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AMICI

Accelerator and Magnet Infrastructure for Cooperation and Innovation

Horizon 2020 / Coordination and Support Action (CSA)

DELIVERABLE REPORT

REPORT ON BEST PRACTICE COLLABORATION BETWEEN INDUSTRY AND TECHNOLOGY INFRASTRUCTURE

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1. INTRODUCTION

In the framework of the AMICI project, the goals of the WP4.3 have been the identification of existing good practices, barriers and ways of promoting the effective engagement of the Technological Infrastructure (TI) in supporting the European Industries for developing commercial products and services that may benefit the society at large. The areas that have been investigated include Intellectual Property (IP) policies, patenting rules, knowledge sharing and all other critical aspects related to the exploitation of competences, equipment and services available at the TI.

The strategy to achieve these objectives has been outlined during the AMICI Industry Days in Padua (2017/04/18), together with the National Laboratories and Industrial stakeholders of the projects. It consisted, in the first part, of data collection from Industries to make a picture of the present status of engagement between TI and the Industries themselves. The subsequent analysis of this data allowed a first identification of profitable practices, issues and barriers and created the opportunity to investigate and define, in depth, the areas of problematic engagements, the motivations of such limitations and the solutions already adopted in the different cases. Based on this analysis, in the second part of the WP activity, we defined some paths forward and proposals to solve such critical issues and effectively overcome the barriers between Industries and TI.

2. METHODOLOGY

To collect data from Industries, the first part of the WP activity has been dedicated to write a survey to be submitted to the European Industries. As illustrated in detail in the following, the guidelines of this survey have been focused to address the size of the enterprises, their area of competences, the frequency and type of collaboration with the Technological Facilities (TFs), their experience and encountered problems in patenting submission and/or intellectual property sharing, etc. We also investigate the difficulties that experienced with access to Technological Facilities , engagement with TI qualified personnel and their experience in the receiving funds from Regional, National and European programs for the development of commercial products.

This activity has been integrated with data collected in dedicated meetings with stakeholders and by the information exchange at conferences and workshops focused on innovation, the accelerator market and technology transfer (TT). We refer, in particular, to the following meetings and workshops:

- *AMICI Industry Days* (Padua 2017/04/18) – first meeting, within the AMICI project, between Industry and National Laboratories in order to define goals and practical actions of the AMICI project;

- *The Accelerator-Industry Co-Innovation Workshop* (Bruxelles – 2018/02/06), organized by TIARA, ARIES and AMICI, that addresses the tools and strategies to enhance industry-academia cooperation in the particle accelerator community;

- *AMICI 1st Annual Meeting* (Uppsala – 2018/02/21) – First check-point of the status of the project;

- *Intellectual Property Workshop* (CERN – 2018/05/16), organized by AMICI and ARIES to point out the typical practices, the different approaches and issues about "Intellectual Property" within the collaboration between National Laboratories and Industries;

- *AMICI 2nd Annual Meeting* (Salerno – 2019/01/23) – Second verification of the status of the project and of the deliverables by different partners;

- *DESY-WP4.3 meeting* (Hamburg - 2019/04/17), organized by DESY and AMICI about the different solutions adopted by the TT office and Innovation group of DESY National Laboratory;

- *AIV XXIV Conference* (Giardini Naxos – 2019/05/07) – Conference of the Italian Society of Vacuum, Science and Technology. Industry and Italian National Laboratories presented the obtained results focused on the prospective for European Programs, Horizon 2020 and Horizon Europe;

- *ILO Industrial Opportunities* (Napoli – 2019/06/06) – Conference organized to present the business and the knowledge transfer opportunities offered by CERN, ESRF, ESS, ESO, Fusion4Energy and Italian National Laboratories.

After the elaboration of the data, illustrated in the following, we had the opportunity to put in evidence the present critical points and to define proposals of good practice to overcome barriers in TI-Industrial collaborations. This second part has been possible also with the helpful discussions and fruitful consultations with the TT offices of INFN, CERN, DESY, STFC and with the precious collaboration of all industrial partners of the AMICI project.

3. INDUSTRIAL SURVEY

The main goal of the Industrial Survey (IS) was the collection of data from a large population of Industries working in the Accelerator and Magnet fields. The proposed questions were devised in order to gather information and data on:

- *Industry General Information* such as commercial operating field, annual company percentage of turnover relative to the field of accelerator technology, etc.;
- *Type of collaborations* with TFs, with particular attention to Intellectual Property agreements, know-how sharing and participation in Regional, National and European funding programs;
- *Opportunities* to access the Technological Facilities.

The survey strategy and its structure were also shared and reviewed by the AMICI partners (both Industrial and National Laboratories). The mailing list of Industries was defined during the first AMICI annual meeting, with the collaboration of ILO offices.

The list was composed of 82 Industries and is given in Table 1. First submission was done on 19th March 2018. The operation was repeated twice until 5th May 2018 with a final amount of 7 responses. Hence, on 11th June 2018, a new submission through personal e-mail produced a further 10 responses in two iterations. After the second AMICI annual meeting a final reminder was sent to the Industries. In Fig.1 it is shown the global geographical distribution of the requested surveys and of the received answers. At the end of June 2019, the percentage of responses is 23% with 19 received surveys.

The relatively small percentage of received answers is, in our opinion, in line with standard survey percentages. The second important point to put in evidence is that we received the largest amount of answers after direct contact with the industries via one-by-one dedicated and personal e-mails. As discussed also in the following, this reflects a general behaviour in the fundamental engagement between the TI and industries that is usually driven by “personal” contacts.

The IS consists of 5 sections with the integration of a 6th section dedicated to the “Magnet Market” that has been prepared and analysed by WP4.2. The five sections of the IS are globally composed by 58 questions structured into:

- Part 1 – Industry General Information (10 questions)
- Part 2 – Collaboration: Description, Results, Agreements (17 questions)
- Part 3 – Access to Technological Facilities of Research Institutes (11 questions)
- Part 4 – Participation to Tenders and/or National/European funding calls (14 questions)
- Part 5 – The collaboration I Wish! (6 questions)

The whole survey is shown in the Appendix A.

Table 1: List of contacted Industrial Partners

1. 40-30 SAS	29. Demcon Kryoz	57. Oxford Instruments Nanoscience
2. Accelerators and Cryogenic Systems	30. DH Industries B.V.	58. Oxolutia SL
3. ALCA Technology Srl	31. DMP	59. Procon Systems
4. Alphysica	32. ELYTT ENERGY	60. Research Instruments
5. ALSYOM	33. EMPRESARIOS AGRUPADOS	61. Röchling Engineering Plastics SE & Co. KG
6. ANTEC Magnets, S.L.	34. ENSA	62. Rolf Kind GmbH
7. ASG superconductors	35. Esteyco	63. RUAG Space GmbH
8. AVS	36. Ettore Zanon	64. Saes getters
9. Babcock Noell GmbH	37. F.W. Hempel Metalli S.r.l.	65. Salzgitter Mannesmann Stainless Tubes
10. Basis Electronique de Puissance	38. FEAC Engineering P.C.	66. ScandiNova Systems AB
11. Bertin Technologies	39. FMB Feinwerk- und Messtechnik GmbH	67. Scanditronix Magnet
12. Bilfinger Noell GmbH (Babcock)	40. Hempel Special Metals	68. SDMS
13. Bruker	41. Heraeus Deutschland GmbH &amp	69. Siemens
14. Bruno Presezzi S.p.A.	42. IBA proton therapy - worldwide	70. Sigmaphi
15. BTESA	43. ICEoxford Limited	71. SIMIC SPA
16. CADINOX	44. IDOM	72. Stöhr Armaturen GmbH & Co KG
17. CAEN ELS s.r.l.	45. Imbach & Cie	73. STRUMENTI SCIENTIFICI CINEL s.r.l.
18. Can Superconductors	46. Indra	74. Sumitomo (SHI) Cryogenics of Europe GmbH
19. CECOM	47. INTERTEC A/S	75. Tesla Engineering Ltd
20. Colombus Superconductors	48. JEMA	76. Thales
21. Cryogenic Limited	49. Kryosystem	77. THEVA Dünnschichttechnik GmbH
22. Cryoworld B.V.	50. Leybold Italia S.r.l.	78. TTI
23. CSC S.P.A.	51. LOT Quantum Design	79. Vacuum-projects
24. CST-Computer Simulation Technology AG	52. MECACHROME	80. VACOM GmbH
25. Danfysik	53. Metrolab Technology SA	81. Walter Tosto S.p.A
26. DB ELETTRONICA TELECOMUNICAZIONI	54. Nortemecanica	82. Weka AG
27. De Pretto Industrie S.r.l.	55. OCEM Power Electronics	
28. DEMACO HOLLAND bv.	56. OSWALD Elektromotoren GmbH	

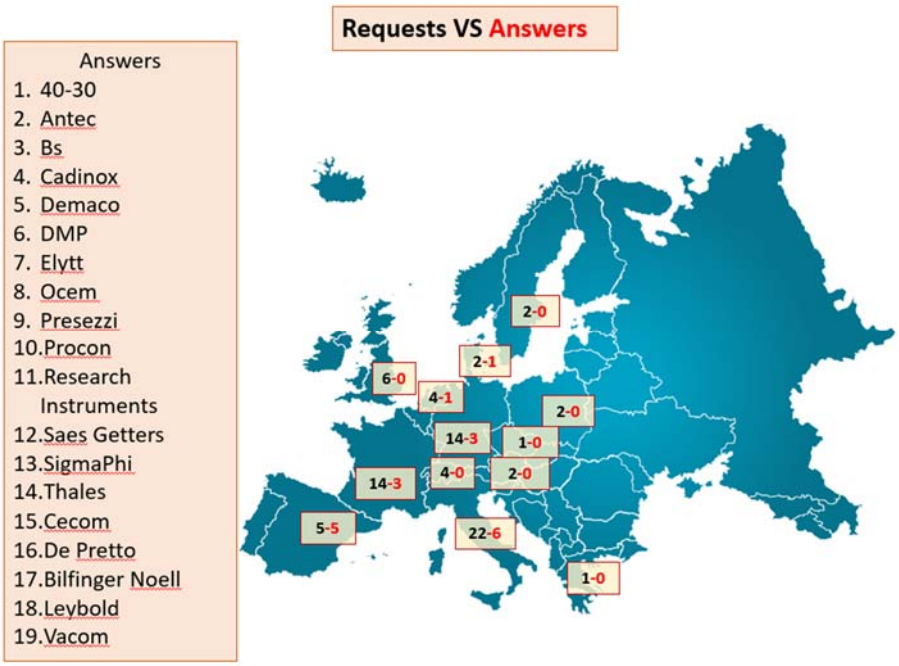


Figure 1: Geographical distribution of IS submissions and received answers. On the left the list of companies who answered

4. DATA ANALYSIS

From a population of 82 contacted companies, the total number of answers was 19 and, within these, not all the questions were answered. Also this information has been used as data in itself as shown below.

The answers have been analysed and the data have been represented through plots, reported in Appendix B. Each plot is labelled by an index correlated to the question while, in parenthesis, we indicated the number of received answers related to the plot itself (as example “Q3.6 (10 answ.)” indicates section 3 of the survey, question 6 and 10 received answers).

In the following we report a critical analysis of the different parts of the survey.

Part 1: Industry General Information

An analysis of the responses shows the presence of companies with a specific commercial field related to accelerator and magnet technology (Q1.3). Vacuum

products (chambers and pumping systems) and cryogenic systems are the most common fields of business, while accelerating structures (normal and super conducting), waveguides, high power systems, diagnostic and mechanics for magnets are more specialized fields highlighted by a smaller number of companies. This information is confirmed by the weight of magnet or accelerator market on the companies' turnover (Q1.5, Q1.6). Only 37% of the companies declare a contribution from the magnet market on their turnover larger than 10%. On the other hand, in the accelerator market there is a higher significant presence of companies. About 61% of the companies declares a turnover on this market larger than 10%. Moreover, the number of companies with a turnover larger than 70% on accelerator technologies, is twice that of those specialized on magnets: 22% and 11%, respectively. Considering the type of business (Q1.10), only 28% of companies is supplier of standard products while 89% designs and develops custom components for the TI. Another significant deduction, obtained by crosschecking the answers (Q1.5-Q1.7), is that the big companies, with more than 200 employers, are those with a small turnover in these two fields. Consequently, we deduce that they are not only specialized in these markets and have other commercial fields for their products.

Investigating the engagement between industrial partners and TFs (Q1.9), nearly all the companies have contracts with CERN (95%) and a great part of them with CEA (75%). The big European projects developed in these RIs (LHC, ITER, etc.) represent the main sources of procurements for the companies while, on average, half of the companies collaborate and have business with the National Laboratories.

We also investigated, through questions (Q1.7, Q1.8), the investment of companies on innovation and R&D asking the number of personnel dedicated to R&D projects. We discovered that in almost all cases, the proportion of R&D personnel is no more than 20%, with an average of 10%, and without a clear correlation between this information and the size of companies.

Part 2: Collaboration: Description, Results, And Agreement

Q2.1 shows that the contracts between industries and RIs/TFs are mostly established within public tenders (100% of all companies) instead of National funding programs done in collaboration (42%) or European funding programs in collaboration (16%). However, low exploitation of "European calls in collaboration" is a warning point: the low participation can be due to a very selective process or to some barriers due to the bureaucracy that dissuade participation, as also more deeply investigated in the following section 4 of the IS.

An interesting observation on the type of contact between the companies and the RIs/TFs is illustrated by the answers to question Q2.2 that demonstrate that for almost

all companies the main contact is a “personal” one instead of that established through Technology Transfer or dedicated offices. This information points out one of the critical questions on innovation: *if the relationship between companies and RIs/TFs is mainly demanded to a “personal contact” how is it possible to have global innovation strategy within RI or TF? Which is the best model to follow?* In order to estimate the efficiency of the present innovation strategy, it is also important to observe what the results are at the end of a collaboration (Q2.6). The answers put in evidence that a great number of publications and a relatively moderate quantity of prototypes mainly comprise the final outputs of such collaborations, while the number of patents and commercial products is very low. This information can be a flag about the interruption of the innovation path but, at the same time, highlights an unexpressed potential of the collaborations that drive a second question: *is the present technology transfer organization suitable to exploit the potential of the of TI-Industry collaboration results?*

The commercial products, created within these collaborations, are mostly developed for accelerator research (62%) while medical and material science markets absorb the remaining 38% as evidenced by the answers Q2.7 and Q2.8. The development of innovative products within a scientific collaboration requires a contract for the regulation of Intellectual Property (IP). 82% of the companies declared that this agreement is based on a standard model, and half of the companies point out issues regarding IP (Q2.16 and Q2.17). Appreciation of the final agreement denotes again a division, with half of the companies satisfied and more than 30% with a bad feedback (Q2.18). Unfortunately, despite asking the companies for further clarification as to the types of problems they encountered, we did not receive any detailed motivation.

