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# Let Others Shine: Key Competencies in European Research Infrastructures and Core Facilities

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***Abstract***

*Research Infrastructures and Core Facilities belong to the First Pillar "Excellence in Science" of the European funding schemes, making them a key compentent in research education. Therefore, the European Commission aims to establish a European School for RI management and to develop pan-European curricula. Accordingly, RI:TRAINplus persues to develop evidence-based recommendations for key competencies to be enhanced. We applied a mixed-method approach, combining a quantitative online-survey among 330 members of Research Infrastructures and Core Facilities with 17 qualitative guided interviews among managers from eight structurally selected countries. The results of both sub-studies can be grouped into three overarching categories of required competencies: communication skills on different levels, organisational leadership & staff management, and academic excellence & deeper knowledge of the respective field of science. To ensure future success of RIs and CFs this needs to be an integral part in the field of scientific and research education.*

***Keywords:*** *European Research Infrastructures; Key Competencies; Curricula Development; Mixed-method Approach; Scientific and Research Education.*

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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. *RIs* and *CFs* are also at the core of the development of the Open Science, Open Education and Open Innovation strategy, and a major factor if those should succeed. Therefore, their establishment and ongoing work is a significant achievement for European research landscape, developing initiatives, practices, shared facilities, common guidelines, and standards that make it possible for European research to thrive. However, the inter-relationships of *RIs* and *CFs* in the same science domain and across domains, as well as the need to align to and contribute to the *FAIR – Findability, Accessibility, Interoperability, and Reuse* of digital assets – approach, to the *EOSC – European Open Science Cloud*, to equal opportunities (including gender balance and diversity) regarding open science policy, highlight a complex field, that often goes beyond the traditional venues of academic and scientific training.

Consequently we are asking in this contribution what competencies and skills are needed to run modern RIs and CFs? And this will be followed up by the question if and how they may be included in curricula.

Understanding academia, and *RIs* and *CFs* as part it, as field in the Bourdiean (1998) sense, with competing and interrelated interestests and struggles, we used a multi-method set-up to gain data on this question. Our aim is to identify what needs to be included in a proper, sustainable educational and training programme. It should serve the purpose to prepare students and professionals for the work in *RIs* and *CF*, and it should be integrally embedded into the broader framework of science and research education. Accordingly, an aim of RI:TRAINplus 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:TRAINplus, 2022). With the final goal to the establish a European School for RI management: "The idea is to give students the opportunity to broaden their existing study programmes 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" (Marialuisa Lavitrano – Project lead of RI:TRAINplus).

## 2. Methodology

In order to create an evidence-based data basis for this undertaking, we developed and implemented an "equally mixed-methods" (Morse, 1991) approach. Our aim was to have a "Convergent Mixed Methods Design" (Creswell & Creswell, 2018, p. 217), which benefits from the equal combination of a qualitative guideline survey among heads and leading

managers of *RIs* and *CFs* with a quantitative online questionnaire, which is also addressed to all employees of these institutions (QUAL X QUANT).

### *2.1. Qualitative substudy*

Our qualitative interview study was in field from October 11, 2021, to January 26, 2022. Based on a multi-level selection procedure conducted as a purposeful sampling (see Rapley, 2004, p. 56) we identified 17 key stakeholder in the European research landscape as "information-rich cases" (Patton, 2002, p. 230; h.i.o.), which are defined as cases "from which one can learn a great deal about issues of central importance to the purpose of inquiry". They are managing RIs and CFs in eight countries (Austria, Bulgaria, France, Italy, Spain, Sweden, Switzerland, United Kingdom) which represent the four regions Eastern Europe, Northern Europe, Southern Europe, and Western Europe in accordance to the United Nations Statistics Division (2021).

The guideline comprises four coordinated parts (Science and Research in Europe, Managing a Research Infrastructure or Core Facility, Requirements for Scientific Staff, and Individual Perspectives). It is built on three pillars, the findings of the previous RI:TRAIN project, a literature review (Bourdieu, 1977; Bourdieu, 1989; Bettinger & Hugger, 2020; Schatzki, 2002; Oswald, Gaventa & Leach, 2016), and collaborative discussion rounds among the extended research group. This was followed by several rounds of evaluation and a pretest. For the analysis, a two-stage qualitative content analysis was carried out in the form of focused and contextual analysis (e.g. Paus-Hasebrink & Sinner, 2021, p. 38), based on inductive and deductive coding. MAXQDA 2020 software was used to support the analysis.

