particularly important to the participants.

The answers are manifold, but they also very clearly underline the results of the closed questions we reported previously. The most frequently mentioned competencies are in the broad field of employee management: More **organisational aspects**, such as "human resource management", "dealing with personnel" and "staff management", on the one hand, and more **team internal aspects**, such as "leadership", "staff motivation", "team management and development" and "conflict management", on the other hand. A second block of answers can be summarised as **organisational leadership and positioning**, including features such as "law and legal aspects", "relevant legislation and licensing", "ethics", "science policy and politics", "compliance", "strategic thinking" and "communication". A third block is dedicated to answers related to **scientific and technical work against the background of the field of activity of the RIs or CFs**: "Acquiring new technical skills", "grant application for CF", "learn innovative technologies" and "technical info about instrument maintenance, methodology". It becomes clear how comprehensive and wide-ranging the requirements for *good* leaders are seen by the members of the RIs and CFs. These relate to both internal and external leadership. Wide-ranging competencies are expected regarding personnel responsibility.

This includes not only the selection of new employees and structuring of the staff, but also the management and development of existing employees. Expectations are high, especially concerning internal team aspects. Management staff should be as responsive to the overall structure and development as they are to individual needs and personal career paths. This particularly includes critical situations that require conflict management and resolution, as well as the field of diversity and discrimination. In addition, leaders are expected to represent the RI or CF strongly to the external stakeholders and be committed to their concerns. In this context, it is important for the staff to further develop the institution and secure its finances, for example, through sound budgeting, dealing with difficult contractual situations and acquiring new grants through third-party funding.

Regarding the further development of the institution, a strong commitment is demanded, particularly from the managers, in both the practical implementation of project applications and longer-term planning and the bundling of competencies. The answers also provide very clear evidence that managers who only see themselves as responsible for management tasks are not an option for many employees. Such people appear unsuitable for the task profile in an RI or CF. Instead, it is expected that managers also come from the respective scientific field. They should have academic and technical competencies, and regularly expand them in order to be able to actively participate in the central tasks of the institution. Especially in this area, the focus is on the specific requirements of the respective RI or CF. Regarding individual projects, managers are expected to participate in grant acquisition and accompany the implementation in terms of content and deadlines. It can, thus, be deduced that a *good* leader in an RI or CF is strongly seen as *primus inter pares*. This requires a combination of personal leadership and management skills, on the one hand, and a high level of professional competency concerning the field of activity, on the other.

In addition to gathering information, this open and non-standardised question also serves on a methodological level to interlink the quantitative with the qualitative survey. In both cases, respondents are given the opportunity to openly reflect their thoughts without being restricted and influenced by predetermined answer options or too narrowly formulated follow-up questions. The following section of this report deals with the implementation and the results of the qualitative survey. In contrast to the quantitative survey, this was only addressed to leaders and managers in RIs and CFs, but not to their entire staff. As a result, we can effectively compare what skills and qualifications employees expect from their managers, on the one hand, and what skills and qualifications leaders and managers themselves consider important for their position, on the other. We see clear overlaps between the views of the two groups by deducing four key competencies from the qualitative interviews: **academic excellence and a broad and deep academic understanding of the field; project management and organisation management; a deeper knowledge about the field of science and research in Europe;**

and **communication skills on different levels**. We will embed these results in the following section and report on further findings of the qualitative study.



**Figure 10 – Please specify in which other sections managers of RIs or CFs should be trained.**

## 3. Qualitative Study

In addition to the quantitative survey, we conducted a qualitative study in the form of expert interviews. The main aim of the qualitative case study was to learn more about the state of the field of science in Europe and to understand more comprehensively RIs and CFs, and their conditions and needs as part of the first pillar (Excellent Science) of Horizon Europe. As part of this, we wanted to get to know the minds behind the organisations and their individual backgrounds. In this context, we also wanted to find out what good leadership means, what qualifications are required and what competencies leaders and staff of RIs and CFs should have. It was important to find out whether pan-European curricula are welcomed and, if so, what content they should cover primarily.

### 3.1. Aims of the Study

Our qualitative interview study identified key stakeholders in the European research landscape and discussed with them how they evaluate the situation and what they identify as core needs against their individual and professional background. This includes the state of research in Europe as a whole, the situation and future prospects of RIs and CFs, and the needs and demands of their own organisation. Furthermore, we asked them for their opinion on the implementation of curricula and the important skills of managers and staff in our specific environment. This will help us gain an understanding of the challenges found in the field and gain an overview of the major tasks that need to be completed to make high-level research possible.

### 3.2. Principals and Structural Design

Accordingly, we developed a qualitative research design as an equal ranking part of the project's "equally mixed-methods" (Morse, 1991) design. Our aim was to realise an "explanatory design" (Creswell, 2003), which benefits from the equal combination of qualitative and quantitative approaches (QUAL X QUANT).

Given the fact that RI:TRAIN Plus is part of the European research funding of Horizon 2020 (European Commission, 2021), we have the task to cover the whole continent, but in a way that is transparent and intersubjectively traceable. This great mission came along with manifold challenges. On the one hand, we had to deal with limited resources (see Flick, 2007, p. 140), which include a tight schedule, defined personnel and financial conditions, and still limited travel options due to the COVID-19 pandemic. On the other hand, we had to deal with not only a multitude of institutions and heterogeneous scientific disciplines with different conditions and traditions, but also a variety of national states defined by their political and economic systems and their historic and socio-cultural backgrounds. In order to meet these challenges appropriately, we decided to set up a multilevel selection procedure, a purposeful sampling (see Rapley, 2004, p. 56; Brosius et al., 2008, p. 83) which is based on conscious and reasoned decisions. The overarching goal is the selection of "information-rich cases" (Patton, 2002, p. 230; emphasis in the original), which are defined as cases "from which one can learn a great deal about issues of central importance to the purpose of inquiry, thus the term purposeful sampling" (ibid.). A particular challenge was the selection of countries: "Little formal attention is paid to the question of country selection, these decisions often being somewhat ad hoc, convenient, or serendipitous, not necessarily best meeting the research aims but depending instead on practicalities of contacts and funding" (Ólafsson et al., 2013, p. 23).



In order to meet this challenge, we decided to follow an approach that is based on maximum differences to conduct purposeful sampling based on the following criteria:

- (1) Region in Europe,
- (2) Size of the country,
- (3) Membership status/tradition within the European Union,
- (4) Economic situation, and
- (5) Particular traditions (e.g. international relations).

This approach also reflects the considerations of Melvin Kohn (1989) concerning “cross-national research”. In this understanding, the countries selected do not only function as an “*object of study*” but also as a “*context of study*” (ibid., pp. 20-21; emphasis in the original).

## 3.2.1. Selection of Countries

In a first step, we organised Europe into regions. Typically used classifications in pan-European research, such as NUTS 1, which refers to the “major socio-economic regions” (Eurostat, 2021), or NUTS 0, which is understood as the national states, is of only limited use to our endeavour, therefore, we decided to draw on the United Nations Statistics Division (2021). This approach organises Europe into four regions: Eastern Europe, Northern Europe, Southern Europe, and Western Europe. We show up the countries selected in the four regions, including the arguments for their selection, in the following:

### Northern Europe – United Kingdom

- Large country
- Long tradition within the European Union, special status, BREXIT
- Strong economy (G7)
- History as the leading nation (British Empire, UN Security Council), bridgehead to the United States of America

### Western Europe – Switzerland

- Small country
- Not a Member State of the European Union, strong relationships
- Very strong economy
- Permanent neutrality, best university in Continental Europe (ETH Zurich) (Shanghai, 2021)

### Western Europe – France

- Large country
- Founding Member State of the European Union
- Strong economy (G7), but economic struggles and reform processes
- Centralist state, significant role of the state

### Eastern Europe – Bulgaria

- Middle-size country, but small population
- Young Member State of the European Union since 2007
- Economically strained situation
- Young democracy, post-Soviet tradition

### Southern Europe – Spain

- Large country
- Member State of the European Union since 1986
- Economically strained situation, fundamentally changing processes
- Bridgehead to Latin America and the Caribbean



In addition to those countries, we started the study with three pilot interviews in **Austria**, which is considered part of **Western Europe** in the United Nations classification and included them into the dataset.

- Small country
- Member State of the European Union since 1995
- Strong economy
- Strong relations with Germany, common language area, bridgehead to Eastern and Southern Europe

## 3.2.2 Core and Satellite Countries

This led to three larger countries, one mid-sized and two smaller ones, with highly diverse cultural and academic backgrounds. Due to this, a large amount of manifold data can be derived.

The countries mentioned above are understood as core countries and were covered by the RI:TRAIN Plus team at the JKU in Linz, Austria. However, RI:TRAIN Plus is a multinational and inclusive project. Therefore, all participating countries were warmly invited to take part in task 2.1 and cover additional European countries. In the course of this, two national teams followed the selection scheme mentioned above and covered two additional countries in **Northern Europe (Sweden)** and **Southern Europe (Italy)** and enriched the dataset.

## 3.2.3. Data Collection, Interviewer Training and GDPR Regulations

Based on three pillars: the findings of the previous RI:TRAIN project, a literature review (Bourdieu, 1977, 1989; Bettinger & Hugger, 2020; Schatzki, 2002; Oswald et al., 2016), and multiple discussion rounds among the WP2.1 team, we built a complex qualitative guide for the interviews. This latter comprises the following four co-ordinated parts:

- Science and Research in Europe – Mapping the Field,
- Now It Is All about You – Managing a Research Infrastructure or Core Facility,
- Building and Developing the Team – Requirements for Scientific Staff, and
- Last Comments (Individual Perspectives) and Closing the Interview.