Part 3: Access to Technological Facilities of Research Institutes
and
Part 5: The Collaboration I Wish!

In the third part of the IS we investigated the use of the equipment and facilities in the present TIs. We have correlated this part of the survey with the last part (5th section) related to information on research programs, available technological facilities in RIs/TIs and wishes in term of communication.

69% of the companies declared they had the possibility to access these facilities for their projects (Q3.1). It is interesting to associate this data with question Q5.1 where only 50% of companies declare knowledge of the facilities that available in the TIs. In the 75% of positive responses, the companies found out these facilities by personal contacts while other communication channels (web sites, open day, seminars) were useful only for less than 50% of the companies (Q5.2). Q5.3 and Q5.4 evidence that only about 50% of companies are relatively well satisfied about the available

information on facilities and research programs and that they would like to have more information on available equipment (92% of companies), available technical personnel (62%) and research programs (77%). These results drive a couple of questions on best practices and effective engagement between Industries and TIs: *are the companies informed enough about the opportunities of the use of facilities in TIs? Are the companies able to understand how to take advantage from that type of instrumentation for their business?*

Answers to Q3.2 put in evidence that the facilities in TIs are exploited for different scientific fields without any prevalent application while in Q3.3 and Q3.4 the companies report a very useful and fruitful experience and consider the access procedures relatively easy. The technical personnel of the TIs are actively involved during these activities in 60% of cases and not only for technical support (Q3.6). The companies perceive the contribution of the TIs personnel to be enthusiastic and consider it very useful for industrial purposes (Q3.7). In this way, TIs become a preferred location for the engagement between the technicians, scientists and industry personnel giving opportunities for the birth of several co-innovation projects. However, even if this feedback is positive, it is the expression of only half of the companies that answered the IS (10 answers) and that had access of the TIs. To conclude, the time lapse for the access to the technological facilities spreads from weeks (45%) to months (33%), in some cases a year (22%), and that 70% of companies consider this time suitable for their timescale.

Part 4: Participation to Tenders and/or National/European funding calls

In the fourth part of the IS we directly investigated the participation to the different tenders and calls, since they represent opportunities for new scientific collaboration and co-innovation projects. Almost all the consulted companies usually participate in RI tenders (Q 4.1) and the experience has a negative evaluation in only 21% of cases, while 48% of companies are well satisfied (Q 4.2). Furthermore, almost all companies (86%) complain of problems with the bureaucracy of institutes and 58% have difficulties obtaining clear explanations and clarification from RIs/TIs offices (Q4.3). The difficulties to participation in tenders are a strong limitation especially for SMEs. Small Industries have smaller technical offices and fewer people dedicated to the preparation of the technical documents required for the participation in tenders, thus reducing the possibility to be competitive.

In addition, participation in National/Regional and European program funding calls has been investigated (Q4.4-Q4.7). Only the 50% of companies participated in regional or national calls, but they are considered generally a good experience: 44% of the companies declared relatively good feedback, but the index of appreciation drops for

the clarity of the calls and their promotion. 45% of the companies indicated that the calls are not well promoted and not clear enough, and this can be easily correlated to the low participation.

Also for the European calls (Q4.9-Q4.12), the participation is low (53%). However, the companies consider them a good opportunity for 63% of them but, also in this case, the calls are not well promoted and clear. In fact, in spite of a general good experience on the results when the call is won, they are considered not clear for 40% of companies and 30% highlight a lack of promotion. Similarly to the previous case, the lack of communication for National and European calls is a greater barrier for SMEs than for larger companies.

5. LIMITATIONS AND BARRIERS

The collected data by the IS and the interaction with companies in the mentioned meetings and workshops, pointed out, from one side, several barriers and limitations in the effective engagement between industries and TI but, on the other side, some good paths through best practices relative to the innovation path.

The barriers and limitations can be summarized in four main points:

- **Lack of communication**

  The IS's results evidence how the companies are not well informed about TF's instrumentation that they can use, and on the potential impacts of these facilities on the Industry's R&D strategy. This lack of communication was pointed out also for European and National calls including the innovation funding programs. Another lack of communication is related to the research programs (present and future) in the National Laboratories.

- **Complex bureaucracy and not suitable timescale for facilities access**

  Complexity of regulations and of documentation is historically a barrier for companies to participate in calls and to collaborate with TFs on co-innovation projects. This complexity is particularly relevant for SMEs and represents a barrier for the entrance of new companies into the accelerator and magnet commercial fields. On the other hand, the complexity of regulation for the access to technological facilities in the TI can cause delays not compatible with the market requests.

- **Lack of innovation strategy**

  Within the innovation path, the novel ideas need rigorous support to become prototypes and then commercial products. Along this path, financial support and legal consultation are required as essential conditions for the evaluation and development of the idea. Since the main source of contact in the National Laboratories is a “personal” one, and may be different from one company to another, a harmonized environment is not developed in which to develop and promote a global innovation strategy. Moreover, usually, researchers are not educated about industrial necessities, legal agreements and commercialization and this can represent a limitation. On the other hand, National Laboratories are not always provided with specific structures able to create a fertile environment for novel ideas and to bridge the gap between Research and Industry worlds.

- **Problem inherent to Intellectual Property Agreement**

  The problems related to the IP agreement surely involve the co-innovation process and can limit industrial-TI engagement. The rules of knowledge sharing have to be clear from the beginning of the collaboration and should take into account all possible cases that can occur during the collaboration. National Laboratories and Industries pursue different goals and follow different rules, with the possibility to reach conflicting situations. One of the most critical points is related to the “open science disclosure”, royalties and the use of the obtained results for future third party collaborations. Companies, in particular, drew attention to this latter point where the National Laboratory share results, achieved in a dedicated collaboration activity with one company, with another company in the framework of a new project. At the same time, the National Laboratories try to avoid the “vendor lock-in” conditions during IP negotiation.

6. PROPOSALS FOR ACHIEVING BETTER PRACTICES

The paths through the best practices, together with some new proposal, are summarized in the following points:

- **Lack of communication: dedicated workshops and supporting programs for information meetings**

  Although communication is, nowadays, easy and immediate, the data collected by the IS highlights a lack of efficient exchange of information followed by a

request for significant discussion opportunities. A possible type of event, already tested by some TFs, are thematic workshops with the participation of a limited number of companies from the same technical field. A limited number of participants is useful to obtain more focused discussions. The combination of these events with the opportunity to visit TI facilities can facilitate the interest for new projects supported by TFs. In this framework the support of Regional/National/European funding programs, dedicated to the organization of these info days, would be extremely useful especially for SMEs. The AMICI website can be a fundamental platform for sharing information, sponsoring the events and the funding programs and for facilitating access to TFs.

- **Complex bureaucracy and not suitable timescale for facilities access: dedicated offices at National Laboratories**

  Well organized and dedicated Technology Transfer (TT) Offices at National Laboratories, and ILOs give the only realistic solution to these problems. These offices have to integrate administrative and technical personnel able, from one side, to help the Industries solve the bureaucratic problems they encounter when they approach a funding call and, on the other, to be the right interface between the technical/scientific TFs personnel and industry. This could reduce the time delay between the industry request and access to facilities and exploitation of the service. If the industry request is not compatible with the National Laboratories activities, the communication must be clear and rapid to allow the company to find other solutions.

- **Lack of innovation strategy: motivation of researchers and Innovation and Technology Transfer Organization**

  Innovative ideas require motivated people in both stakeholders: National Laboratories on one side and Industries on the other. From the former point of view, researchers and technicians need to be “educated” and “informed” to understand the advantages and opportunities for their institutes as well as the social impact of the exploitation of new technologies developed with industries. At the same time, the technology transfer activities should be integrated into the researchers’ job as an opportunity for their carrier and a fundamental mission. Furthermore, to facilitate the dialogue between National Laboratories and companies, the promotion of specific courses about TT during academic education and the creation of more PhD shared positions can be effective. From the Industry side, the motivation for companies can be encouraged by a clear return of investment from these projects. All the innovation strategies and

funding programs are usually coordinated by the technology transfer offices. In order to make effective strategies, the technology transfer office must be the bridge between RI and companies and cannot be limited to a legal office for the agreements with companies. For this reason, the TT offices require specialists educated in both scientific and economic matters. These specialists will be consigned to scout the technology with potential market interest within National Laboratories, and then to scout the companies interested to be involved into innovation projects. Hence, the novel technology can be integrated into innovation programs and can be followed from the idea to the final prototype and product. Along this path, the TT office should rely on legal and administrative offices able to speed bureaucracy duties and to resolve issues. Figure 2 (top) shows schematically the structure of an ideal Innovation and Technology Transfer Office with all crucial elements that have to interplay in the process:

- TTO (Technology Transfer Office) focused on technology screening, interface between researchers and industry, transfer of know-how and ideas from National Laboratories for commercial use, IP and licensing;

- IRC (Industry Relations and Communication) focused on the relationship with industries, meeting, open days organization, industrial screening;

- PO (Project Office) focused on management of National Laboratories internal funding program, promotion of Regional/National/European calls, support in participation to Regional/National/European calls.

The roles of the different Innovation and TT offices integrated in the innovation path are schematically represented in Figure 2 (bottom).

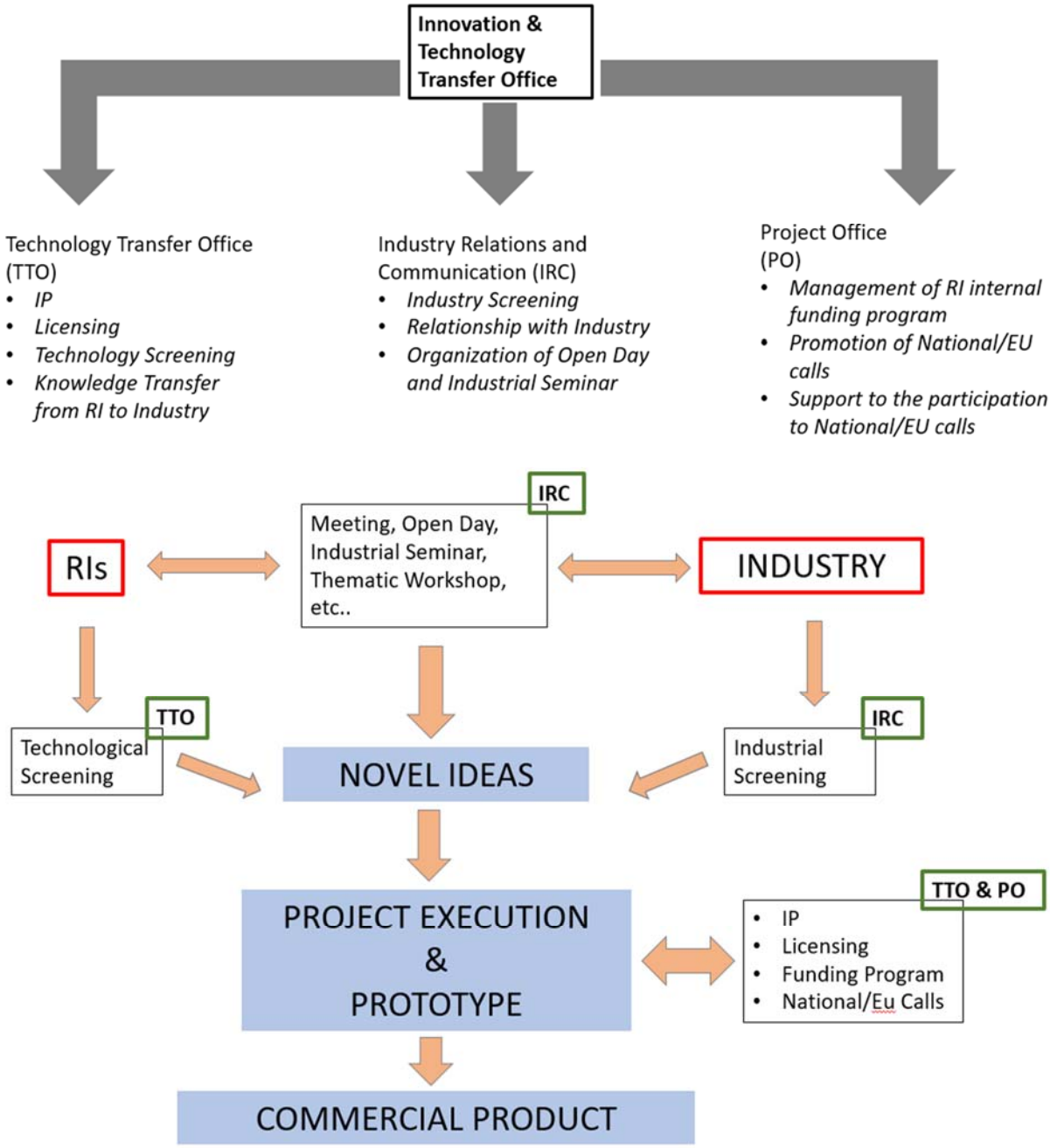


Figure 2: (top) Proposal of an ideal Innovation & Technology Transfer office structure in National Laboratories. (bottom) Innovation path, from novel ideas to commercial product, with possible roles of Innovation & Technology Transfer offices.