### *2.2. Quantitative substudy*

The accompanying quantitative online survey was in field from November 17 to December 24, 2021, resulting in a field period of 37 days. Originally the field phase was 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 that work in European Research Infrastructure, and in particular the *ESFRI* landmarks and projects. The complete list contains 493 entries covering all of Europe. To contact the individuals a multi-step procedure was used. Firstly, all the defined landmarks and projects 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 an involved researcher, followed between December 2 and December 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 is still online until December 24. Additionally the coordinators of RI:TRAINplus spread the information that the survey is online. Doing so, the population could be defined and

strategically contacted. This approach made it possible to track and cover who accessed the questionnaire, completion rate and potential methodological issues. Overall, 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.

On a substantive level the questionnaire tracked job details, including position and current tasks, demographic and academic backgrounds, and attitudes towards scientific work as a whole. Examples for specific questions and answers can be found in section 3.1.

## 3. Results

The results of the evaluation clearly show how diverse and varied *RIs* and *CFs* are. These differences must be considered for the development of curricula, but also for future policy strategies and funding programmes for *RIs* and *CFs* even more than before. In this context, not only the different academic disciplines, such as natural sciences, social sciences, or humanities, play a central role. According to their thematic orientation, the *ESFRI* Roadmap (2021, p. 18) assignes them to the six categories *Computing & Digital Research Infrastructures, Energy, Environment, Health & Food, Physical Sciences & Engeneering,* and *Social & Cultural Innovation*. Those, of course, have a great influence on what the requirements and needs of the organisations are, as they play a special role in the European research landscape. 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 organisation with a view to their main task: **Data-generating organisations**, **data-providing organisations**, and **hybrid organisations**.

### *3.1. Quantitative Results*

Although the topic area is still controversial and must continue to be discussed in the future, the evaluation of both part-studies gives broad and deep insight into which key competencies and skills good leaders and managers in RIs and CFs should have, that consequently need to be developed and deepened in the corresponding modules of the curricula. Looking at select quantitative results (for further results see also figure 1), we can distill the following three categories:

- **Communication and engagement:** Here the interpersonal skills and how to talk and communicate with different groups can be highlighted.

- **Leadership and staff management:** Develop and manage structures for leading teams and what is necessary to do so in a strong and decisive way. Here regional and organisational structures need to be reflected on.
- And **positioning in the scientific community:** Most importantly based on how to do empirical and technical work, but also when it comes to writing and preparing communication for the scientific communities, both in the form of publications as well as grant proposals.

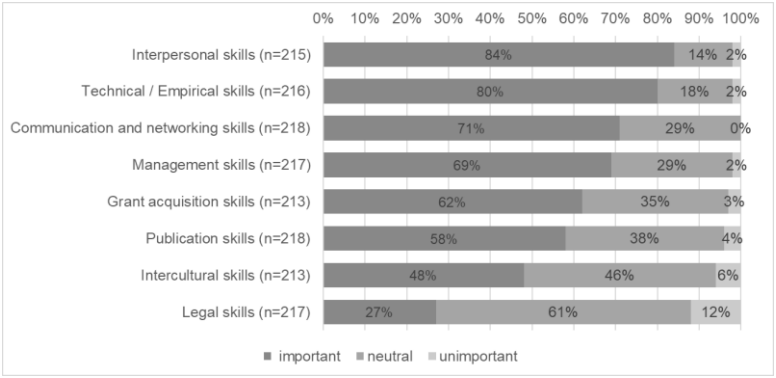


*Figure 1. Skills needed to succeed in an RI / Manage an RI.*
*Q: How important are the followings skills to your work – A: 1 very important to 7 not important at all. Grouping in figure: 1 to 2 is "important"; 3 to 5 is "neutral"; 6 to 7 is "unimportant". Source: RI:TRAINplus survey (2021).*