After completion, the guide was made available to all members of WP2.1 in two rounds of review and all comments received were incorporated. Having done this, three pretest interviews were conducted in Austria and final updates of the guide completed the instrument. A final part of the preparation involved all members of WP2.1 who invited to an interactive interviewer training session. This took place on October 19, 2021, via Zoom and lasted 90 minutes.

The data collected contains information on the country of residence and origin, age, sex, career track, and affiliation to specific RIs and CFs, and are, thus, highly sensitive. This is particularly true because the value of qualitative expert interviews is based largely on the fact that the interviewees' real names are mentioned. Therefore, we set up a consent form that matches GDPR regulations in order to use the data for analysis and scientific publications. The consent form was handed out before each interview and had to be signed before the interview began. All interviews were conducted via Zoom in the period October 11, 2021, to January 26, 2022, due to the restrictions against the COVID-19 pandemic and to make a low-threshold offer for a pleasant conversation situation (Schulz & Ruddat, 2012).

## 3.2.4 Data Processing, Data Analysis and Preliminary Dataset

All interviews were recorded via Zoom. The video track was immediately deleted and only the audio track was stored on local hard drives. There was no storage or transmission via cloud services. Subsequently, the interviews were transcribed and prepared for analysis (Kowal & O'Connell, 2005; Dresing & Pehl, 2015). A two-stage qualitative content analysis was carried out in the form of a focused and contextual analysis (developed by Paus-Haase et al., 1999; Paus-Hasebrink & Sinner, 2021, p. 39), based on inductive and deductive coding. MAXQDA 2020 software was used to support the analysis.

The following results are based on a preliminary analysis and focus on these codes:

- *Structure of RIs and CFs, particular needs of RIs and CFs;*
- *Skills and competencies needed for heads and managers of RIs and CFs;*
- *Skills and competencies required for RI and CF staff members;*
- *The need for a curriculum for heads and managers of RIs and CFs;*

- *The need for a curriculum for RI and CF staff members;*
- *The contents desired for a curriculum for heads and managers of RIs and CFs; and*
- *The contents desired for a curriculum for RI and CF staff members.*

All interviews conducted have been integrated into the evaluation. Therefore, the results are based on 17 interviews with interviewees in all eight countries covered:

- Dr. Annika Jenmalm Jensen (Sweden): Infrastructure Director SciLifeLab, Karolinska Institute
- Assoc. Prof. Dr. Jessica Lindvall (Sweden): Joint Head of Facility, National Bioinformatics Infrastructure Sweden (Support and Infrastructure)
- Dr. Alice Solazzo (Sweden): Project Co-ordinator SciLifeLab, Uppsala University
- Dr. Elisabet Carlsohn (Sweden): Head of the Core Facilities, Sahlgrenska Akademien, University of Gothenburg
- Prof. Dr. Atanas Palazov (Bulgaria): Deputy Director of the Institute of Oceanology (Bulgarian Academy of Science), Euro-Argo
- Dr. Ekaterina Markova (Bulgaria): Senior Research Fellow at the Institute for Philosophy and Sociology (Bulgarian Academy of Sciences), National Leader of SHARE
- Prof. Dr. Christian Rüegg (Switzerland): Director of the Paul Scherrer Institute (ETH), European Spallation Source (ESS)
- Dr. Michèle Ernst-Stähli (Switzerland): FORS Head of Group Int, National Leader European Social Survey (ESS) and SHARE
- Dr. Davide DiCioccio (France): Access Officer, European Marine Biological Research Centre (EMBRIC) ERIC
- Prof. Dr. Jean-Marie Flaud (France): Ministry of Higher Education and Research France, Chair of the ERIC Council Euro-Argo
- Prof. Dr. Enzo Terreno (Italy): National Co-ordinator Multimodal Molecular Imaging Node, Euro-Biolmaging
- Dr. Marco Borra (Italy): Head of the European Marine Biological Resource Centre, EMBRIC<sup>IT</sup>
- Dr. Isabella Buber-Ennsner (Austria): Wittgenstein Centre for Demography and Global Human Capital, Head of Austria – The Gender and Generations Programme (GGP)
- Mag. Michael Radhuber (Austria): JKU Linz, Leading Scientist and Project Manager of SHARE Austria
- Lisa Hönegger, MA (Austria): Managing head of AUSSDA (CESSDA)
- Dr. Helen Taylor-Curran (United Kingdom): National Co-ordinator UK Node (British Geological Society), ECCSEL ERIC and EPOS
- Dr. Mónica Morales Ballus (Spain): Head of Core Technologies Programme at Centre for Genomic Regulation (University of Barcelona), CGR

### 3.3. Selected Results on the Character of Research Infrastructures and Core Facilities

One of the overarching results of the qualitative study concerns the orientation of RIs and CFs in the field of science and, consequently, their needs. The RIs are typically classified according to their scientific disciplines. Alternatively, they are assigned to superordinate categories, such as natural sciences, social sciences or humanities. This is particularly true of RIs and CFs, which are increasingly diverse. According to their thematic orientation, they are assigned to the six categories of DIGIT, ENERGY, ENVIRONMENT, HEALTH & FOOD, PHYSICAL SCIENCES & ENGINEERING, and SOCIAL & CULTURAL INNOVATION (ESFRI, 2021, p. 18). This is associated with different needs in terms of technical and personnel equipment, skills and competencies, processed data, accessibility, infrastructure and much more – according to their thematic orientation. Across categories, however, RIs and CFs can also be classified regarding their predominant character and the approach of their working aims:

- **Data-generating organisations:** Those RIs and CFs that conduct primarily empirical research and generate new data.
- **Data-providing organisations:** Those RIs and CFs that prepare and make available primarily empirical data for use by the scientific community (e.g. archives, networks).
- **Hybrid organisations:** Those RIs and CFs that contribute almost equally to both approaches.

Again, this is associated with different needs in terms of technical and personnel equipment, skills and competencies, processed data, accessibility, infrastructure and much more – according to their predominant character and the approach of their working aims. Against this background, it becomes more than clear and understandable why the heads and leading managers of RIs and CFs sometimes place very different demands on their staff so that they can be considered excellent.

An example of data-generating organisations is the Paul Scherrer Institute (PSI) as part of the European Spallation Source ESS. It is a very large research institute and both excellence and many years of experience in science are required here, as well as several years of experience abroad:

**Christian Rüegg, PSI**

*Well, the characteristic of PSI is that people here are working at the facilities. That's right. But they also are fully eligible scientists for all science programmes. So, we are doing a particular thing here, it is that they can apply for grants of science foundation. [...] We have 60 professors joined with us and other universities at PSI. So, mostly all labs have some division heads who are professors as well. And I mean real professors, I mean, like they work for that title, but mostly people also teach, and they register projects and so on. [...] In Switzerland, you have always to go abroad because it is too small, so everyone has to leave. And even if I don't do an academic career, people effectively have to go to Europe or the U.S. for some years. Then they may come back. [...] I think we are more set up towards doing science, our own science, not just service. That's the deal here is really that I expect somebody to be an ambitious scientist on top of that, on top of building the instruments of the user support. You clearly don't have a service model that's a little more like a collaboration with them.*

In contrast to this, the AUSSDA, as part of the CESSDA, does not conduct empirical work on its own; it is a data-providing organisation. Their main goal as a digital archive is “to make social science data accessible and reusable”. This includes “integrity in archiving and advocate for compliance with data protection and ethical principles in research data management” (AUSSDA, 2022). Against the background of the divergent field of work, the requirements for excellent employees are also different and adapted to the conditions of the RI. The daily routines there are not seen as typical academic work:

**Lisa Hönegger, AUSSDA**

*So, from a really scientific career perspective, I cannot judge it because I haven't chosen the path of a scientific career, but I see how it is at our university and I see how it is generally; it's very competitive [...] Nevertheless, work is seen as an integral part of scientific excellence: Yes, I think it's a very important aspect and I think it's essential for research excellence as well because it is part of, I mean, for example, just research data management, which is our core activity and is part of research support, and what Research Infrastructures need to manage is more and more defined as part of this good scientific practice and of research excellence. So it is, I think, more and more becoming a part of research excellence not just as it maybe was before the results in itself and the process, but really the whole process of what started from data collection until the publication and then the reuse possibly. In order to fulfil that service approach, a strong connection to the underlying field of research is named to be the most needed competence: From our experience here, it always helps if they have been part of the research community themselves, not only for the connections that they bring, which is an important part because it's sometimes really hard to reach your scientific community that you have the services for, but then also it's important really to understand in this case the underlying product, which is social science research output for us, for example. And I think it's very helpful if people have been part of this scientific community, part of this world, understand what their needs are, because sometimes Research Infrastructures, which are more on the administrative or service unit side, are very disconnected from the researcher community and then it's difficult to understand what the needs are, but then also to interact and to get in connection. So, it is very helpful if people who come to work at our infrastructure have been part of the scientific community that we then actually serve.*

The perspectives of SciLifeLab, which also emphasise the service aspect of Ris, are very similar to this:

**Annika Jenmalm Jensen, SciLifeLab**

*I think, umm, you should, you need to have a passion or a drive to enable other people's biological questions, other people's science. Aah, I think that's important. I mean, not to drive your own, umm, science, aah, but to enable other people's science and to do that, aah, with very high quality. Because I think that is infrastructure. I mean, that's the beauty of combining infrastructures with big biological questions from PIs is that there is ehm. I mean, you have your clear roads in the beginning. And I think that combining those two, actually it's one plus one makes four or something like that. Because, if you compare it to a research collaboration to PIs, both want there to be the last author on the paper, that sort of competing negotiating. So, I think that's ehm. The roads is clear from the beginning, if you combine the infrastructure with the, with the PI.*