- **Problem with Intellectual Property Agreement: IP Agreements**

  The general path through a joint scientific collaboration and development between National Laboratories and Industry is schematically represented in Figure 3. There are basically three phases: the preparation phase, the execution phase and the exploitation phase. In the first one we have the identification of research topics immediately followed by a Non-Disclosure Agreement (NDA), the definition of the R&D project and the securing of funds to sustain the R&D activity. The second one is the execution of the R&D project and the final one is the conclusion of the project with possible commercialization and licensing. In this framework, we can identify two phases for the IP definition. A first phase that occurs in the preparation phase in which the National Laboratory and industry have to clearly define the background and the foreground including all the possible critical occurrences during the execution of the project. The second one, at the end of the project, with a definition of the patenting rules and know-how sharing. The first phase is the most critical one because it has to take into account the possibility of an interruption of the R&D project, or an unsuccessful conclusion, and also the novel ideas born during the activity

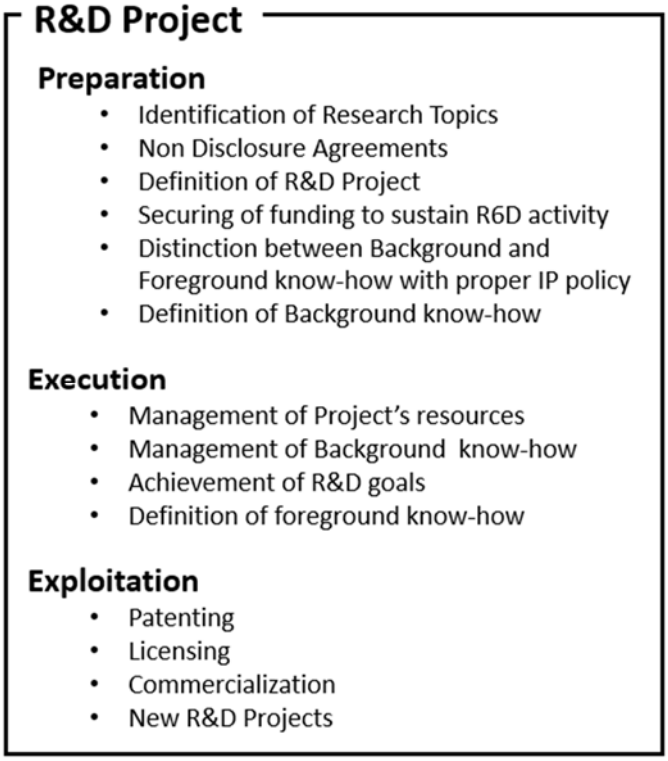


Figure 3: Schematization and description of the different phases of an R&D project with particular attention for the management of IP, know-how sharing and patenting.

In both cases, it is important to establish how the obtained results and the potential ones are managed. Usually there is not a unique solution; however, there is the possibility of negotiation case by case. A possible solution is to maintain a database that contains the records of previous scientific collaboration contracts and the right/wrong practices to help avoid issues about IP during and after the collaboration. This database requires to be continuously updated during time with new cases and related feedbacks. Use of this tool can be useful to simplify the negotiation phase and to achieve clearer contracts for a fruitful National Laboratory-Company engagement. Just as a reference, we report below a number of critical points mostly addressed during the meetings and discussion with industries:

- *If, in the R&D program, there are parallel obtained results, it should be clarified if, and under what conditions, the National Laboratories can use them for successive correlated projects and procurements;*

- *vice versa if the Industry wants to use this parallel results for the implementation and eventual commercialization of new products it is important to establish what type of royalties have to be payed to the National Laboratories;*

- *it is important to identify the personnel (temporary, permanent or students from National Laboratory and Industry side) that participate to the R&D activity and define their obligations if they move to other institutions or companies;*

- *concerning the scientific publications related to the R&D activity (including also the mentioned parallel achievements) it is important to define the policy to be adopted: i.e. has the industry to approve the publication before its disclosure?*

7. CONCLUSION AND ROLE OF "AMICI NETWORK"

The Deliverable 4.3 focused on the main results of the analysis relative to the present engagement between Industries and Technological Infrastructures (TIs) with particular attention to the best practices and main limitations. The investigated areas of interest have been the Intellectual Property (IP), knowledge sharing, patenting rules

and the exploitation of TIs equipment. The first part of report has been dedicated to the illustration of the results of the survey submitted to the European industries and oriented to address the size of the enterprises, their area of competences, the frequency and type of collaboration with the Technological Facilities (TFs), their experience and encountered problems in patenting submission and/or intellectual property sharing, etc. With the survey we also investigated the difficulties experienced with access to TFs, engagement with TI qualified personnel and their experience in the receiving funds from Regional, National and European programs for the development of commercial products. These results have been integrated with data collected in dedicated meetings with stakeholders and by the information exchange at conferences and workshops focused on innovation, the accelerator market and technology transfer (TT).

Hence, within the areas of interest, different limitations and barriers have been identified classified and illustrated in the report. In particular, we identified four main critical areas: the communication, the bureaucracy, the innovation strategy and the IP agreements. For each area, we also identified different best practices, proposals and suggestions to overcome such a limitations and to obtain a real and effective engagement between industries and TI in the future. These proposals have been similarly classified in four main points, one for each critical area.

In this framework, the network created during the AMICI project has been an ideal tool to discuss and conceive some of the proposals for best practices and can be, in the future, an ideal platform to implement some of the proposed solutions. In particular, the proposed IRC (Industry Relations and Communication Office) can found in AMICI an ideal platform to create a centralized point for information exchange between industry, TIs and Research Infrastructures (RI).

In the near future, AMICI can be also:

- the platform used by the industries to know the opportunities and services provided by the different TIs;
- the European website platform used by the Industries to require and ask a particular service and/or competences that can be re-addressed by the AMICI organization to the particular TIs offering that service;
- the first sponsor of success stories between industries and TIs and of the new TIs implementations. A periodical bulletin (annual/biannual) about new achievements and status of the TIs can be a useful tool to explain the potentiality of TIs and the feasibility of collaborations;
- the platform to sponsor local/regional/national/international meetings or information days.

In the long term:

- AMICI can be the coordinator of the series of the thematic workshops, locally organized, within the TIs to promote new co-innovation projects and the entrance of new industries in the specific commercial fields. The creation of funding programs dedicated to support the participation of SMEs can be also fundamental;
- AMICI network can be the promotor of shared industry/academy PhD positions, or co-innovation projects;
- AMICI can be also a European repository that contains the records of previous scientific collaboration contracts and the right/wrong practices to help avoid issues about IP during and after the collaboration.

APPENDIX A: *INDUSTRIAL SURVEY*

PART 1 – INDUSTRY GENERAL INFORMATION

1) **First, Last Name and function (of the person answering the survey)**
2) **Name of the Company**: *free answer*
3) **Company Commercial Operating Field**: *multiple choice answer*
   - Accelerating Structures-Normal Conducting
   - Accelerating Structures-Super Conducting
   - Waveguides and waveguides Components
   - High Power Systems (Klystrons, Modulators, Inductive Output Tubes,…)
   - Vacuum Chambers
   - Pumping Systems (Ion Pumps, Turbo-molecular,…)
   - Diagnostics
   - Normal Conducting Magnets
   - Super Conducting Magnets
   - Magnets Power Supplies
   - Cryogenic systems
   - Other specialized mechanical components for accelerators
   - Other specialized mechanical components for magnets
   - Electronics and instrumentation for accelerators
   - Electronics and instrumentation for magnets
   - Other
4) **Other details on Company Operating Fields**: *free answer*
5) **What is the annual company % of turnover relative to the field of accelerator technology?** *multiple choice answer*
   - 0-10%
   - 10-40%
   - 40-70%
   - Over 70%
6) **What is the annual company % of turnover relative to the field of magnet technology?**
   - 0-10%
   - 10-40%
   - 40-70%
   - Over 70%
7) **Number of Employees**: *free answer*
8) **Number of Employees (FTE) devoted to R&D**: *free answer*
9) **Do/did you have collaborations/business/supply of components with these Institutes?** *multiple choice answer*
   - Commissariat à l'énergie atomique et aux énergies alternatives (CEA)

- European Organization for Nuclear Research (CERN)
- Stiftung Deutches Elektronen-Synchrotron Desy (DESY)
- Istituto Nazionale Fisica Nucleare (INFN)
- The Henryk Niewodniczanski Institute of Nuclear Physics, Polish Academy of Sciences (IFJ)
- Centre National De La Recherche Scientifique (CNRS)
- Science and Technology Facilities Council (STFC)
- Uppsala Universitet (UU)
- Paul Scherrer Institut (PSI)
- Kalsruher Institut Fuer Technologie (KIT)
- Other: specify

10) What kind of business/collaboration do/did you have with the mentioned Institutes? *multiple choice answer*

- Supply of standard/catalogue components for Institute
- Development of custom components for Institute including design
- Supply of build to print component for Institute
- Purchase of special components from Institute
- Use of Technical Platforms in the Institute
- Research Collaboration
- Licensing
- Other

PART 2 – COLLABORATION: DESCRIPTION, RESULTS, AGREEMENT

1) **How was the collaboration with Institute established?**
   - Public tender
   - Supply of standard/catalogue components for Institute
   - European project that foresaw a collaboration between Institute and the private Company
   - National funding that foresaw a collaboration between Institute and the private Company
   - Other: please specify
2) **Who is your contact in the Institute?** *grid answer*
   - Personal – The contact is based on one or more researcher/technician
   - Dedicated Offices (e.g. Technology Transfer Office)
   - No Contact
3) **Among the interactions you had with Institute, what percentage was problematic:** *multiple choice answer*
   - 0-10%
   - 10-40%
   - 40-70%
   - Over 70%
4) **In particular you had immediate interaction on:** *free answer*
5) **In particular you had problematic interaction on:** *free answer*
6) **During the past 10 years, did you collaborate with Institute in scientific publications, commercial products development, prototype development, patent requests?…** *tick boxes*

	0	1-2	3-5	6-10	>10
Publication					
Patent					
Prototype					
Commercial product					

7) **The commercial products you developed in collaboration with Institute were finalized to:**
   - Products of interest for the Institute only
   - Products for external market whose idea has been conceived by Institute
   - Products for external market whose idea has been conceived by the Company

8) **What type of commercial products have you developed in collaboration with Institute?**
   - Research Equipment
   - Medical products (e.g. diagnostics systems, etc…)
   - National security (e.g. X-ray scan systems)
   - Material treatment (e.g. sterilization,…)
   - Other: please specify

9) **Did the collaboration have the possibility to support qualified personnel like Ph. D students, temporary contract researcher, technician, interns? If so, please indicate who paid for them?** *Multiple Choice Answer*
   - The company
   - The RL
   - A co-financing programme

10) **Other comments on the social impact of Collaboration (e.g. after the collaboration the qualified personnel has been hired by the Industry, etc…)** *free answer*

11) **In the framework of the collaboration, were there some training/education from the Institute to Industry personnel?** *Multiple Choice Answer*
   - Yes
   - No

12) **Has the training/education from the Institute to Industry personnel been useful?** *linear scale answer*
   - Not useful(1)->Useful(5)

13) **In the framework of the collaboration, were there some training/education from the Industry to Institute personnel?** *Multiple Choice Answer*
   - Yes
   - No
   - Other

14) **What training your company will be interested in?** *Multiple Choice Answer*
   - Superconducting radiofrequency
   - Vacuum Technology
   - Cryogenics Technology
   - Superconducting Magnet Technology
   - Beam Diagnostic
   - Other: specify

15) **Would your company be interested in:** *Multiple Choice Answer*
   - E-learning (MOOC)
   - On-line training (professor somewhere trainees at another location) for the theoretical part
   - Hands-on training
   - Other: specify

16) **Within the collaboration, were there issues on Intellectual Property Rules and/or Patenting Rules?** *Multiple Choice Answer*
    - Yes
    - No
    - Other
17) **If yes, was there a standard agreement model on Property Rules and/or Patenting Rules proposed by the Institute?** *Multiple Choice Answer*
    - Yes
    - No
18) **Were you satisfied with the proposed "agreement" with the Insitute?** *Linear scale answer*
    - No (1)-> Yes (5)
19) **Were there particular problems/limitations during this phase? Or do you have suggestions in order to facilitate/to improve the "agreement" stipulation/management?** *Free answer*

PART 3 – ACCESS TO TECHNOLOGICAL FACILITY OF RESEARCH INSTITUTES

1) **Have you ever had the possibility to use/have access to Technological Facility of Institute?** *Multiple Choice Answer*
   - Yes
   - No
2) **What type of Technical Platform did you use?** *Multiple Choice Answer*
   - Test beam facilities
   - Magnet manufacturing equipment
   - Magnet measurement equipment
   - Cryogenics plants
   - Radiofrequency cavity measurements
   - Chemistry, clean room and assembly halls
   - Characterization and measurement laboratories
   - Other
3) **How was the utility for the Industry?** *Linear scale Answer*
   - Not Useful(1) -> Useful(5)
4) **How was the access to the equipment?** *Linear Scale Answer*
   - Difficult(1) -> Easy(5)
5) **Do you have any suggestions in order to improve or facilitate the use of equipment of Institute?** *Free answer*
6) **In the collaboration, has Institute personnel been involved?** *Multiple Choice Answer*
   - Yes technician
   - Yes researcher
   - Yes but for the use of the Institute equipment only
   - No
   - Other
7) **Referring to the involvement of Institute personnel, how was the utility for the Industry?** *Linear scale answer*
   - Not useful(1)->Essential(5)
8) **Referring to the Institute personnel, was it easy to involve them?** *Linear scale Answer*
   - No(1)->Yes(5)
9) **In case of not easy access to support from Institute personnel what were the main limitations?** *Free answer*
10) **What was the time lapse from the request to the effective access to Technological Facility equipment or support from Institute personnel?** *Multiple Choice answer*
   - Weeks
   - Month
   - Up to six months

- Year
- Other: please specify

11) **Is it suitable for the project timescale of your company?** *Multiple Choice Answer*

- Yes
- No

PART 4 – PARTICIPATION TO TENDERS AND/OR NATIONAL/EUROPEAN FUNDING CALLS

1) **Did you participate to a tender published by Institute?** *multiple choice answer*
   - Yes
   - No
2) **Was the participation easy?** *linear scale answer*
   - Difficult(1)->Easy(5)
3) **In case of difficult participation what were the issues?** *multiple choice answer*
   - Bureaucracy complications
   - Difficulties in submitting the documents
   - Difficulties to have clarifications on the tender
   - Other: please specify
4) **Did you ever participate to a National/Regional funded Call in collaboration with Institute?** *multiple choice answer*
   - Yes
   - No
   - If yes please specify
5) **How can you describe this experience?** *linear scale answer*
   - Not useful(1)->Useful(5)
6) **Are the National/Regional funded Calls sufficiently promoted from the Institutions?** *linear scale answer*
   - No (1)->Yes(5)
7) **Are the National/Regional funded Calls sufficiently clear in their purpose and easy to submit?** *linear scale answer*
   - Not (1)->Yes(5)
8) **Suggestions for enhancing the impact of National Call for Companies:** *free answer*
9) **Did you ever participate to a European Call in collaboration with some Institute?** *multiple choice answer*
   - Yes
   - No
   - If yes please specify
10) **How can you describe this experience?**
   - Not Useful(1)->Useful(5)
11) **Are the European funded Calls sufficiently promoted from the Institutions?** *linear scale answer*
   - No (1)->Yes(5)
12) **Are the European funded Calls sufficiently clear in their purpose and easy to submit?** *linear scale answer*
   - Not (1)->Yes(5)
13) **Suggestion for the improvement of the impact of European Call** *free answer*

14) **Do you think Institute are well prepared in "Project Writing"?** *Linear Scale Answer*

- Absolutely not Prepared(1)->Expert(5)

PART 5 - THE COLLABORATION I WISH!