In order to broaden the view and to improve the evidence base, but also to ensure a link with the qualitative survey, we gave participants the opportunity to provide open answers on key competencies and skills of good heads and managers as well. Therefore, we added the open question "Please specify in which other sections managers of RIs or CFs should be trained" to the quantitative survey. The results of the evaluation correspond well with the results of the structured answers. The most frequently mentioned competencies are in the broad field of **employee management**: More **organisational aspects** as "human resource management", "dealing with personnel", and "staff management" on the one hand, and more **team internal aspects** 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 as "law and legal aspects", "relevant legislation and licensing", "ethics" and "science policy and politics", but also "compliance", "strategic thinking", and "communication". This was of a special interest, as some of those were not seen as common in the more structured answers. A third block is dedicated to answers related to **scientific and technical work, against the background of the RI's or CF's field of activity**: "Acquiring new technical skills", "grant application for

CF", "learn innovative technologies", and "technical info about instrument maintenance, methodology".

### *3.2. Qualitative Results*

The evaluation of the quantitative data allows a clear classification. The combination with the results of the qualitative evaluation gives a proof and makes it possible to record the depth and breadth of the required competencies and skills. While the qualitative responses on desired qualifications for heads and managers of RIs and CFs are diverse, their thrust nevertheless complements well with the findings of the quantitative study. Here we can deduce four key competencies: **Academic excellence & broad and deep academic understanding for the field.** This includes interdisciplinary concerns, developments, and tasks. **Project management & organisation management.** This 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.** This includes political and strategic developments, the variety of different funding schemes, opportunities for cooperation between different organisations, and strategical long-term acting. And **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).

Correspondingly, there are also statements from the qualitative study on which skills and qualifications the employees in RIs and CFs should have. Those must also be developed and deepened in the corresponding modules of a curriculum, because heads and leading managers of RIs and CFs are in charge to select, to challenge, and to encourage their staff: **Academic excellence – based on academic education and professional experiences.** This includes 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 the integration into (specific) scientific communities with special needs and attitudes. **Interdisciplinarity.** This includes the cooperation 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, charismatic appearance, presentation skills, visualising skills, and writing skills in different contexts (proposal, paper, websites, social media etc.). 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").

### *3.3 A Qualitative Review concerning the Implementation of pan-European Curricula*

With a view to developing specific curricula and establishing a European School of RI Management, we can offer evidence-based proposals for key competencies and skills. However, it should be noted that the development and introduction of such pan-European curricula for RIs and CFs is meeting with divided response. Such a step is perceived as an intervention in academic self-administration, while the local organisation is seen as having high competence for the further development of team members. Only a few interviewees reject common curricula on principle. Arguments against are duplication of strategies, excessive bureaucracy, and European over-regulation. It is also critically questioned whether the time is already ripe for this and whether there are not more urgent challenges at the moment. However, many also favour the introduction of common curricula. In some cases, major developments are associated with this, up to and including full Master's courses and even dedicated Ph.D. programmes for Research Infrastructures and Core Facilities. 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. It is critically questioned how the diverse and individual needs can be brought together in common modules without these remaining too superficial in terms of content. Another point of criticism, raised by proponents in particular, concerns time resources and workload as well as financial issues. It is not yet clear to the persons 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. Regarding 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.

## 4. Outlook

The development of common curricula and the establishment of a *European School for RI Management* still requires a lot of work and will likely generate controversial discussions. Especially as the high heterogeneity of the field puts a lot of – sometimes highly contradictionary – demands on the indviduals actors, this can also be seen in the fact that most of the expected educational content, is at a very high abstraction level. This highlights that the field at the moment is still gestalting and finding a from on the demands issues towards it. How people interact, how people communicate and how RIs and CFs have to be positioned in the academic landscape and holding on to traditional values like scientific excellence makes it clear that the field is both tied to the academic field on the one hand, while on the other it is currently struggling to find an own position in regards to traditional

boundaries of the field. A curriculum and formalisation would provide the chance to enrich and design this process.

In this regards a lot of convincing will have to be done to reach previously sceptical members of the community and to win them over to the joint project that puts the education for the work on *RIs* and *CFs* at the forefront. This process will have to go hand in hand with further empirical work. The strong involvement of the interviewees and their partly very comprehensive reflections on the question raised also show their enthusiasm for this joint project and their willingness to actively participate in it – they are hoping that science and research education in the future will include the needs and demands of *RIs* and *CFs*. 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 take into account 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. Furthermore, national contexts and difference of the countries involved (Kohn, 1989, p. 20-21) will need to be taken into account.

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