While the working situations at PSI or AUSSDA and SciLifeLab are fundamentally different from each other, the Institute of Oceanology at the Bulgarian Academy of Science, which is part of Euro-Argo, is, so to speak, moving along a middle path. On the one hand, it is conducting its own empirical research and data collection, and, on the other hand, these raw data will also be made available to other organisations and researchers for further evaluation. It is a typical example of a hybrid organisation. This character goes hand in hand with the fact that employees must meet both requirements: excellent empirical work, on the one hand, and selfless provision of data for others, on the other:

**Atanas Palazov, BAS, Euro-Argo**

*Oh, I think we are working very well with Euro-Argo ERIC, because Bulgaria is a small country but the only country that participated in the Black Sea region, and we are giving our support for this very important programme I mean. And it's our component and we are actively participating, not only the routine management, but also taking decisions about how to develop this infrastructure, what is the priority now and what will be next year and so on. I think it's important, because now we are, we now have a good position in the Black Sea. We are the main donor of Euro-Argo floats. Government is supporting us with this to buy at least three floats every year and to deploy these floats and to receive enough amount of data from the sea. Because last year the research vessels, they are not so active in the Black Sea [due to political problems in the region and a lack of funding] and now they are based, and the data, the profiles that we are receiving from our Euro-Argo floats is more than that is collected by ships, by vessels, by research vessels. And, we have a very good support I mean. You know, Argo data are free, everybody can use it and we have very good examples for this. We are collecting, we are providing this data, but other scientists, scientists from other countries, they are writing very nice papers. And the articles and publications using this Argo data and I think Argo data is very important for ocean science. [...] Actually, we are lacking physical oceanographers in our institute, also our marine biologists are focused on other issues. And actually, the problem is that we are publishing in Bulgaria several papers per year using Argo data. But ehm, I could say that Russia has some very, very big number of scientists and they are very active, you know. And they are publishing very nice papers and also our partners from Europe, they're also working very actively in this field. So, but it's a, it's open science, we are not going to close these data, we are obliged to publish these data and everybody can use it for scientific issues. I don't want to denounce. So, we are not jealous about this data.*

Another example for such a kind of hybrid organisation is the Centre for Genomic Regulation at the University of Barcelona. The insight into this organisation also shows how broad and diverse the requirements in RIs and CFs are and points out which (often not considered) competencies are necessary due to the individual structures:

**Mónica Morales Ballus, CGR**

*First of all, you need to be a scientist, that is clear. You need to understand the technologies and the researchers. I think having done a PhD or even a Postdoc is very needed in the position. But of course, there are many other skills you can learn by doing. What you need to be is very, [...] having a problem-solving mindset. But what I do most of the time is helping the researchers to solve their problems – not only at the service level in different units, but also other conflicts. You really need to look behind what is happening, having critical thinking and problem-solving. But also, I think [...] you need to be very flexible, but at least in my position I am dealing with many different persons. Of course, researchers, but also with many very different personalities of unit heads. So, one head may be very organised, the other super chaotic, but a super good scientist. And you try to harmonise this, you really need to be flexible and work with them on a different way. I would say: critical and analytical thinking, problem-solving and flexibility.*

We must keep this distinction in mind for further evaluation steps. However, the last sentence by Atanas Palazov, “I don't want to denounce. So, we are not jealous about this data”, highlights a very important training need for many employees in different RIs and CFs. When one thinks about research, one thinks primarily about carrying out projects, evaluating data and publishing the results. And that is absolutely right, however, it is only one side of the coin. The other side of the coin is making data available to other colleagues, archiving the data and keeping it accessible to society. We need to recognise and internalise that both aspects have equal value and are part of a greater whole. This insight, as pointed out by Lisa Hönegger, is of particular importance for employees of data-providing and hybrid organisations. Even if they do not pursue a typical academic career, their work is essential for science and society, but it is not ranked lower. Working in an RI or CF is, in many cases, service to society, and service to society is at the core of what science is all about. This becomes abundantly clear when one recalls the words of Charles William Eliot, long-time president of Harvard University: “Depart to serve better thy country and thy kind”. This sentence reminds the graduates to be aware of their role as they leave the university through Dexter Gate (Gewertz, 2005). These are unquestionably pathetic words, especially since “thy country” today must, at least, also be understood as Europe, if not as the global world community (“thy kind”), because borders of national states should no longer be obstacles in a knowledge society. Nevertheless, the inscription also reflects the clearly more modern ideals of Norbert Elias (1987), who

calls for a science committed to the well-being of humanity, an “engaged (social) science”. To conclude, the different character of the diverse RIs and CFs should be consistently considered for further research and development of the field, both when it comes to their needs and the development of curricula and staff training, as well as with a view to their future development as organisations and resources.

### 3.4. Further Analysis Concerning the Need for RI:TRAIN Plus Curricula and Contents Desired

The quantitative evaluation has already given numerous indications as to which contents should be covered in future curricula. It has also shown that different target groups with different needs have to be addressed. The following sections deepen these findings based on the evaluation of the qualitative survey. First and foremost, the aim is to find out whether there is a need for such RI:TRAIN Plus curricula, which concrete topics should be covered and which competencies should be promoted. A distinction is made between the needs of leaders and managers and those of employees. It is important to bear in mind that the quantitative survey was addressed to all team members of RIs and CFs, while the qualitative survey only interviewed heads of units and senior managers in ERICS.

#### 3.4.1. Should There Be a RI:TRAIN Plus Curriculum for Heads and Managers?

It is difficult to give a clear answer to this question because the answers differ strongly on this point. There are basically **dismissive attitudes**, arguing that leaders do not reach their positions without the necessary experience, based on their personal development and career. The diversity of existing programmes is also cited, as well as the primacy of the local organisation and support from the national government. More **moderate positions** agree that a curriculum for leaders may be of interest in the future. However, it is noted that there are more relevant issues now, such as the long-term funding of projects and the deferment of employment contracts. But there are also **voices advocating** basic curricula or even extensively designed master’s programmes or even PhD programmes in something like “Research Infrastructure Management”, as an alternative track to universities. The introduction of common curricula at this high level will not be possible in one quick measure and not be successful against the will of the heads and managers. It will be indispensable for success to get all those concerned and involved on board. An open and discursive approach should also be adopted in the future, including both the development and implementation of curricula. All those affected should continue to be given the opportunity to participate and contribute, and have their concerns heard. A key challenge will be to address the multiple differences at all levels: national states and their different conditions and objectives, different scientific disciplines with their traditions and ways of working, and individual characteristics of single RIs and CFs with their institutions. Based on our qualitative study, the following quotes already give an insight into the views of the interview partners and highlight the diversity of perspectives in the field:

**Christian Rüegg, PSI**

*The general management stuff, you know, people have to get just a bit of training, but you know, that is not the core, you have to just learn also by doing these jobs over time. You know, it’s not that you do a course of a big Research Infrastructure in the sector. I also know, after doing just an academic career, I came back to PSI and let’s say, had 30 to 60 people at the end. And then it was 250, and now it is 2,500. You have to do this, there are no shortcuts. Yeah. So it is you know, and that is done locally. You see, you have to do it in a local organisation and then people switch, you know, from maybe to some European infrastructure. But the training has to be local in some sense. [...] But then, I mean, certainly it’s good to have a dedicated programme, but I think there is a combination of just doing these jobs and then get a bit of management training from what is available. I think it’s kind of OK. But you know, it is that such a thing has to happen. Otherwise, you also don’t get these leaders at the European scales. But I think that training has to be local somehow. Because, to take almost a larger ERIC project as ESS: I think to be a good leader there, you have to be a good manager. But hopefully when you become a leader at ESS, you have already learned new things, so the new one, which has already been added, I mean, there’s no way you can be the head of ESS at one point, at the end three billion project and 500 people, without having it all before.*

**Michael Radhuber, SHARE Austria**

*I think they should [exist]. Yeah, but there should be such things. But the highest priority for now is stable employment contracts, stable relationships and, and getting things under control concerning patient personal policy of infrastructures and, and human capital building in these infrastructures, keeping people. So, so once in many years as I feel, these things have been, um, solved. Yes, of course.*



**Helen, Taylor-Curran, BGS**

*I know there is the ERIC forum, sitting around table and sharing ideas. But I think this should be brought to the more organisational level. [...] But there is definitely more scope to do such thing. [...] Maybe something more interactive (compared to a webinar), exchange with existing ERICS, drawn from the ERIC forum, sharing experiences.*

**Ekaterina Markova, BAS, SHARE**

*Well, one of the problems that I see is the funding, really, really. I am interested, and I think many people would be interested. But in the way as we saw the calls for such kind of applications for infrastructure managers, we had a serious lack of funding. That is why no one from my site participated. Probably it should be better part of the national educational programme. Or we need some European funding devoted to support such countries without that kind of funding. It should be easier to participate in such kind of training. [...] I am not involved in such training. I checked, and I could not find any kind of funding for that.*

**Mónica Morales Ballus, CGR**

*I think in general it is very much needed, this research curriculum. But more than for the heads for the technicians right, and for the postdoc who wants to become a unit head or for a postdoc who wants to enter a Core Facility. Indeed, now what we see is that technicians, the only motivation [...], well they have a lot of motivation to conduct research, but in career ways and in that it is basically the money, the salary that gets increased. But they do not see any other exit. So, it is very important. On technical skills, but also on soft skills: managing people, also leadership right, the different styles of leadership. And I think leadership courses are very important to do.*