1) **Do you know the research activities and the available Technological Facilities of the Institute whom you collaborate with?** (visit http://eu-amici.eu/technology_infrastructure) *Linear Scale Answer*
    - No (1) -> Yes(5)
2) **How did you know them?** *Multiple Choice Answer*
    - Seminars
    - Open day event
    - Personal relationship
    - Web Sites
    - Other: please specify
3) **Do you think the available information is satisfying?** Linear Scale Answer
    - No(1)->Yes(5)
4) **In any case, what kind of information would be useful for you?** *Multiple Choice Answer*
    - Available equipment
    - Available personnel profile
    - Details of Research projects
    - Other
5) **How would you like to have this information presented (website, dedicated meetings…)?**
6) **In particular, let us know if you would like to suggest improvement in the presentation on the AMICI website? http://eu-amici.eu/** *Free Answer*

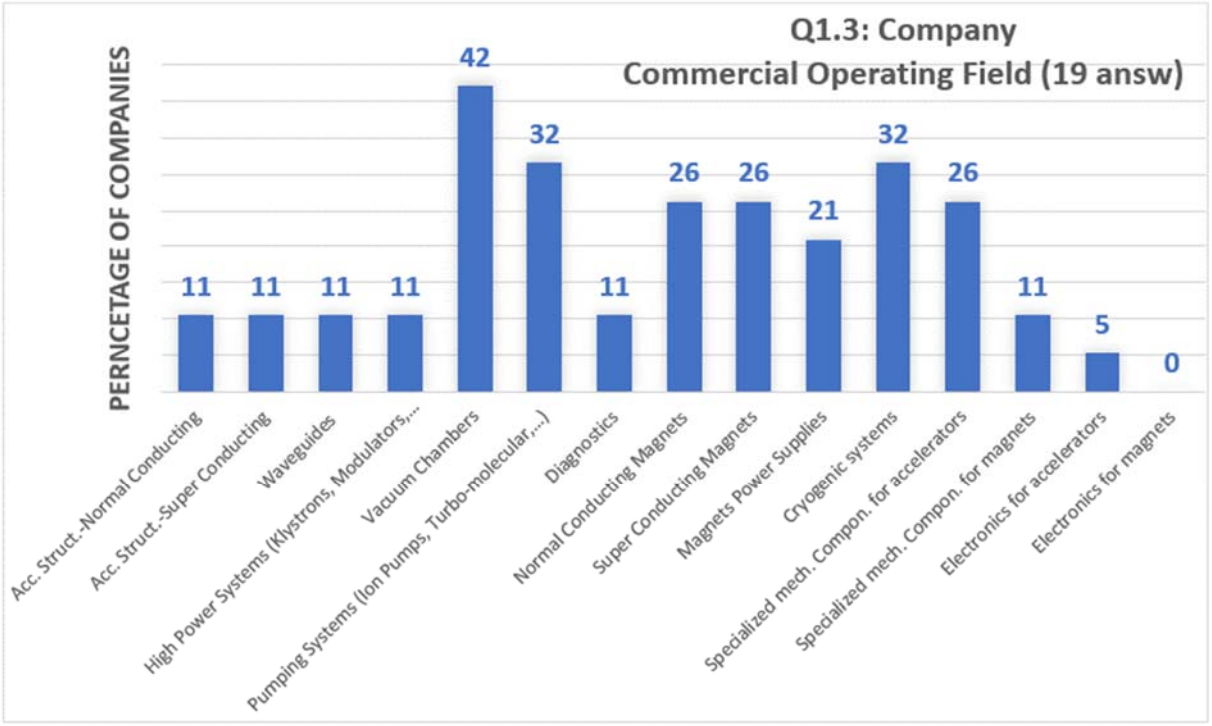
PART 6 – THE MAGNET TECHNOLOGY MARKET I WISH!

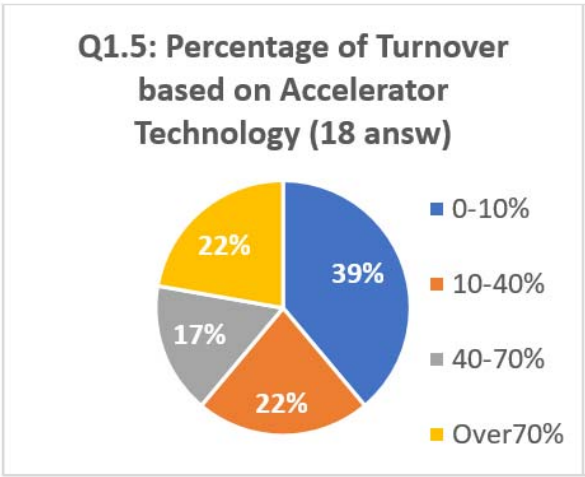
1) **Which segment of your market could benefit from the Technology Infrastructure?**
   - *Free Answer*
2) **What is the expected percentage growth in your segment of market, which could benefit from the Technology Infrastructure in 5 years?** *Multiple Choice Answer*
   - 0-5%
   - 5-10%
   - 10-20%
   - Over 20%
3) **What kind of magnet product or technological developments using the Technology Infrastructure are you expecting in the next 5 years?** *Multiple Choice Answer*
   - Magnets for Research infrastructures
   - Magnets for health markets (new imaging systems and therapy) Magnets for energy markets (production transportation and use),
   - Magnets for transportation (high speed trains, zero frictions conductor free cars, space crafts)
   - Other applications: please specify
   - Magnets for scientific applications (high field , NMR, etc..)
4) **Are you expecting new potential markets in magnet technologies applications, which could benefit from the Technology Infrastructure?** *Free Answer*
5) **What potential breakthrough innovation translated into your market could be developed in the Technology Infrastructure or could be an application of technologies developed in the Technology Infrastructure?** *Free Answer*
6) **What kind of Technical Platforms of the Research Laboratories would you like to use in the future for your magnet market development?** *Multiple Choice Answer*
   - Characterization laboratories
   - Magnet winding and impregnation laboratories
   - Integration and assembly laboratories
   - Magnet Test stations
   - Others: please specify
7) **At which steps of your magnet product development could you/would you like to use Technological Facilities?** *Multiple Choice Answer*
   - R&D
   - Proof-of-concept model
   - Prototyping
   - Series
   - others

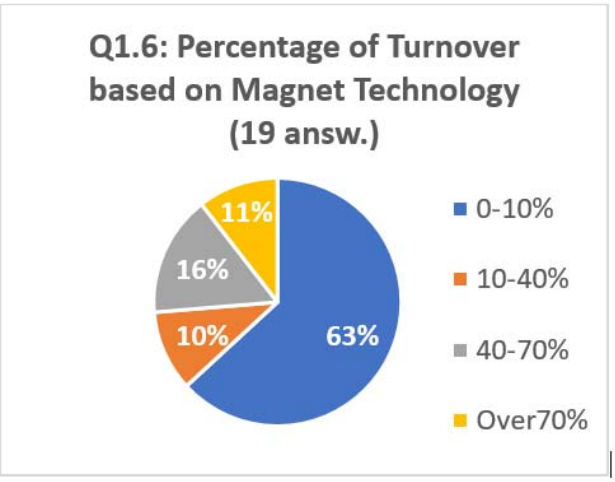
8) **What are the barriers to benefit from future collaborations with the Technology Infrastructure?** *Multiple Choice Answer*
   - Access Cost
   - Availability
   - IP
   - others

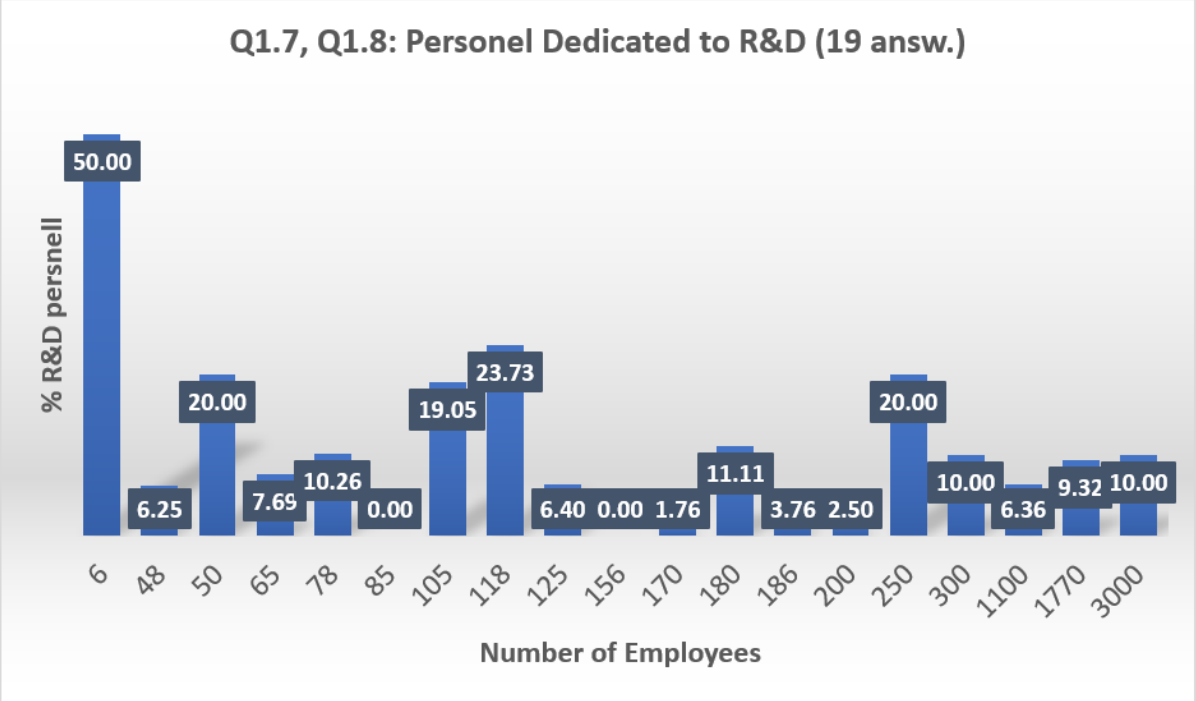
9) **What are the reasons which would make you preferably choose to use the Technical Platforms located at Research Laboratories or your own Technical Platforms ?** *Free Answer*

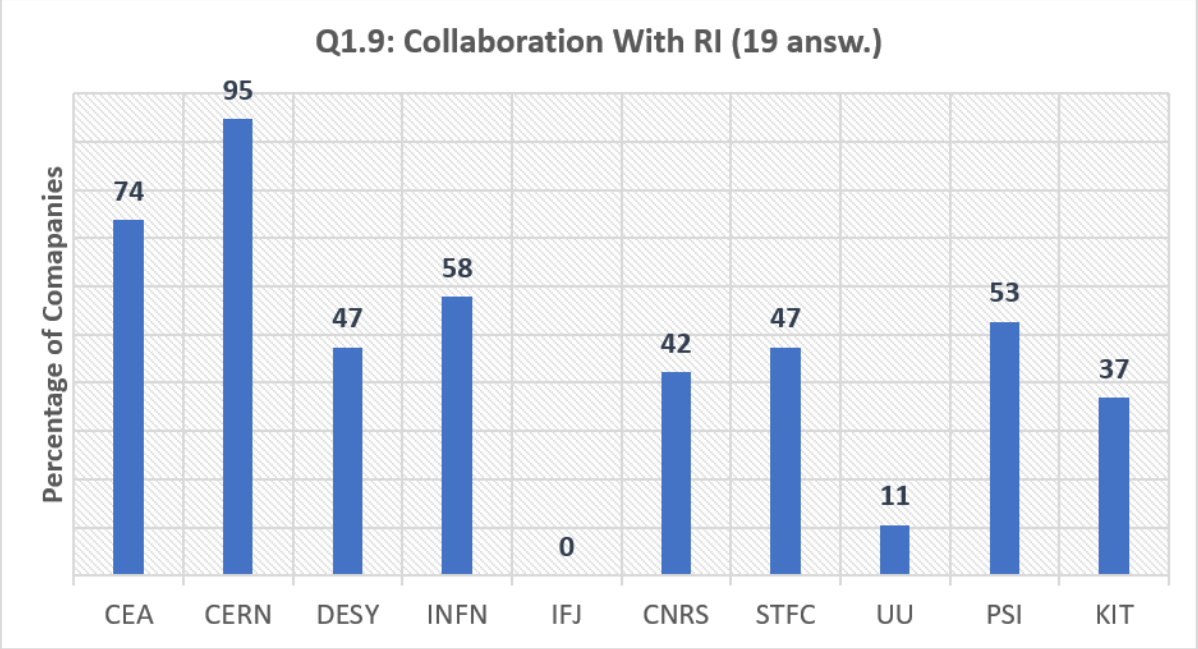
APPENDIX B: *PLOTS AND DATA ANALYSIS*

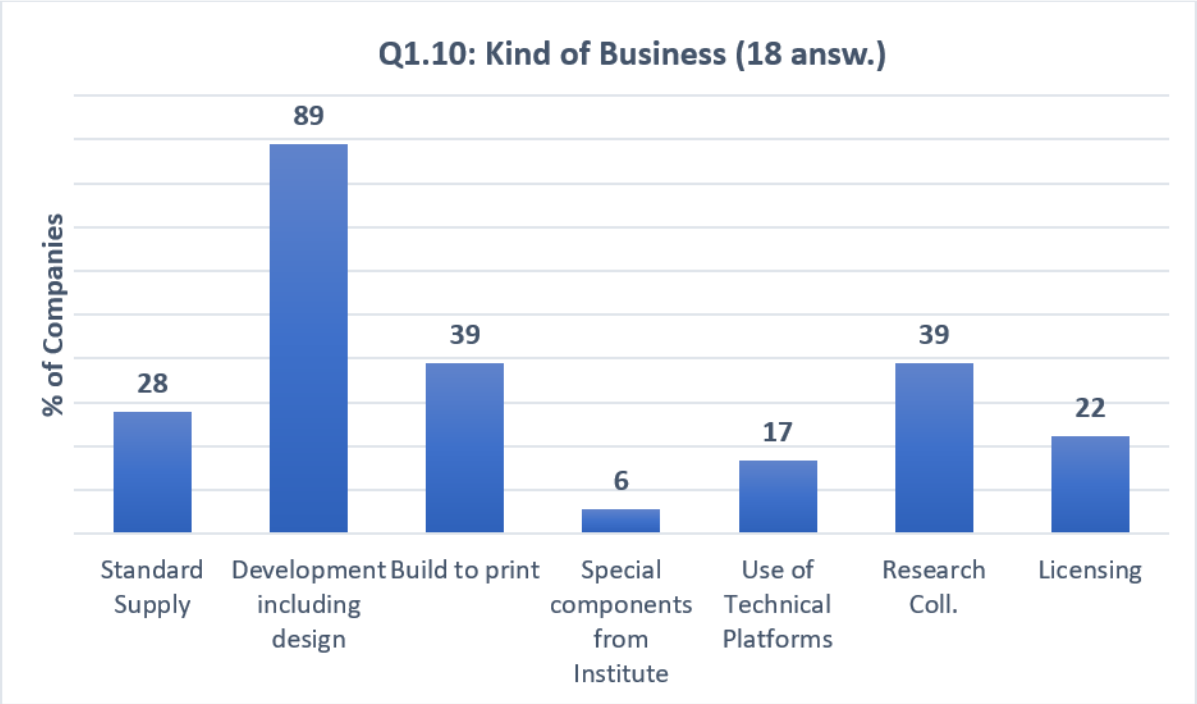


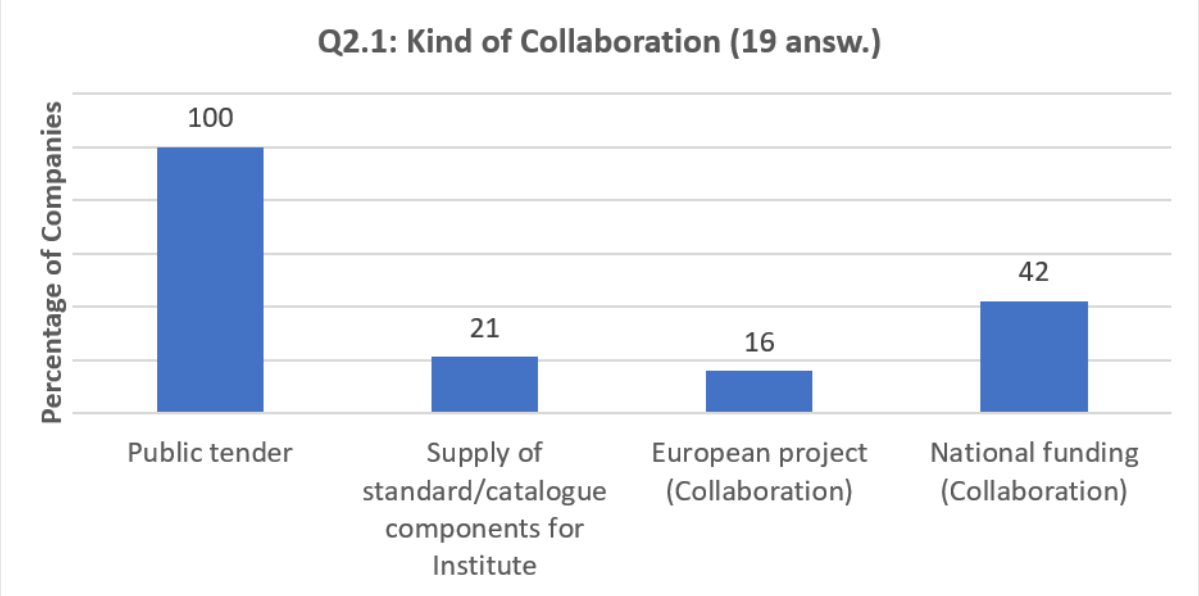


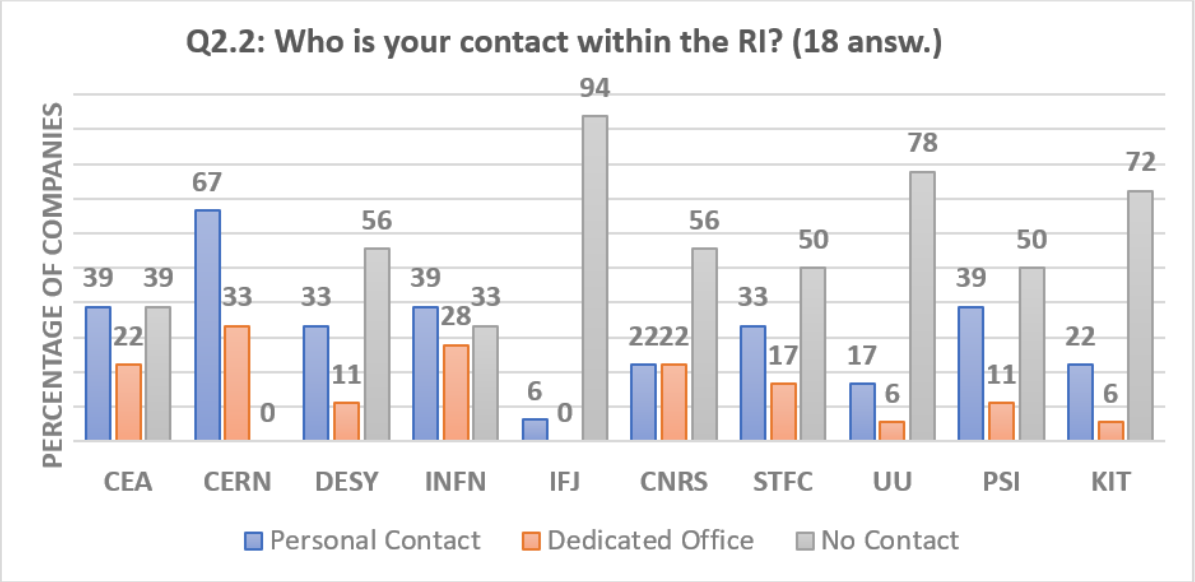


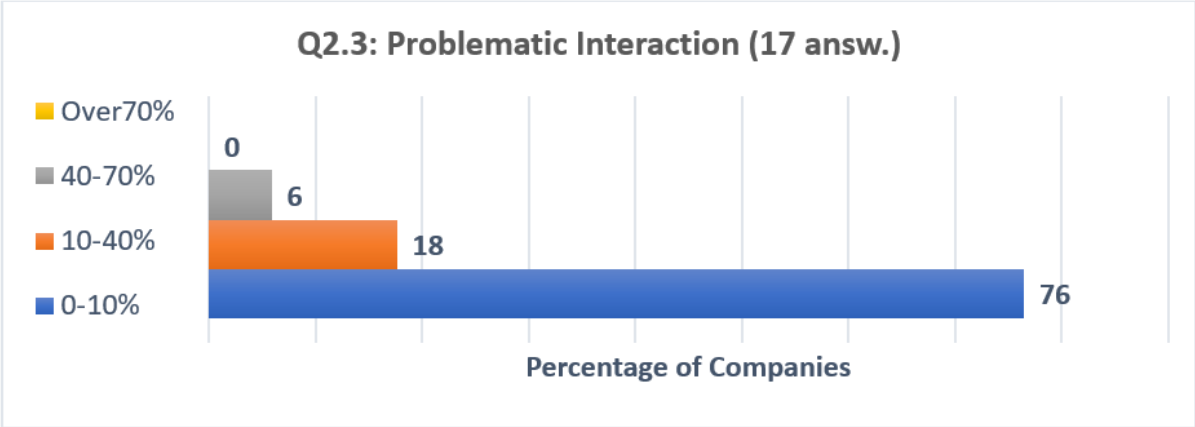

Q1.7, Q1.8: Personel Dedicated to R&D (19 answ.)
% R&D persnell
50.00
6.25
20.00
7.69
10.26
0.00
19.05
23.73
6.40
0.00
1.76
11.11
3.76
2.50
20.00
10.00
6.36
9.32
10.00
6
48
50
65
78
85
105
118
125
156
170
180
186
200
250
300
1100
1770
3000
Number of Employees

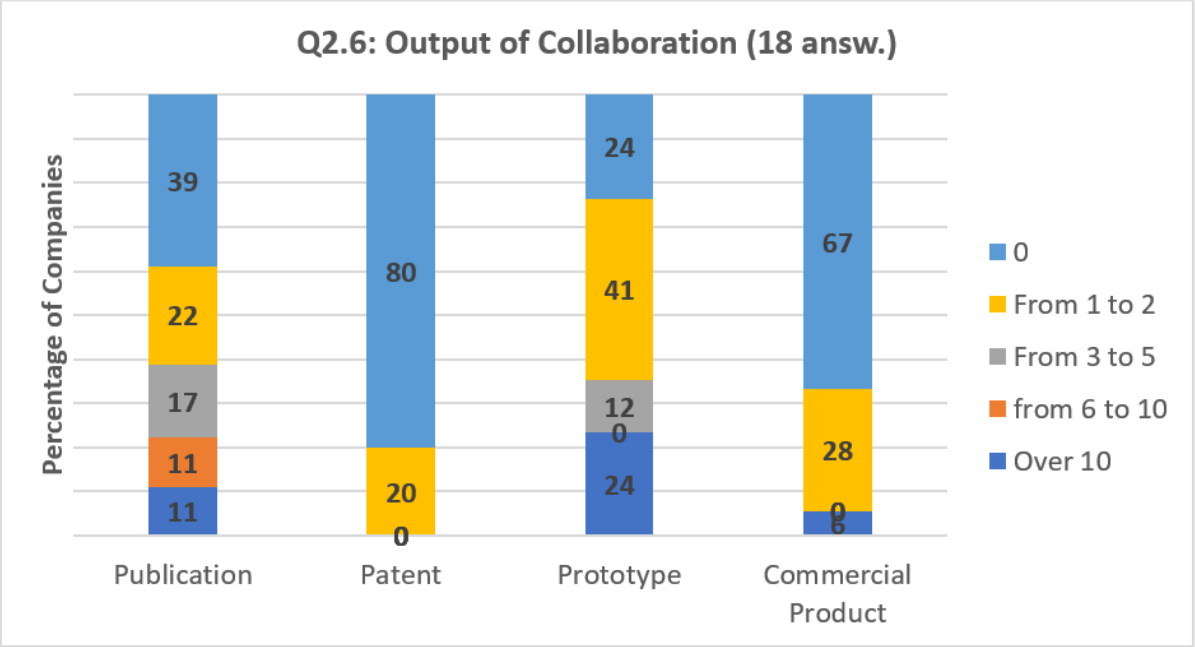

Q1.9: Collaboration With RI (19 answ.)
Percentage of Comapanies
74
95
47
58
0
42
47
11
53
37
CEA
CERN
DESY
INFN
IFJ
CNRS
STFC
UU
PSI
KIT

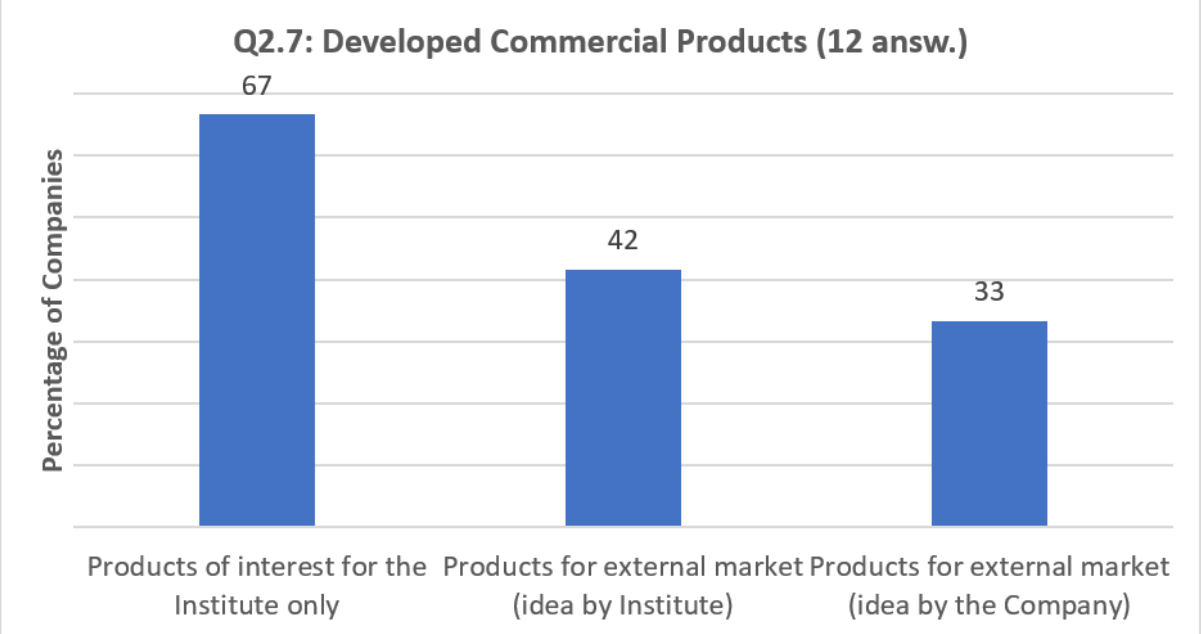

Q1.10: Kind of Business (18 answ.)
% of Companies
28
89
39
6
17
39
22
Standard Supply
Development including design
Build to print
Special components from Institute
Use of Technical Platforms
Research Coll.
Licensing

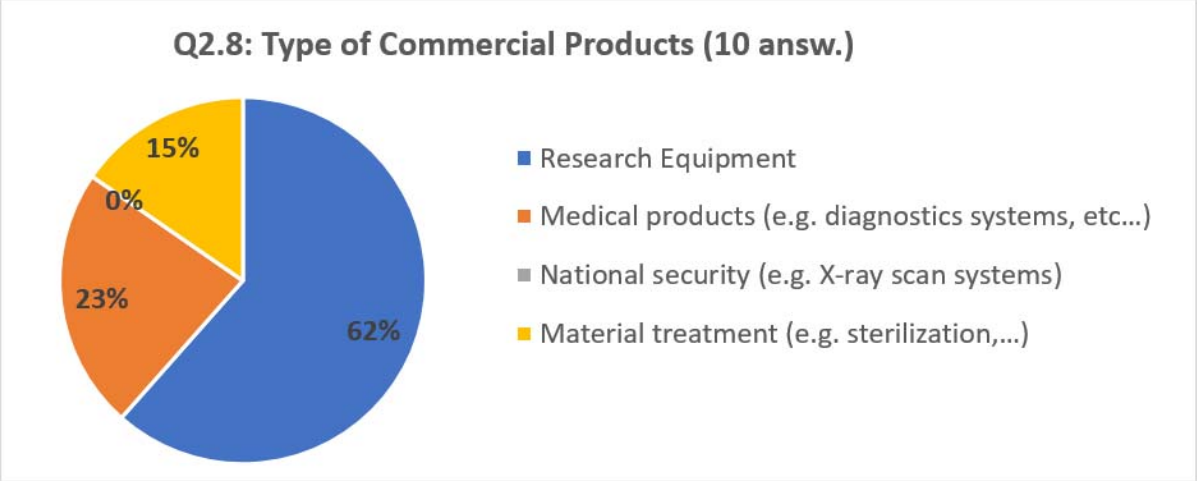

Q2.1: Kind of Collaboration (19 answ.)
Percentage of Companies
100
21
16
42
Public tender
Supply of standard/catalogue components for Institute
European project (Collaboration)
National funding (Collaboration)