**Isabella Buber-Ennsner, GGP Austria**

*Yeah, I'm scared because you know, I mean, there are, there are so many, there are so many workshops and webinars and things out there, and [...] I think at some point it's more the institution where you're affiliated, which is important and which helps you perhaps more than, than some programme, than some online courses that you have followed somewhere.*

**Lisa Hönegger, AUSSDA**

*I mean Research Infrastructure can be very broad and so it's difficult to see, what kind of qualification apart from managing qualifications you need but I think definitely you need to understand your product a little, and this is in Research Infrastructures it's mostly or it's a lot of it is very technical, so you need to understand, or you need to have skills in this regard as well.*

**Elisabet Carlsohn, University of Gothenburg**

*I think that is very good and very important [...]. In the future, we will have so many more Research Infrastructures. We will need more leadership, and we don't have time to create people like years ago.*

**Annika Jenmalm Jensen, SciLifeLab**

*I think it's important because this has been lacking, but it's improving ehm, in Sweden is that the leaderships leadership, the management of the infrastructures that they actually have, uhm, are visible as leaders within the university system so that they are fully responsible for personnel budgets, for operation and things like that so that they are salary wise and, uhm, that they are sort of taken care of by the universities in terms of attending, I mean. To be developed in terms of their leadership. Development because there are lots of actually within the university systems in Sweden with courses for management and yeah [...] So that they are as recognised as prefects or any other management positions within the university. So, this is a separate management track within the university. But then, we have the separate expert track. That's another track.*

#### **Jessica Lindvall, NBIS**

*Yes, it should definitely be a structured curriculum. I'm just thinking that, I think it should be maybe on kind of a master level. So, people have an undergraduate in whatever science, whatever topic they have chosen. And then as you can do a master in, I don't know bioinformatics, you could do or maybe it should be after master I have no idea. No, no. I feel a bit lost. [...] I think that it should definitely be not only a master, but also something later that corresponds to a research programme of some sort, because becoming equivalent to a PhD in academia. But for Research Infrastructure it requires other measurements of independence because that is we are measuring the higher order of cognitive thinking, right? So, we need to measure a person how much knowledge and how much kind of cognitive connectivity, uh, independence that person has kind of reached through their trajectory. And here I think there are other measurements. Then it's not publish papers for instance. It's not the number of published papers, something else, which I don't really know yet. A part of that is the soft skill, it is definitely something because it's such a key thing as a service provider. Um, yeah, that is all of this is communication, but also thinking about the science hard core thing in a Research Infrastructure, if you're at least data-producing facilities, you have machines or something, you are probably method developing something, for instance, or you are setting up a new method as a Research Infrastructure. Those things can be kind of measured and part of your CV to reach a PhD or professor level within Research Infrastructure.*

#### **Davide DiCioccio, EMBRC ERIC**

*I think, I mean, when I see what RI:TRAIN Plus is doing, I think that this will be very good, I mean, I thought there is the idea to create a master courses or anything, anything like that. But I think that a training for the people who also want to become a project manager, will be in a particular in a specific scientific domain, would be something good because sometimes, not but most of the time, if not all the time, this scientist, me included, did not have proper training of project management. So sometimes, I mean, I say, I mean, I was not a project manager, and I didn't know anything about Research Infrastructure. But if training for these can be offered, can useful also to be a person already in infrastructure like me, in case you want to change a little bit, you want, want to acquire new competencies, understand a little bit more the big picture about the European funding because project Horizon 2020 and the new announced Europe, but I don't know anything about the COST actions. Also, other funding that put together enterprises with research. A good so I mean, understanding of these I mean, although overall landscape of the European funding, the European research and the funding related would be something really, really helpful. Yeah, to also to guide the Research Infrastructure, or any of the organisation work the research toward funding or toward this idea around market but interested person that are there. Sometimes, I mean, the person there that would like to have I mean, they're not waiting, but maybe they are there but it seems to me there is no bridge between the two. Then the I mean these are synergy is not created. And so, I mean they're striving to achieve their objectives. So, I mean, a good understanding given by a training, specific training for these, I think would be really helpful. And also, we have small courses of three months to six months courses, I don't know.*

#### **Marco Borra, EMBRC**

*I think a curriculum should be requested for managers, the future managers. But I have bad feelings with "mandatory" because this can cut out opportunities. Some colleagues that move into different fields, and this can become very high level of competence. So, if I will be in the position of selecting people: I will ask for this kind of curriculum but letting a small door open. I would do it in an Italian way. I would put such a curriculum to the preferred ones but not to the mandatory (aspects).*

#### **Enzo Terreno, Euro-Biolmaging**

*This is one of the issues. For the scientific activity, of course, in our field it is easier, because the skills are given to the students during the courses. And depending on the infrastructure, in our case we have several master's degrees focusing on the field. Biolmaging for instance, and of course I am also involved in such courses, and this is very important. Now we are proposing a new master's degree, in order to present a new professional profile sort of chemistry and biotechnologies to work in the bio-medical field. And again, this initiative is thought to have a professional profile that can have a future in this kind of network.*



### 3.4.2. Summary

The picture is still a little ambiguous and further analysis needs to be conducted in the future. However, it becomes very clear that the interviewees are reflecting intensively about the needs within the organisation and, in some cases, have far-reaching ideas about how RIs and CFs can be strategically developed in the future. By contrast, it can be very clearly deduced from the qualitative interviews which characteristics good leaders in RIs and CFs should possess. Consequently, this also means that these desirable characteristics can be concrete starting points for the development of a corresponding curriculum. It must be emphasised that these are very similar to the three key competencies from the quantitative survey. Furthermore, there is a clear overlap with the answers to the open question “Please specify in which other sections managers of RIs or CFs should be trained” from the quantitative survey shown previously (see Figure 10).

The four key competencies deduced from the qualitative interviews are the following:

- **Academic excellence and broad and deep academic understanding for the field.** This includes interdisciplinary concerns, developments and tasks.
- **Project management and organisation management.** This includes good leadership skills, supporting employees and giving them a high level of freedom, team building, collaborative work and modesty.
- **Deeper knowledge about the field of science and research in Europe.** This includes political and strategic developments, the variety of different funding schemes, opportunities for co-operation between different organisations and strategic long-term acting.
- **Communication skills on different levels.** This includes internal communication (with all staff members), communication with experts (scientists), and communication with external groups and stakeholders (politics, economy, society, technical partners, funding bodies).

Selected answers can continue to highlight the importance of these four key competencies and clarify the character of a good leader in an RI or CF by giving illustrative examples:

#### Marco Borra, EMBRC

*It is important to have a quite strong academic preparation. That is something that is needed. He cannot have the highest experience in all fields compared to all colleagues in the department. But at least it is important that he grows in doing that work. So, he needs at least experience in one the fields, to understand the difficulties and needs of colleagues. [...] The academic experience is mandatory. I also think the experience in the field is mandatory. Then social: I think it is important that he can have an open mind to listen before he takes a decision, to listen to the position of other persons. The ability to deal with teams, and to direct teams and colleagues. And finally, what is really a difficult call, is the capacity to be recognised by the colleagues as a [...], not by the position you have, but because of what you are, what you can do, and what your work will add to the structure you are co-ordinating.*

#### Jean-Marie Flaud, Euro-Argo

*The main point is to be able to reach people. That means you have to be quiet when someone else speaks. Spend time with them! I remember a technician in a funded programme, I spent time with him from 9 am to midnight, to discuss with him his personal problems. So, you have to be flexible, that is the point. Not to shout at the people what they should do. That takes a lot of time, but the main thing is the management of people, to respect people! [...] Scientists only respect scientists. That is a problem. If you are not a scientist, it is very difficult to bring a scientist to do something. But on the other hand, you have to manage the human beings – that is the management part!*

#### Elisabet Carlsohn, University of Gothenburg

*I think, as always, it is important that you get life experience, ehm that not everything is career, that you have something that takes you out, that is essential. And then you can build on different things: knowledge, soft skills, competencies to create, what is actually needed in leadership in that particular infrastructure. [...]*

*I think management skills of course. Maybe to have something like a mentor programme or something like that. So, that you have someone with more experience, and have that for quite some time. Not only for like five-week programme you*

*know, but maybe for a year or so, part time of course. Being connected, really see different areas, really see what is needed. I would say ehm, there are many things that should be in this programme. And I would be happy to, when you come up with a structure, maybe give some input on that. But management skills, having good examples for different infrastructures: how they are structured, because they look very different. We may have something that has worked good for us, but I think getting the impact from others can develop much, much more.*

**Michèle Ernst-Stähli, FORS-ESS**

*The first thing I was thinking about was “networking of people”. But for the content (of curricula) it is management competencies that we do not have as researchers. And really, some people have this, thrive naturally, but others do not. Then the knowledge of the functioning of these projects and funding systems. Maybe also, this is also on the management level, organising events or bringing people together. How to approach people on a high level, on a political level. How to approach people like this and get them involved in events. I think this could be quite important.*

**Alice Solazzo, SciLifeLab**

*Yes of course [we need such curricula]! What I am afraid of is that we are always thinking about the higher, in the Core Facility, the higher part of management. And it is also what I was trying to say: it is something that is good for everyone! Because everyone should manage the facility or the Core Facility. So, this is for sure something that is always good. But how can we address something that is good for any person that is working in the lab? How to motivate them? This is [...], I don't know to answer this question now. Because everyone is interested into different things. [...] For the management it is easy – everyone needs, more or less, the same things: How to solve problems in the lab? How to deal with people? How to address those one that belong?*

### 3.4.3. Should There Be a RI:TRAIN Plus Curriculum for Staff Members?

Once again, the response to the development of an overarching curriculum is rather reserved. Arguments against this are the overlapping importance of scientific excellence, the importance of professional training and passion for a job, and the great diversity of different areas of activity within an organisation and across organisations. Another argument is the already existing quality of academic education, but also the important experiences a person gathers outside the educational sector – in this context it becomes visible that people should have time for personal development, instead of only fast career track models. European overregulation is also cited as a sign of the dominance of bureaucracy. Structuring and standardisation in education and training can significantly advance RIs and CFs and, thus, the field of science in the future. In this context, however, it will be indispensable to convince all parties involved and get them on board. Especially those who have doubts so far should be convinced with arguments and content. The success of such a programme will depend on developing flexible offerings and tailoring them according to the needs of the diverse stakeholders. It will be very important to take into account the varying conditions at different levels: European unification is advancing, and science is a part of and driver of this positive development. Nevertheless, the national states still have different conditions regarding traditions, resources and options – these must be considered and bridged. Similarly, the different scientific disciplines have various traditions, approaches and ways of working. Common curricula must take these into account and enable diversity to be maintained. Finally, all RIs and CFs involved are also individual organisations with specific conditions, requirements, objectives and ways of working – this has to be reflected in curricula as well, so that those involved can adopt them and make them useful for their work.