Q2.2: Who is your contact within the RI? (18 answ.)
PERCENTAGE OF COMPANIES
39 22 39
67 33 0
33 11 56
39 28 33
6 0 94
2222 56
33 17 50
17 6 78
39 11 50
22 6 72
CEA
CERN
DESY
INFN
IFJ
CNRS
STFC
UU
PSI
KIT
Personal Contact
Dedicated Office
No Contact

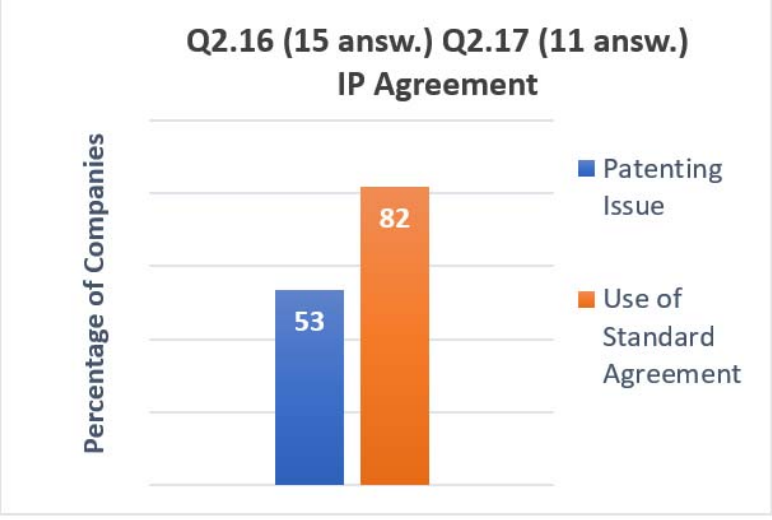

Q2.3: Problematic Interaction (17 answ.)
Over70%
40-70%
10-40%
0-10%
0
6
18
76
Percentage of Companies

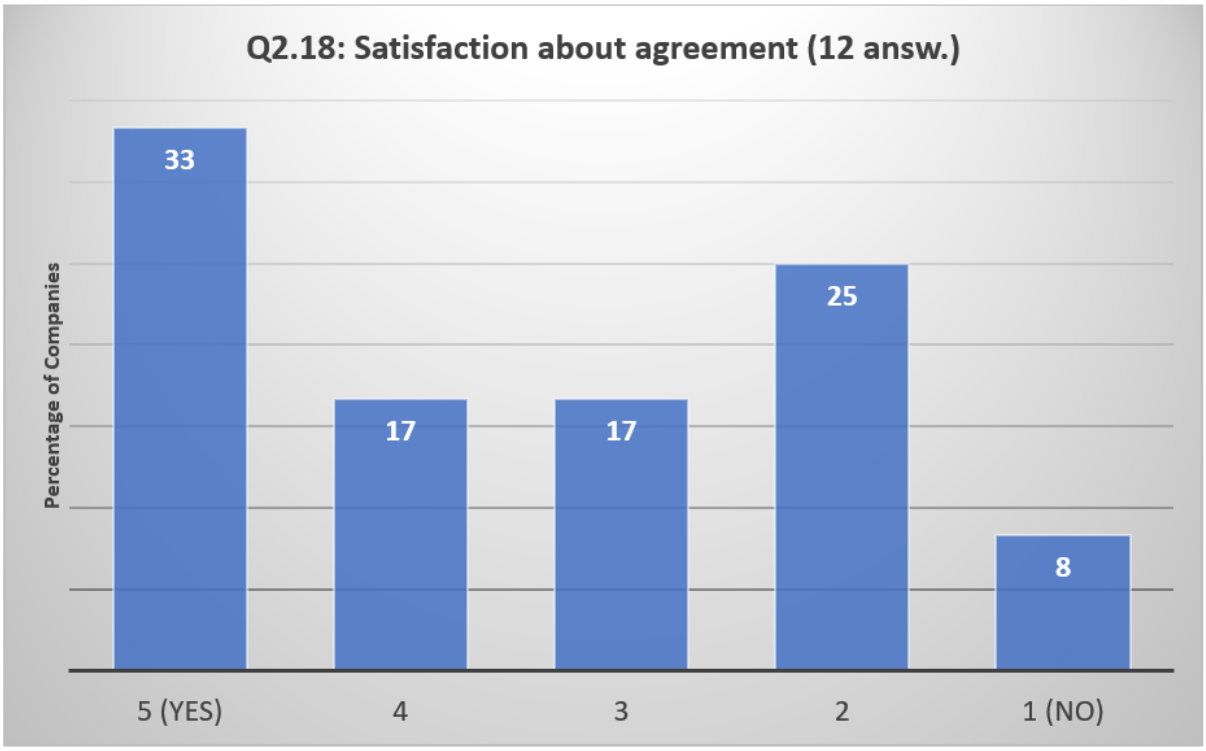

Q2.6: Output of Collaboration (18 answ.)
Percentage of Companies
39
22
17
11
11
80
20
0
24
41
12
0
24
67
28
0
6
Publication
Patent
Prototype
Commercial Product
0
From 1 to 2
From 3 to 5
from 6 to 10
Over 10

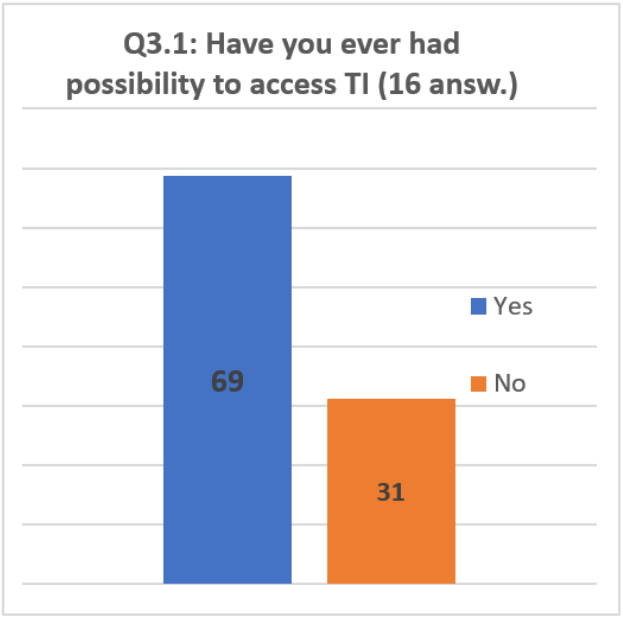

Q2.7: Developed Commercial Products (12 answ.)
Percentage of Companies
67
42
33
Products of interest for the Institute only
Products for external market (idea by Institute)
Products for external market (idea by the Company)

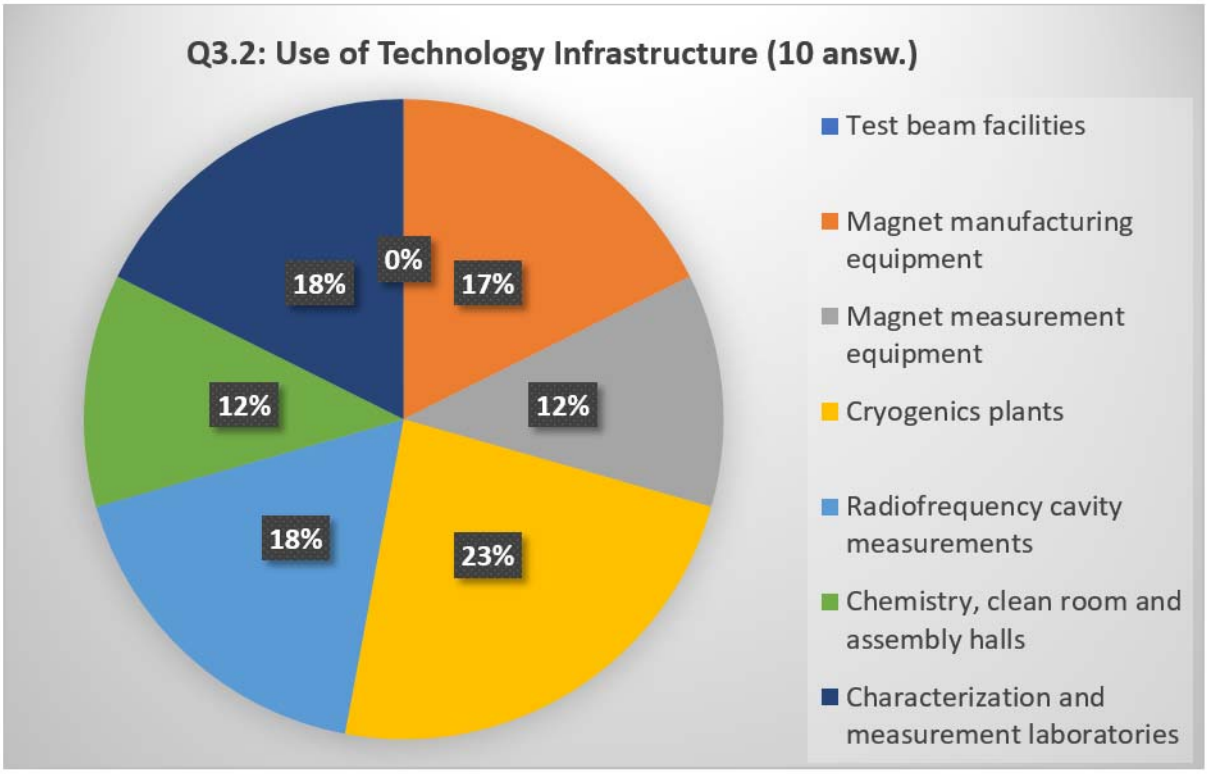

Q2.8: Type of Commercial Products (10 answ.)
15%
0%
23%
62%
Research Equipment
Medical products (e.g. diagnostics systems, etc...)
National security (e.g. X-ray scan systems)
Material treatment (e.g. sterilization,...)

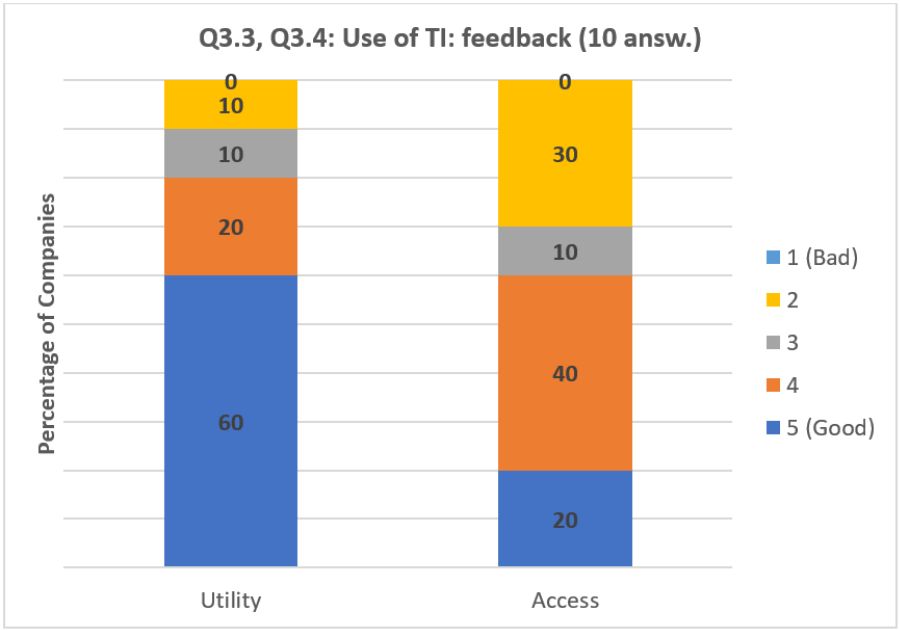

Q2.9: Personnel Involved in Collaboration... who pay for them? (11 answ.)
The Company
The Research Institute
A Co-Financing Programme
25%
8%
67%

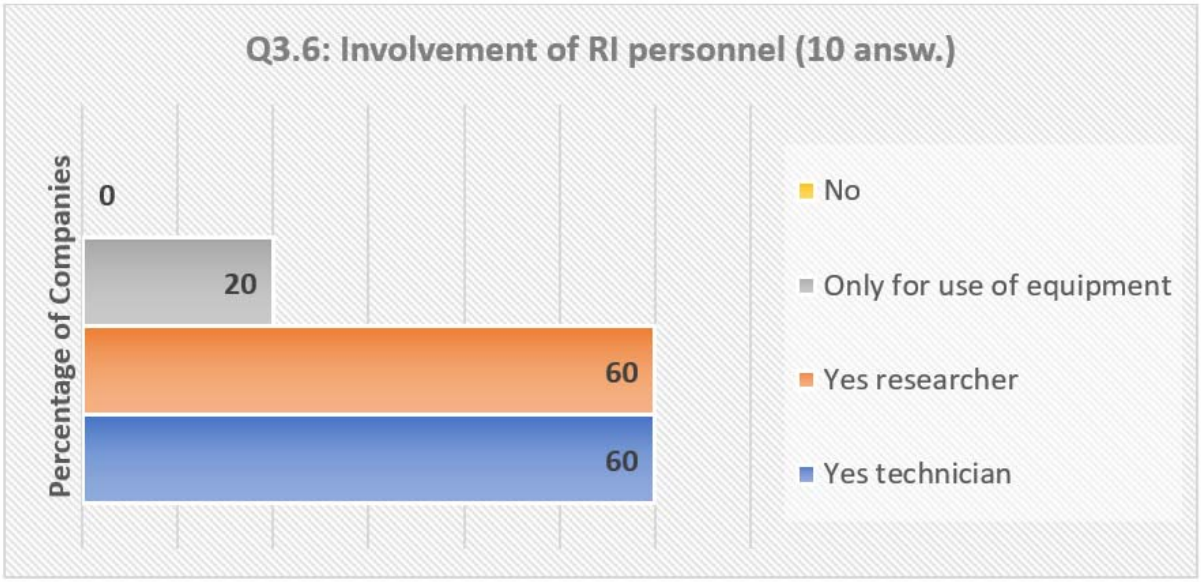

Q2.16 (15 answ.) Q2.17 (11 answ.)
IP Agreement
Percentage of Companies
53
82
Patenting Issue
Use of Standard Agreement

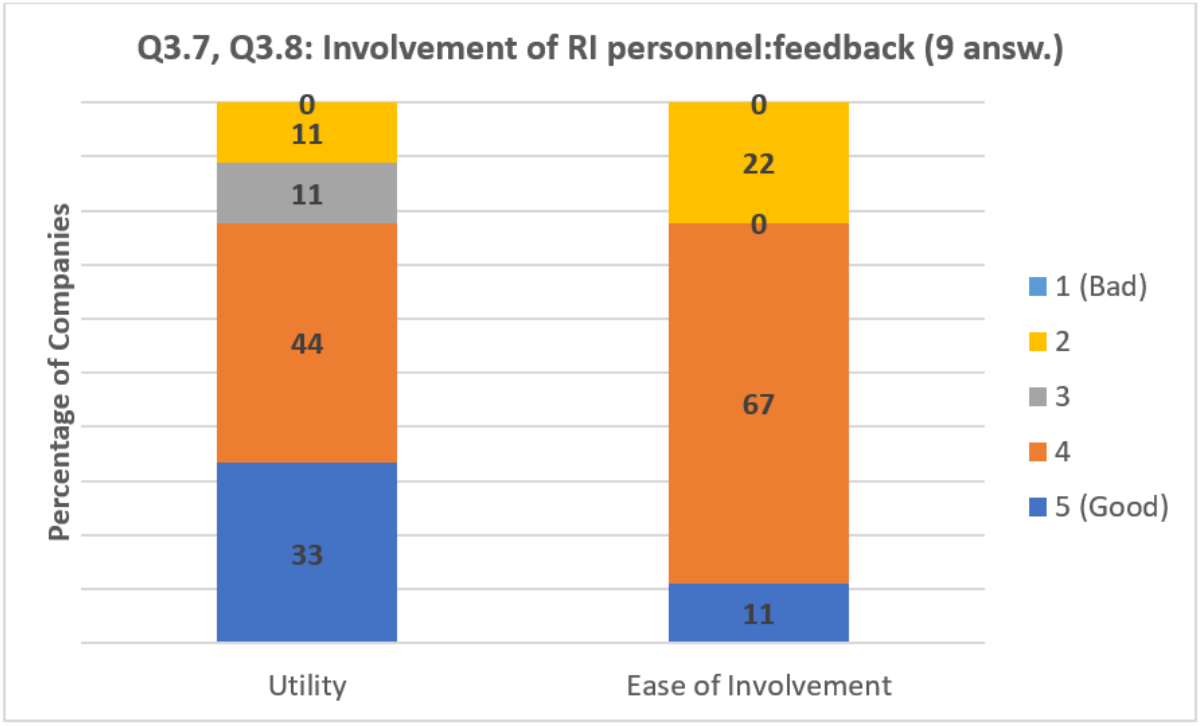

Q2.18: Satisfaction about agreement (12 answ.)
Percentage of Companies
33
17
17
25
8
5 (YES)
4
3
2
1 (NO)

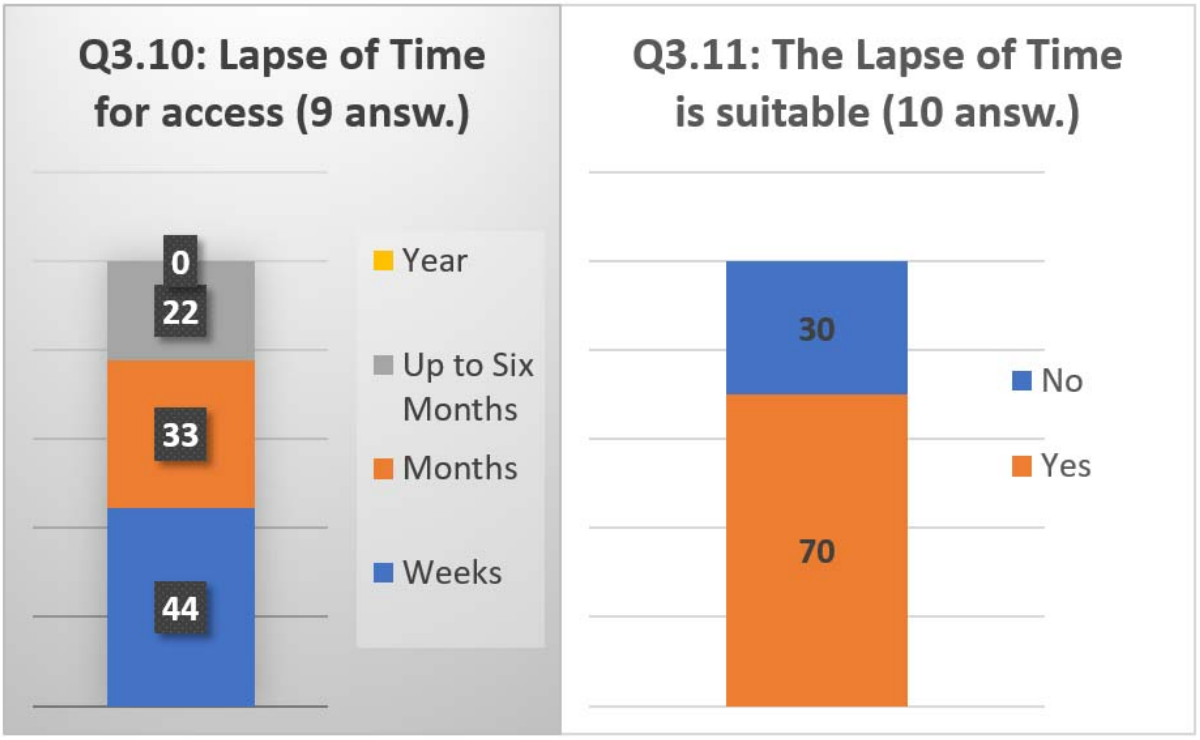

Q3.1: Have you ever had possibility to access TI (16 answ.)
69
31
Yes
No

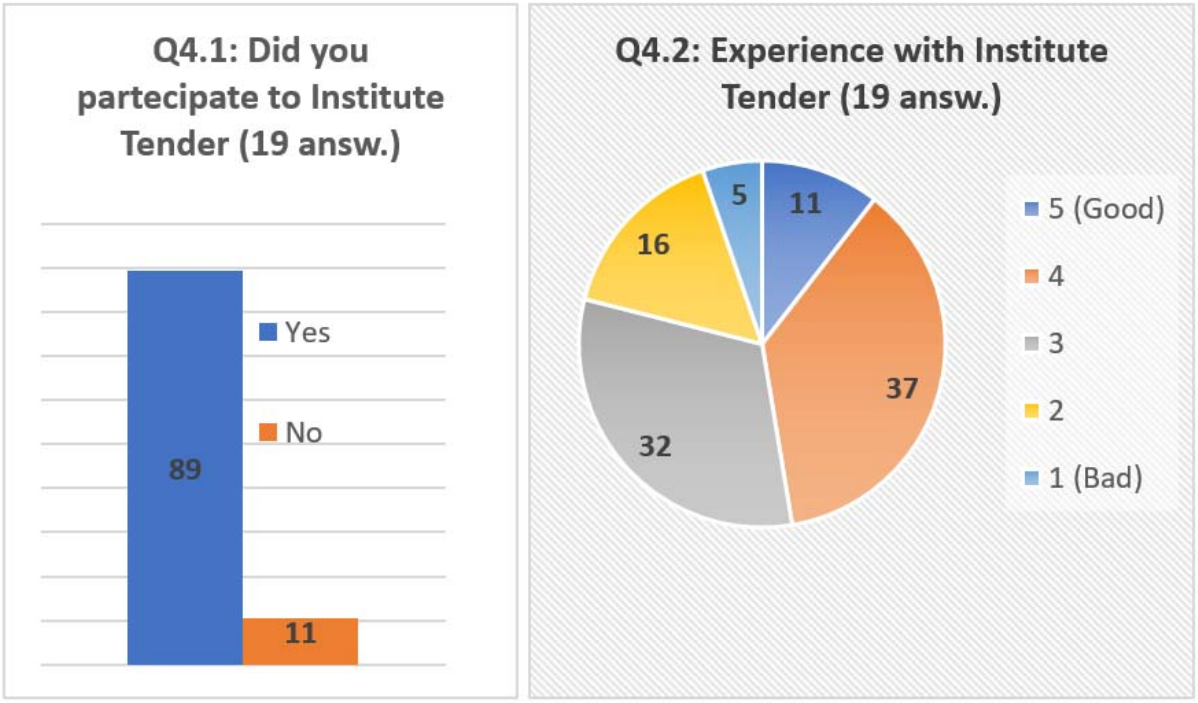

Q3.2: Use of Technology Infrastructure (10 answ.)
0%
17%
12%
23%
18%
12%
18%
Test beam facilities
Magnet manufacturing equipment
Magnet measurement equipment
Cryogenics plants
Radiofrequency cavity measurements
Chemistry, clean room and assembly halls
Characterization and measurement laboratories

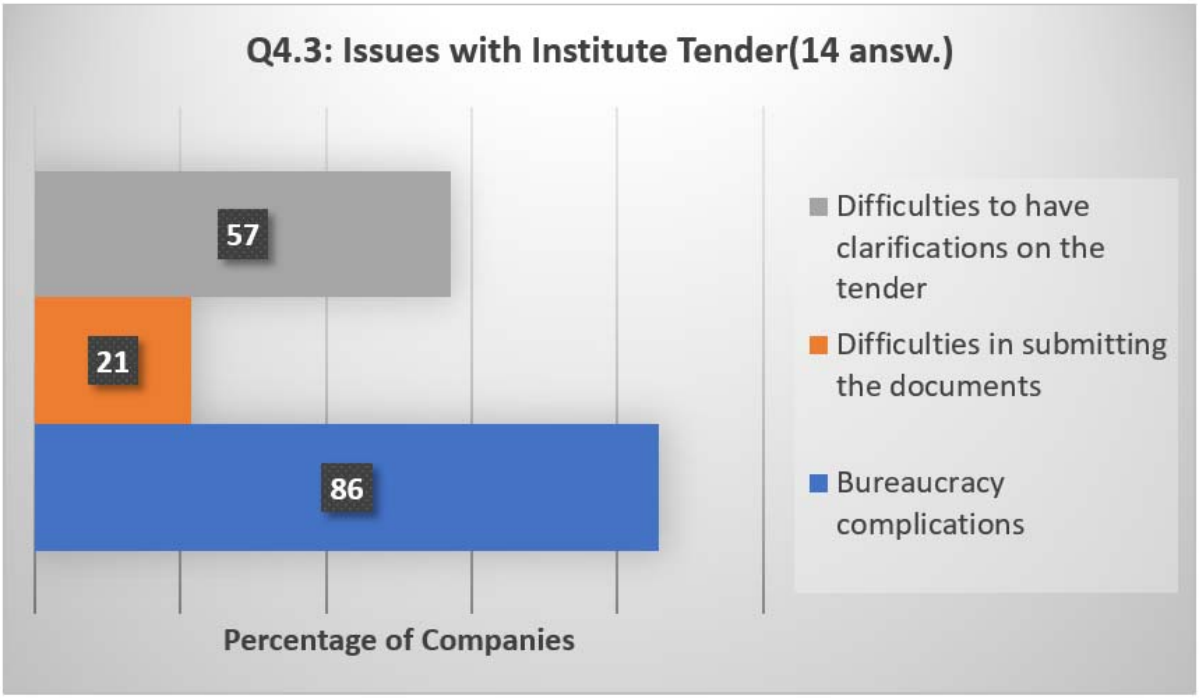

Q3.3, Q3.4: Use of TI: feedback (10 answ.)
Percentage of Companies
0
10
10
20
60
0
30
10
40
20
Utility
Access
1 (Bad)
2
3
4
5 (Good)

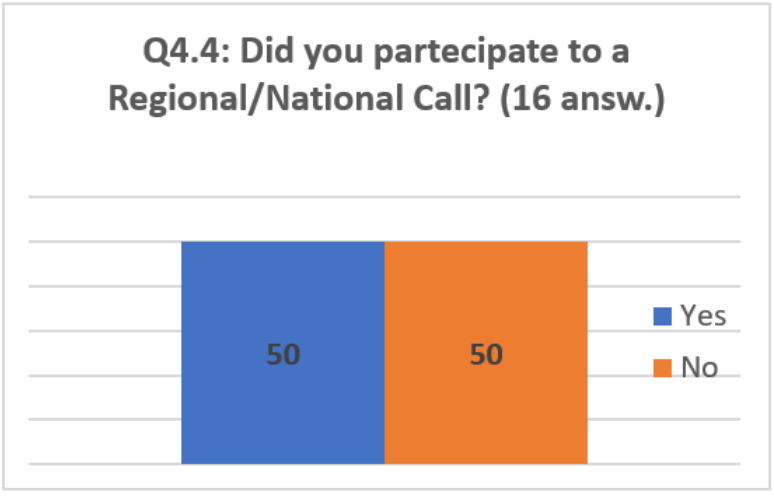

Q3.6: Involvement of RI personnel (10 answ.)
Percentage of Companies
0
20
60
60
No
Only for use of equipment
Yes researcher
Yes technician