**Lisa Hönegger, AUSSDA**

*I mean for the management of Research Infrastructures it's probably more useful I would say, because there are aspects that are probably the same, they're working in in similar frameworks. But to the other staff, I think, in our case especially, they are so like I said before, they're so hmm they're experts for very specific things, so I cannot imagine a course where I can get all the stuff that we need, educated centrally because yeah the needs are just too specific I would say.*

**Michael Radhuber, SHARE Austria**

*Having also accumulated experience outside university, be it job or voluntary work or anything, yeah, whatever they did – having not just this great academic record behind you, but also having had other experiences. For example [...] well, I myself*

*was tenure in the emergency medical services. I accumulated, I lost a lot of time there, yeah for myself too, but I accumulated a lot of experience. I've been to Columbia for one year, for the international Red Cross. Then, based on this experience, I chose Southern Italy for my further development studies. And so, this is not really a kind of classic career. [...] Yeah, but I learned really a lot and a lot of things I would have never learned in academia. And I think that's what characterises me now today. And I'm not, I don't know if I'm a good or bad manager. I am also only part of a team. Yeah, that's the most important thing to say here. I'm only as good as my team is, as my bosses, as my colleagues are.*

#### **Christian Rüegg, PSI**

*People have a CV now as well. The CV also shows an A, B, C, D. And you know, I don't need a European stamp on this. I can judge people just from their CV you know.*

But there are also positive voices that support a curriculum for young scientists. However, even in these cases, there are critical questions about how heterogeneity in content is to be covered. In addition, questions arise about funding and how the additional time required can be made possible. However, it is generally advocated that young scientists should receive more support overall, including through more supportive career prospects. It is also mentioned that regional programmes can be useful, as neighbouring countries and their scientists often face similar challenges. Another concrete aspect is to address employees at different stages of their career and depending on the time they spent within an organisation – this includes very basic information for beginners, but again, very specific and individually selectable modules for advanced employees. Another important point mentioned is that data-providing organisations require different soft skills than traditional academic work at a university. Furthermore, such curricula are seen as a way of promoting interdisciplinary work and broadening the view of the totality of science – this also picks up on networking with other RIs and CFs.

#### **Isabella Buber-Ennser, GGP Austria**

*So yes, I think that this will be definitely helpful. I mean, the question is, you know, who is doing that and who is financing that? Because at some point when you're in research, well, you have to work on your topics and your papers. You have deadlines, you have submissions, your proposals for conferences and so on. So, you have to, ah, have a lot of different work to do. But I think that something like this, like ah supporting people who are new in science, definitely would be good because, yeah, because I think, also within my group, I mean, I personally dedicate quite some time to that because I perceived it as very helpful to get such a support when I was, when I started. And this is why I'm also supporting, ah, the young ones.*

#### **Atanas Palazov, BAS, Euro-Argo**

*You should have good infrastructure, you should have staff for maintaining this infrastructure, good scientists to work with this infrastructure, this is the really complex task and not easy to have all things together. But I think it is important also to have good staff maintaining infrastructure to give possibility to scientists to focus on the scientific work not to focus on maintaining infrastructure. We had collaboration with some kind of infrastructures in other countries, like Croatia for example, and the problems were similar, very similar between these two infrastructures. I think you know infrastructures in our countries, I mean East European countries have the same problems, the same kind of problems with the infrastructure. But we are trying to manage them because without infrastructure we cannot do science now.*

#### **Davide DiCioccio, EMBRC ERIC**

*So, I think I mean, there are different there are different needs of course. Okay, for very young position, I think a stage in an organisation like this may help to understand how it is structured and the kind of work of the daily, the day-by-day work that is conducted by a specific team member, of course, there are different in each group there are different kinds of expertise. So, yeah, so there is a person for communication to holding all the projects and checking in finances. And I mean, the task performed by me as access officer, I'm mostly into the databases and updating information, in, in collecting the information that I put in them on the website about data analysis. So, there are many different things. And so, for young position, I think a stage of two months, three months, six months may be very helpful. For some more in the middle part of their career, like me, I would say, probably, seminar courses about Europe is important, creating their scheme, like, currently we have them follow the some courses about how Horizon Europe is, is different from H2020, so understanding how the funding mechanism change, but also, yes, me also other kind seminars on how specific subject of the research are changing, like all over Europe, but I mean, these things are currently I mean, each team member, as if it is signed on newsletter receive this kind of workshop seminar that I've done, but to do. So, there is no formal training. So, each person depending on the curiosity, and the affinity towards a specific topic, is free to follow whatever. So, this is also fine, let's say having a standard, no not standard, but different kind of*

*curriculum, different kinds of courses combined together may also be something really important to offer. So, yeah, I would say, being informed about what's going on, but in general, the research you do at RI:TRAIN, I mean when we research, we are signed to probably have Google Alerts that tell you when there is a paper, scientific paper that is released. So, you're there engaged. So, I mean, the curiosity, these information means mindset to be to be trained all the time you I mean, there will be never a moment where you just sit there and you perform your job the job just because you have a permanent position. So, I mean, we are invited to I mean to receive trainings to get what is going on. This is what I've seen in general, or at least this is what I do.*

**Jessica Lindvall, NBIS**

*Yeah. Yes, I think it would be very good if one could have that because I think even if it's not part of your daily Research Infrastructure life today, I think this will become important later on. And to be prepared for that, just to get to raise awareness about other disciplines, maybe. I don't know. Yes. So, I would see that. And so, it's yeah, but from from a bottom up approach or from, from the inner core and outward. So, all this eh um complementary skills, both soft skills, but also ethical, open science, whatever thinks there might be to that scientific skills for the specific Research Infrastructure if needed. And then also lifting the eyes to see, OK, if I look at the landscape from this higher level, the multi or the cross disciplinary across Research Infrastructures? Yes. [...] So, this is interesting because I think that for me, I didn't think really about the soft skills and the need of soft skills like service mind minded, how communication, how to deal with uh difficult clients, for instance. All these things were not really on my radar until I got the head of unit role. Which is strange because when I entered the recent infrastructure in the best scenario, my boss would have just said that these are skills you need to acquire when you come to the Research Infrastructure as an expert. So here are courses that we provide or think you should go to.*

### 3.4.4. Summary

Compared to the management level, the question of the core competencies of employees in RIs and CFs proves to be much more complex. This can be explained by the diversity of organisations, activities, individual backgrounds and career stages addressed. Nevertheless, it is possible to group the skills and core competencies mentioned into superordinate categories. As a result, possible contents and modules for co-ordinated curricula can be derived.

- **Academic excellence – based on academic education and professional experiences.** This includes not only qualitative and quantitative methods and work with data, but also contacts with (former) colleagues and the ability to be perceived and recognised as an insider in the field.
- **Flexibility and curiosity.** This includes working in international settings, collaborative teamwork, interaction with (technical) partners, and integration into (specific) scientific communities with special needs and attitudes.
- **Interdisciplinarity.** This includes not only the co-operation with and understanding of different disciplines but also the ability to take a broad view of science and society as a whole.
- **Communication skills on different levels.** This includes being fluent in English, having a charismatic appearance, presentation skills, visualising skills, and writing skills in different contexts (e.g. proposals, papers, websites, social media).
- **Service orientation and support.** This includes diplomatic work, dealing with difficult clients, and the ability to personally step back and enable the research of others (“let others shine”).

## 4. Reflexion on the Results - Group Discussion

The results were presented to the members of WP2 via Zoom on January 25, 2022. In the spirit of collaborative work and to obtain further input and heterogeneous perspectives, the presentation was concluded with a group discussion. All participants were called upon to explain their views, offer criticism and make suggestions for categorisations and how to proceed. Regarding a structured approach, we proposed some core elements to initiate the discussion. A second round of discussions was held on March 1, 2022.

### 4.1 Summary of the Discussion

The results presented are recognised as excellent work and the quote “Let others shine!” is chosen to frame the results of the study and the dissemination. This is supported by the fact that the phrase reflects a central core competency that is needed in RIs and CFs by staff at all levels: staff scientists, PhDs, postdocs, and heads and managers; everyone needs to internalise this. If one starts to work in a CF or RI, he or she is already experienced, but they must learn and accept this as one of the most important characteristics of the nature of these institutions. This context becomes particularly true for such staff members and managers who have split positions, working part-time for a RI or CF and part-time at a university or academy, with their specific characteristics and independencies. Therefore, they must deal with the task of accepting and fulfilling both roles at the same time. It is emphasised that appropriate knowledge about the requirements and an awareness of the necessary understanding of the role must also be part of the curricula to be developed. However, the participants also link this with a demand: supporting other scientists with data and services is a core concern of RIs and CFs. Therefore, this work of all staff members should be more strongly recognised in the future and fully ranked as an academic achievement (for example, authorships, association with projects, supervision of students/candidates). Nowadays, staff members in RIs and CFs must consider consequences for evaluations and future job opportunities because evaluation criteria for them are the same as for scientists and professors at a university. However, that cannot work properly, as the fields of work are very different in many aspects (for example, the number of supported/supervised students and scientists).

Linked to this is another aspect to be taught, which the participants emphasise, and which is closely connected to the service character of RIs and CFs. They are seen as key players in the realisation of “big science” in the meaning of “open science”. Similar to many other scientific institutions, they provide “open data”. However, this means much more than just the provision of open access to results and publications. This means literally “open to everything”, which includes planning and implementing instruments and methods, data to be used and reused, processing of data, analysis of data and publications. In order to meet these challenges, the discussion participants emphasise, on the one hand, the need for appropriate courses in education and training. On the other hand, they also point out that the wide range and variety of activities required in RIs and CFs must be communicated to those interested in the profession and future managers in training at an early stage.

Another highlighted requirement concerns the ability to work in a team, especially in an interdisciplinary, translational and transnational way in changing teams with different objectives. The reason given for this is that research today is hardly ever carried out by a “one-man show” or only by small teams. Instead, in almost all areas, larger groups must work together and various actors must be involved. Accordingly, teamwork skills and appropriate communication strategies must be taught sustainably and applied to all areas. In this course, more far-reaching aspects in the scientific cosmos are also named, to which those interested in further education programmes must be made aware. In times of scarce resources, this also includes questions of research economics: collaborations on a larger scale and advanced co-working might prevent a loss of data that has been collected once but not yet used for analysis.

In the following, the term “team science” is proposed as a designation for a possible module in the future curricula. This could be aimed not only at future managers and managers in further education but could also already be part of summer schools for bachelor students. In this way, in addition to imparting knowledge, students’ attention could also be increasingly directed towards key players in the field of science who are often unknown or overseen up to now. Two contents are particularly emphasised:

- It must be emphasised that teamwork is crucial and important, in science generally and in RIs and CFs particularly.
- This especially includes teaching respect for other disciplines. Interdisciplinarity must also be understood far beyond disciplinary boundaries, and not only as a collaboration of different disciplines that already have a certain proximity relationship.
- RIs and CFs need to be positioned as important players in science, but not as some kind of “second choice” compared to universities and research institutes.

Science generally strives for excellence. This is all the more true for RIs and CFs, which are assigned to the “Excellent Science” pillar in the European science system. “Activities under this Pillar aim to reinforce and extend the excellence of the Union’s science base and to consolidate the European Research Area in order to make the Union’s research and innovation system more competitive on a global scale” (European Commission, 2021). This is also a driver for all those involved who want to deliver excellent work. In this context, the

discussants point to an increasing specialisation of activities in RIs and CFs, and, thus, a move away from generalists. This raises questions that need to be resolved, because looking at the results of the qualitative and the quantitative study in contrast reveals that the qualifications and skills desired are often defined in a very broad way by the heads and managers involved. Therefore, the discussants formulate aspects for which attention should be generated in further education curricula on all levels:

- For the moment, they report from inside the RIs and CFs about both very broad fields of work and activities, on the one hand, and very high specialised jobs on the other hand.
- It should be highlighted that many staff members of RIs and CFs have a lot of different tasks and that their work is manifold and not monotonous.
- By contrast, more awareness is needed that, in some cases, managers should be prepared to be involved in daily research business and do almost all tasks by themselves. This is particularly true for smaller RIs and CFs, while larger institutions have an increased division of labour and a more distinct separation between management and research tasks.
- However, especially for larger RIs and CFs, and particularly for ERICS, extensive management competencies are required, which need to be taught as a core content of specific modules.

Closely connected to this, the discussants also formulate aspects that managers should consider when selecting and managing employees, and which should be addressed accordingly in their training:

- The fact that most of the staff members in RIs and CFs are not only staff members but also scientists with ambitions should be considered. Consequently, on the one hand, they have a need for personal freedom to pursue their own projects and, on the other hand, they also need the support of their managers to be able to pursue successful career paths.
- Against this background, the fact that technologies used in science are becoming increasingly complex should be considered. As a result, the demands on existing and future employees are manifold: on the one hand, highly specialised experts are needed for specific areas of activity; on the other hand, there is also a great need for people who are able to collaborate in an interdisciplinary manner and across departmental boundaries. This includes aspects of team work and knowledge about processes in the background (e.g. informatics, data processing).

The last aspect discussed was the overwhelming importance of “communicative skills”, which were identified as extremely significant in both sub-studies, qualitative and quantitative. Participants underline this importance and highlight three different approaches that should be part of curricula:

- Communication of results;
- Communication in a team and with team members; and
- Communication about the needs of others (other people, other disciplines, stakeholders).

Complementary to “communicative skills”, it is discussed that aspects of networking are not mentioned as very important in the quantitative study. This provokes irritation, as this competency is perceived as far more important within the discussion group. As a possible explanation, it is assumed that networking has become increasingly important over the past 20 years and is now internalised by many people involved. Therefore, respondents no longer mention it separately because they perceive networking as somewhat normal. Nevertheless, the discussants emphasise the importance of networking aspects and express the wish that these should also be considered in curricula. In addition to traditional approaches, the role of comparatively new communication channels is also referred to in this context. This includes conference tools, such as Zoom or Webex, whereby their (future) significance is to be clarified. These have enabled collaboration during the COVID-19 pandemic and substituted meetings that could not be realised in person. The question arises as to what significance the participants assign to them. The assumption is made that such digital networking might be too easy, which is why people assign it less importance than physical meetings, which also facilitate informal exchange and social activities better.

## 4.2 Conclusion of the Discussion

In summary, it can be emphasised that the implementation of an additional group discussion has proven to be purposeful and profitable. Findings from the two empirical sub-studies could be discussed, classified and verified. In addition, the discussion approach also enables abstract and partly broad competencies to be backed up with specific requirements that can be elaborated into the learning content of individual modules within the future curricula. This provides an additional foundation for the subsequent tasks of the following work packages.



## 5. Conclusion

The results of the evaluation clearly show how diverse and varied RIs and CFs. These differences must be considered for the development of future policy strategies and funding programmes for RIs and CFs even more than before. In this context, not only do the different academic disciplines play a role, but these also, of course, have a great influence on what the requirements and needs of the organisations are. But RIs and CFs are not *per se* congruent with universities and academic research institutes. They play a special role in the European research landscape, and the specific character of the respective RIs and CFs must be taken into account when it comes to their support, as well as their infrastructural and personnel resources. We can deduce three different types of organisations with a view to their main task: “**data-generating organisations**”, “**data-providing organisations**” and “**hybrid organisations**” (see Figure 11).

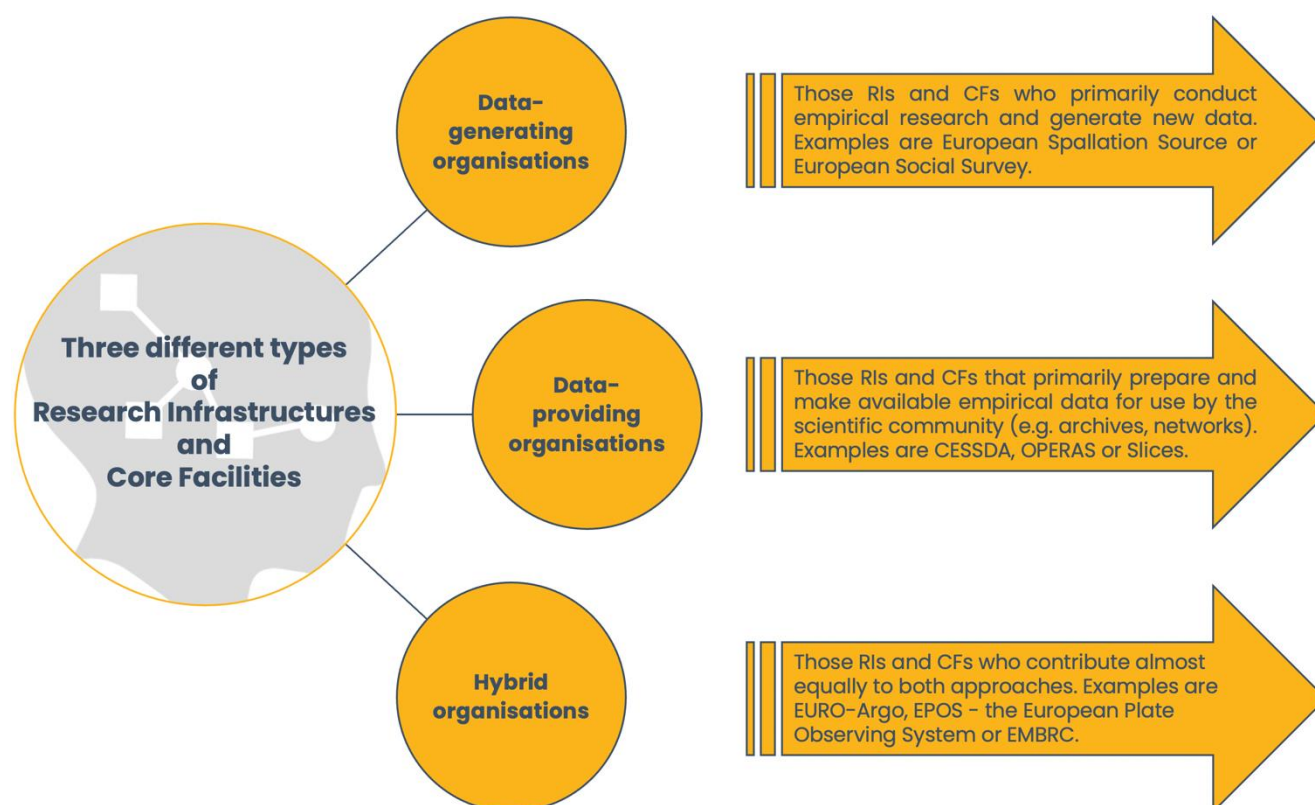


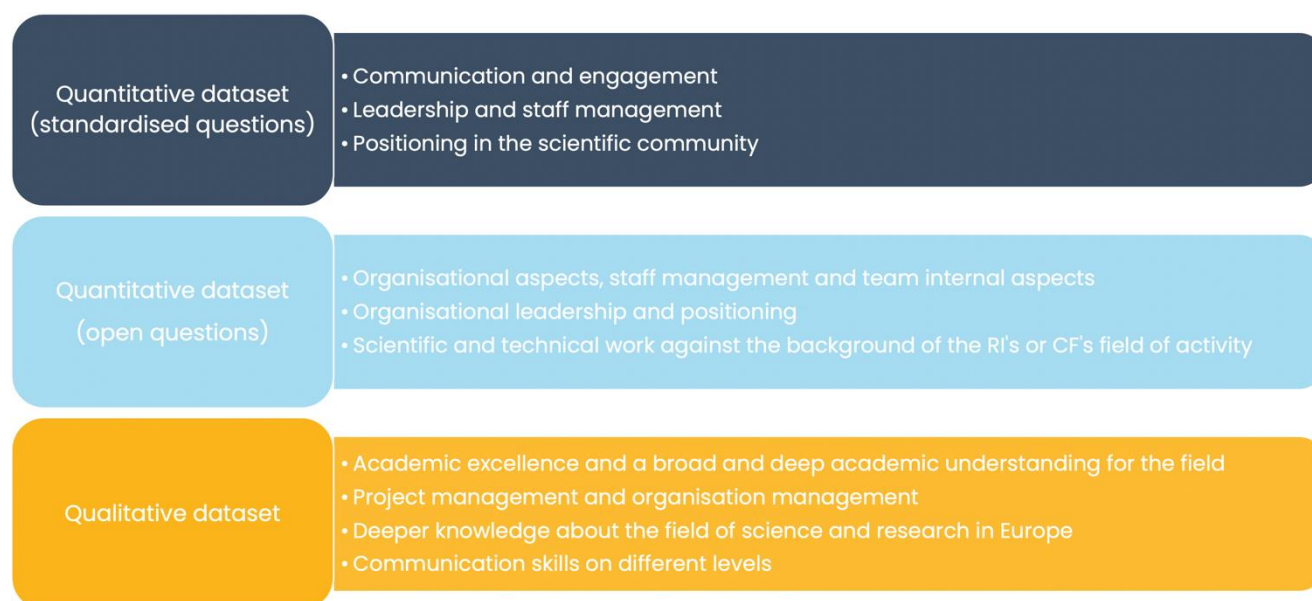
Figure 11 – Three different types of RIs and CFs and their main fields of activity.

With a view to developing specific curricula and establishing a European School of RI Management, we can offer evidence-based proposals which are founded on the integrative mixed-method approach that was implemented. It consists of an online survey among 330 members of RIs and CFs and a qualitative expert survey among (17) leaders and managers of selected RIs and CFs in structurally selected countries. It should be noted that the development and introduction of European curricula for RIs and CFs is meeting with a divided response. Such a step is perceived as an intervention in academic self-administration, while the local organisation is seen as having a high competency for the further development of team members. Only a few people reject common curricula in principle. Arguments against the curricula are duplication of strategies, excessive bureaucracy and European over-regulation. If the time is already ripe for this and whether there are not more urgent current challenges are also critically questioned. However, a lot of people also favour the introduction of common curricula. In some cases, major developments are associated with this, up to and including master's courses and dedicated PhD programmes for RIs and CFs. However, a central problem perceived by all interviewees is the huge diversity of different RIs and CFs, and associated with this, the diversity of different areas of activity and training needs. How the diverse and individual needs can be brought together in common modules without these remaining too superficial in terms of content is critically questioned. Other points of criticism raised particularly by proponents concerns the time resources, workload and financial issues. It is not yet clear to the people interviewed how the programmes and their implementation are to be financed. Furthermore, they are sceptical about how additional courses can be completed in the already tight working hours. In the course of labour law issues, the



problem of fixed-term employment contracts is also critically addressed. On the one hand, these employees lack the time and security to complete training programmes; on the other hand, the heads of the institutions fear that they will quickly lose newly trained staff due to fixed-term contracts.

Although the topic area is still controversial and must continue to be discussed in the future, the evaluation of both part-studies already gives broad and deep insights into which skills and qualifications good leaders and managers in RIs and CFs should have that, consequently, need to be developed and deepened in the corresponding modules of the curriculum (see Figure 12). These include the following categories and contents: **Communication and engagement**: how to talk and communicate with different groups; **leadership and staff management**: develop and manage structures for leading teams and what is necessary to do in a strong and decisive way. Regional and organisational structures need to be reflected on here; and **positioning in the scientific community**: how to write and prepare communications for the scientific communities, both in the form of publications and grant proposals.



**Figure 12 – Skills of heads and managers desired in RIs and CFs (quantitative and qualitative answers).**

These results of the evaluation of the structured questions of the online survey can also be found in a similar way in the open answers. The most frequently mentioned competencies are in the broad field of **employee management**: more **organisational aspects**, such as “human resource management”, “dealing with personnel” and “staff management”, on the one hand, and more **team internal aspects**, such as “leadership”, “staff motivation”, “team management and development” and “conflict management”, on the other hand. A second block of answers can be summarised as **organisational leadership and positioning**, including aspects such as “law and legal aspects”, “relevant legislation and licensing”, “ethics”, “science policy and politics”, “compliance”, “strategic thinking” and “communication”. A third block is dedicated to answers related to **scientific and technical work against the background of the field of activity of the RI or CF**: “acquiring new technical skills”, “grant application for CF”, “learn innovative technologies” and “technical info about instrument maintenance, methodology”.

While the mirrored responses on the qualifications desired for leaders and managers of RIs and CFs are diverse, their thrust, nevertheless, complements well with the findings of the qualitative study. We can deduce four key competencies here: **academic excellence and a broad and deep academic understanding for the field**, which includes interdisciplinary concerns, developments and tasks; **project management and organisation management**, which includes good leadership skills, supporting employees and giving them a high amount of freedom, team building, collaborative work and modesty; **deeper knowledge about the field of science and research in Europe**, which includes political and strategic developments, the variety of different funding schemes, opportunities for co-operation between different organisations and strategical long-term acting; and **communication skills on different levels**, which includes internal communication (with all staff members), communication with experts (scientists), and communication with external groups and stakeholders (politics, economy, society, technical partners, funding bodies).

The results of both sub-studies, quantitative and qualitative, can be grouped into three overarching categories of the competencies required: **communication skills on different levels**, **organisational leadership and staff management** and **academic excellence and a deeper knowledge of the respective field of science**.

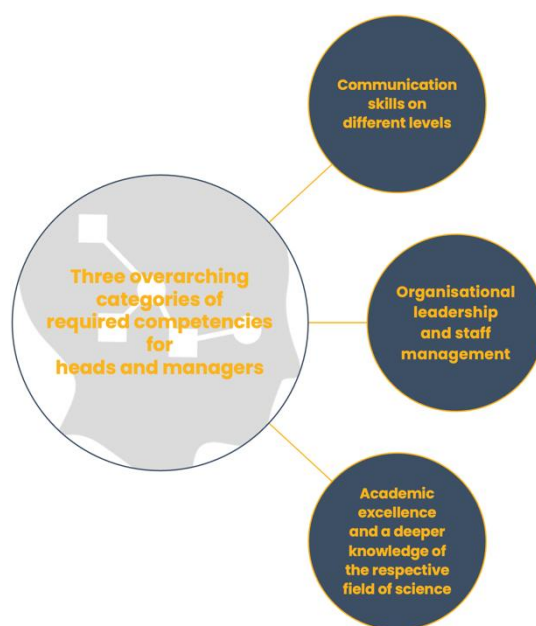


Figure 13 – Three overarching categories of the competencies required for heads and managers.

Correspondingly, there are also statements from the qualitative study on which skills and qualifications the employees in RIs and CFs should have, which must also be developed and deepened in the corresponding modules of a curriculum (see Figure 14): **Academic excellence – based on academic education and professional experiences**. This includes qualitative and quantitative methods, work with data, contacts with (former) colleagues, and the ability to be perceived and recognised as an insider in the field. **Flexibility and curiosity**. This includes working in international settings, collaborative teamwork, interaction with (technical) partners, and the integration into (specific) scientific communities with special needs and attitudes. **Interdisciplinarity**. This includes the co-operation with and understanding of different disciplines, and the ability to take a broad view of science and society as a whole. **Communication skills on different levels**. This includes being fluent in English, having a charismatic appearance, presentation skills, visualising skills and writing skills in different contexts (e.g. proposals, papers, websites, social media). And **Service orientation and support**. This includes diplomatic work, dealing with difficult clients, and the ability to personally step back and enable the research of others (“let others shine”). The open answers on the competencies and qualifications of good heads and managers in the quantitative sub-study especially show the high demands that employees place on them. At this point, it becomes clear that managers must have extensive knowledge of the area of work of the respective RI or CF in order to be able to support the team accordingly. In addition to staff leadership and conflict resolution, employees particularly want support in their personal development and pursuing career paths. A combination of both is necessary so that heads and managers can also develop the team according to their ideas.



**Figure 14 – Five core competencies of employees in RIs and CFs (desired by heads and managers).**

The development of common curricula and the establishment of a European School for RI Management still requires a lot of work and will continue to generate controversial discussions in the future. A lot of convincing will have to be done to reach previously sceptical members of the community and win them over to the joint project. The strong involvement of the interviewees and their partly very comprehensive reflections on the questions raised also show their enthusiasm for this joint project and willingness to actively participate in it. A key element for success will be to continue to take a communicative and integrative approach. All parties involved must be included and there must be continuous opportunities for participation to make one's voice heard. This concerns both the structural decisions on the curricula and the specific content of the modules. It is important to consider the diversity of organisations as well as the diversity of areas of activity and needs. A convincing argument in this context will be a free choice of specific courses in order to be able to put together programmes that are as individual as possible.

Such an integrative approach also does justice to the importance that RIs and CFs have not only for scientific work in Europe, but beyond that, also for social cohesion. In this respect, it became more than clear in the qualitative interviews what a great importance the interviewees attribute to RIs and CFs for the advancing unification of Europe. This includes not only project-related co-operation but also interstate exchange and overcoming former borders and inequalities. These aspects should by no means be underestimated and should also find their way into further work steps and curricula.

## 6. References

- AUSSDA (2022). Mission Statement. AUSSDA. <https://aussda.at/en/about-aussda/mission/>
- Bettinger, P., & Hugger, K.-U. (2020). Praxistheorien in der Medienpädagogik – Einleitung. In P. Bettinger & K.-U. Hugger (eds.), *Praxistheorien in der Medienpädagogik* (pp. 1-18). Springer VS.
- Bourdieu, P. (1977). *Outline of a Theory of Practice*. Cambridge University Press.
- Bourdieu, P. (1989). Social space and symbolic power. *Sociological Theory* 7(1), 14-25.
- Brosius, H.-B., Koschel, F., & Haas, A. (2008). *Methoden der empirischen Kommunikationsforschung. Eine Einführung*. VS Verlag.
- Cornesse, C., Blom, A. G., Dutwin, D., Krosnick, J. A., De Leeuw, E. D., Legleye, S., Pasek, J., Pennay, D., Phillips, B., Sakshaug, J. W., Struminskaya, B., & Wenz, A. (2020). A review of conceptual approaches and empirical evidence on probability and nonprobability sample survey research. *Journal of Survey Statistics and Methodology* 8(1), 4-36.
- Creswell, J. W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (2<sup>nd</sup> Edition). Sage.
- Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5<sup>th</sup> Edition). Sage.
- Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, Phone, Mail, and Mixed-mode Surveys: The Tailored Design Method* (4<sup>th</sup> Edition). John Wiley & Sons.
- Dresing, T., & Pehl, T. (2015). *Praxisbuch Interview, Transkription & Analyse. Anleitungen und Regelsysteme für qualitativ Forschende*. Audiotranskription.
- Elias, N. (1987). *Engagement und Distanzierung. Arbeiten zur Wissenssoziologie I*. Suhrkamp.
- ESFRI (2018). *Roadmap 2018. Strategy Report on Research Infrastructures*. ESFRI.
- ESFRI (2021). *Roadmap 2021. Strategy Report on Research Infrastructures*. ESFRI.
- European Commission (2021). Horizon Europe. Excellence Science. European Commission. <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/excellent-science>
- Eurostat (2021). NUTS – Nomenclature of territorial units for statistics. Eurostat. <https://ec.europa.eu/eurostat/web/nuts/background>
- European Union (2022a). Aims and Values. European Union. [https://european-union.europa.eu/principles-countries-history/principles-and-values/aims-and-values\\_en](https://european-union.europa.eu/principles-countries-history/principles-and-values/aims-and-values_en)
- European Union (2022b). EU motto. European Union. [https://european-union.europa.eu/principles-countries-history/symbols/eu-motto\\_en](https://european-union.europa.eu/principles-countries-history/symbols/eu-motto_en)
- Flick, U. (2007). *Qualitative Sozialforschung. Eine Einführung*. Rowohlt.
- Gewertz, K. (2005). Enter to grow in wisdom. A tour of Harvard's gates. *The Harvard Gazette*. <https://news.harvard.edu/gazette/story/2005/12/enter-to-grow-in-wisdom/>
- Kohn, M. L. (1989). Introduction. In M. L. Kohn (ed.), *Cross-national Research in Sociology* (pp. 17-31). Sage.
- Kowal, S., & O'Connell, D. C. (2005). Zur Transkription von Gesprächen. In U. Flick, E. von Kardorff & I. Steinke (eds.), *Qualitative Forschung. Ein Handbuch* (pp. 437-447). Rowohlt.
- Lavitrano, M. (2022). Future European School for RI management. *RI:TRAIN Plus*. <https://ritrainplus.eu/>
- Lisbon Treaty (2016). Consolidated versions of the treaty on the European Union and the treaty on the functioning of the European Union. European Union. <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:12016ME/TXT&from=EN>
- Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research* 40(2), 120-123.
- Ólafsson, K., Livingstone, S., & Haddon, L. (2013). *How to Research Children and Online Technologies? Frequently Asked Questions and Best Practice*. EU Kids Online, LSE.
- Oswald, K., Gaventa, J., & Leach, M. (2016). Introduction: Interrogating engaged excellence in research. *IDS Bulletin* 47(6).
- Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods* (3<sup>rd</sup> Edition). Sage.

- Paus-Haase, I., Hasebrink, U., Mattusch, U., Keuneke, S., & Krotz, F. (1999). *Talkshows im Alltag von Jugendlichen. Der tägliche Balanceakt zwischen Orientierung, Amüsement und Ablehnung*. Leske+Budrich.
- Paus-Hasebrink, I., & Sinner, P. (2021). *15 Jahre Panelstudie zur (Medien-)Sozialisation. Wie leben die Kinder von damals heute als junge Erwachsene?* Nomos.
- Prandner D., & Weichbold M. (2019). Building a sampling frame for migrant populations via an Onomastic approach – Lesson learned from the Austrian Immigrant Survey 2016. *Survey Methods: Insights from the Field*. <https://surveyinsights.org/?p=10641>
- Quatember A. (2019). Inferences based on probability sampling or nonprobability sampling – Are they nothing but a question of models? *Survey Methods: Insights from the Field*. <https://surveyinsights.org/?p=11203>
- Rapley, T. (2014). Sampling strategies in qualitative research. In Uwe Flick (ed.), *The SAGE Handbook of Qualitative Data Analysis* (pp. 49-63). Sage.
- RI:TRAIN Plus (2022). Home. *RI:TRAIN Plus*. <https://ritrainplus.eu/> [20.01.2022].
- Schatzki, T. R. (2002). *The Site of the Social. A Philosophical Account of the Constitution of Social Life and Change*. The Pennsylvania State University Press.
- Schulz, M., & Ruddat, M. (2012). "Let's talk about sex!" Über die Eignung von Telefoninterviews in der qualitativen Sozialforschung. *Forum Qualitative Sozialforschung* 13(3).
- Shanghai (2021). Academic ranking of world universities. *Shanghai Ranking*. <https://www.shanghairanking.com/rankings/arwu/2021>
- United Nations Statistics Division (2021). Geographic Region. *United Nations* <https://unstats.un.org/unsd/methodology/m49/>
- Verba, S. (1973). Cross-national survey research: The problem of credibility. In I. Vallier (ed.), *Comparative Methods in Sociology. Essays on Trends and Applications* (pp. 309-356). University of California Press.

## 7. List of Tables

Table 1 – Role in RI/CF and PhD. ....	14
Table 2 – Skills that are (very/somewhat) important when working for/leading an RI, by team size. ....	17
Table 3 – Exploratory factor analysis, type of work x time spent on this task. ....	18
Table 4 – Linear regression model explaining what leads to an orientation towards administrative (Model M1) or scientific (Model M2) tasks. Significant Effects in the models are in bold ....	19
Table 5 – Drivers of success by discipline.....	20
Table 6 – Drivers of success by team size. ....	21
Table 7 – Time spent on different tasks. ....	22
Table 8 – Qualifications desired for managers of RIs and CFs.....	23
Table 9 – Qualifications desired for scientific staff members of RIs and CFs. ....	23
Table 10 – Importance of services provided. ....	24
Table 11 – Importance of career drivers. ....	25

## 8. List of Figures

Figure 1 – Three overarching categories of competencies required for heads and managers. ....	4
Figure 2 – Three different types of Research Infrastructures (RIs) and Core Facilities (CFs). ....	5
Figure 3 – Project timeline. ....	8
Figure 4 – Timeline of the RI:TRAIN Plus Survey. ....	11
Figure 5 – Response to the survey during the field phase (orange bars: complete datasets, grey bars: additional useable datasets). ....	12
Figure 6 – Overview of the dataset: discipline, positions and roles (n = 330 each). ....	14
Figure 7 – Skills needed to lead an RI or CF.....	15
Figure 8 – Skills per discipline. ....	16
Figure 9 – Drivers for success.....	20
Figure 10 – Please specify in which other sections managers of RIs or CFs should be trained. ....	27
Figure 11 – Three different types of RIs and CFs and their main fields of activity. ....	43
Figure 12 – Skills of heads and managers desired in RIs and CFs (quantitative and qualitative answers). ....	44
Figure 13 – Three overarching categories of the competencies required for heads and managers. ....	45
Figure 14 – Five core competencies of employees in RIs and CFs (desired by heads and managers).....	46