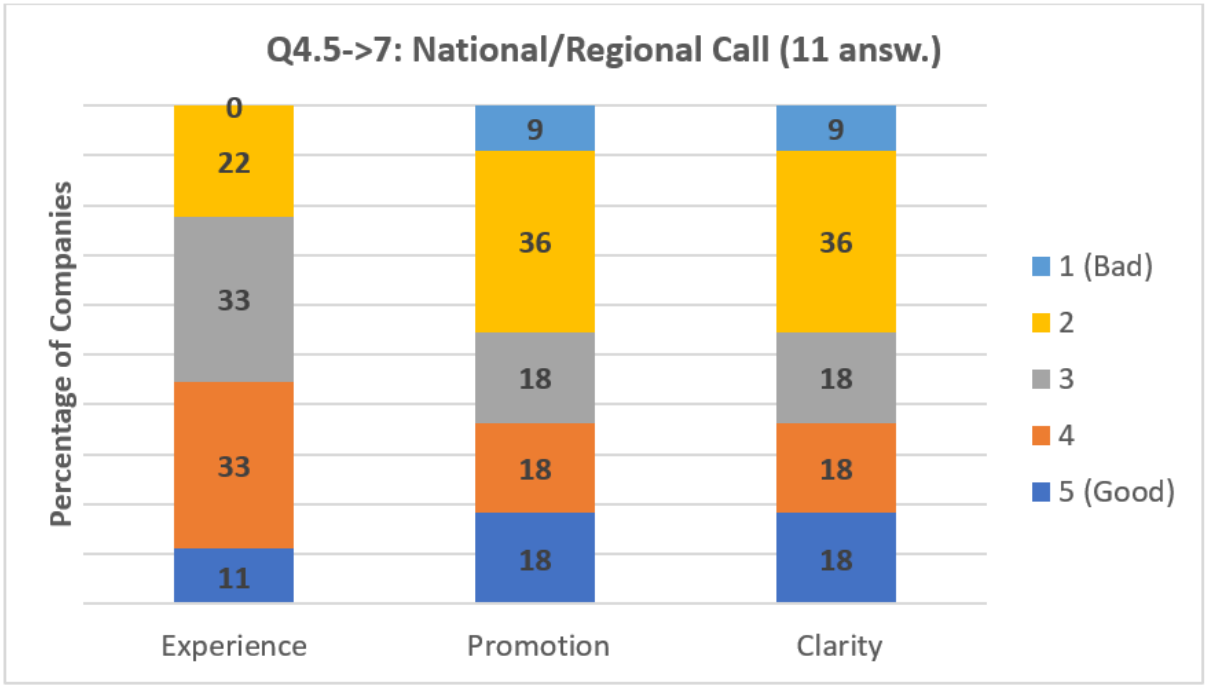

Q3.7, Q3.8: Involvement of RI personnel:feedback (9 answ.)
Percentage of Companies
0
11
11
44
33
0
22
0
67
11
1 (Bad)
2
3
4
5 (Good)
Utility
Ease of Involvement

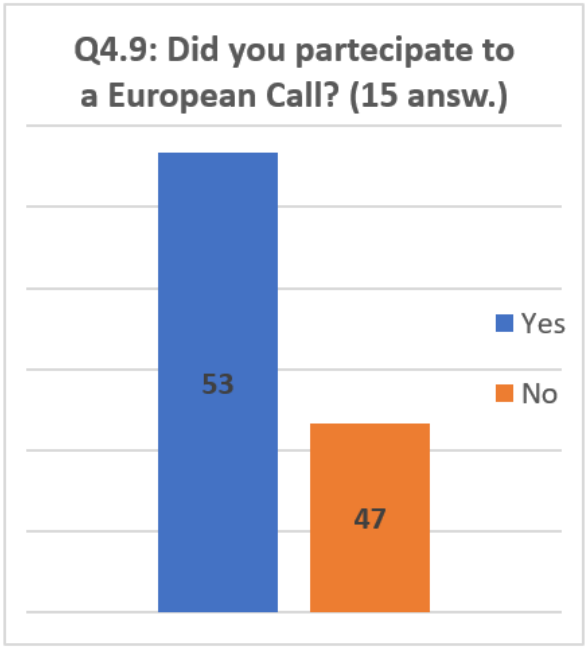

Q3.10: Lapse of Time for access (9 answ.)
0
22
33
44
Year
Up to Six Months
Months
Weeks
Q3.11: The Lapse of Time is suitable (10 answ.)
30
70
No
Yes

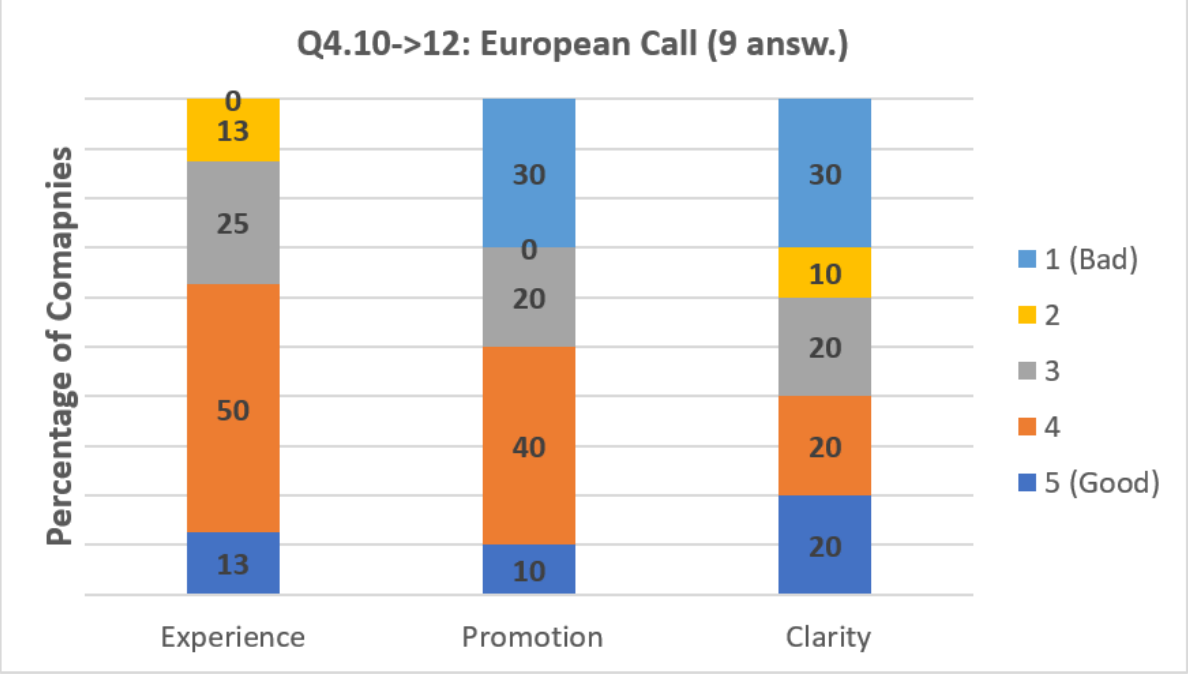

Q4.1: Did you partecipate to Institute Tender (19 answ.)
89
11
Yes
No
Q4.2: Experience with Institute Tender (19 answ.)
11
37
32
16
5
5 (Good)
4
3
2
1 (Bad)

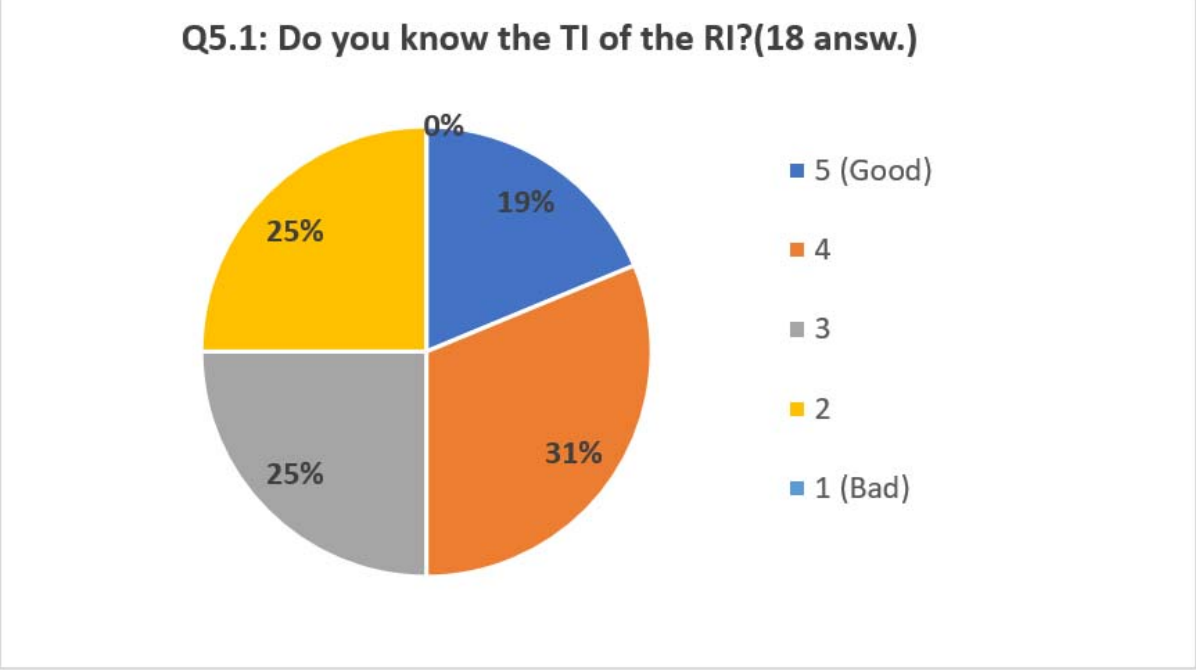

Q4.3: Issues with Institute Tender(14 answ.)
57
21
86
Difficulties to have clarifications on the tender
Difficulties in submitting the documents
Bureaucracy complications
Percentage of Companies

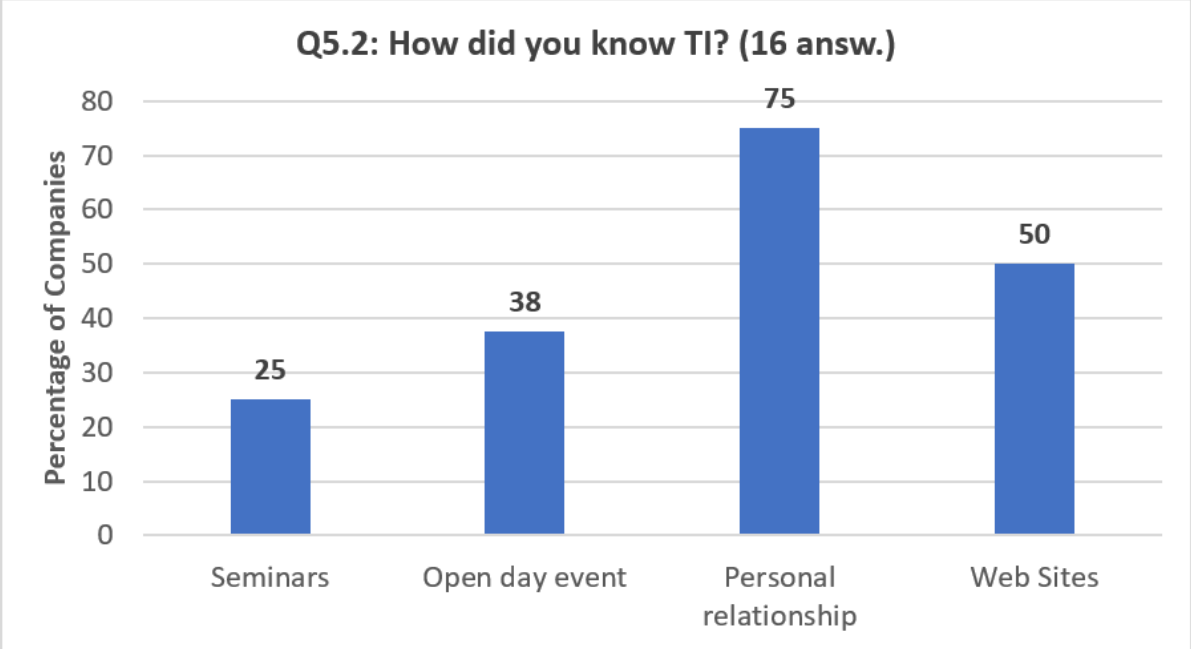

Q4.4: Did you partecipate to a Regional/National Call? (16 answ.)
50
50
Yes
No

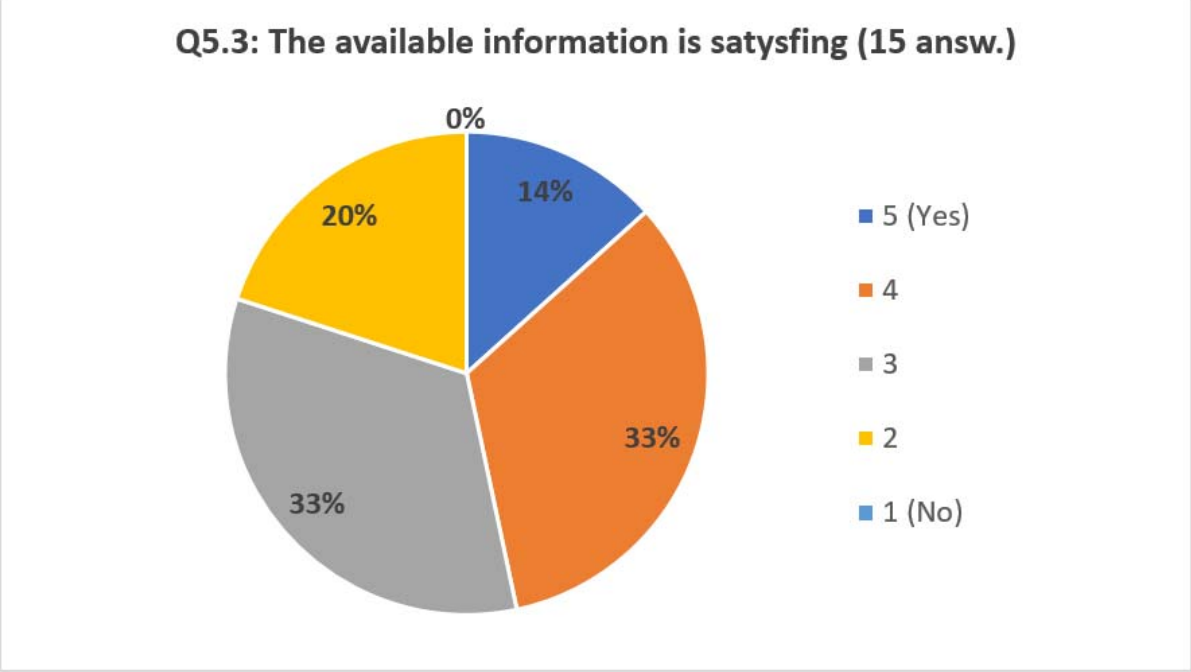

Q4.5->7: National/Regional Call (11 answ.)
Percentage of Companies
0
22
33
33
11
9
36
18
18
18
9
36
18
18
18
Experience
Promotion
Clarity
1 (Bad)
2
3
4
5 (Good)

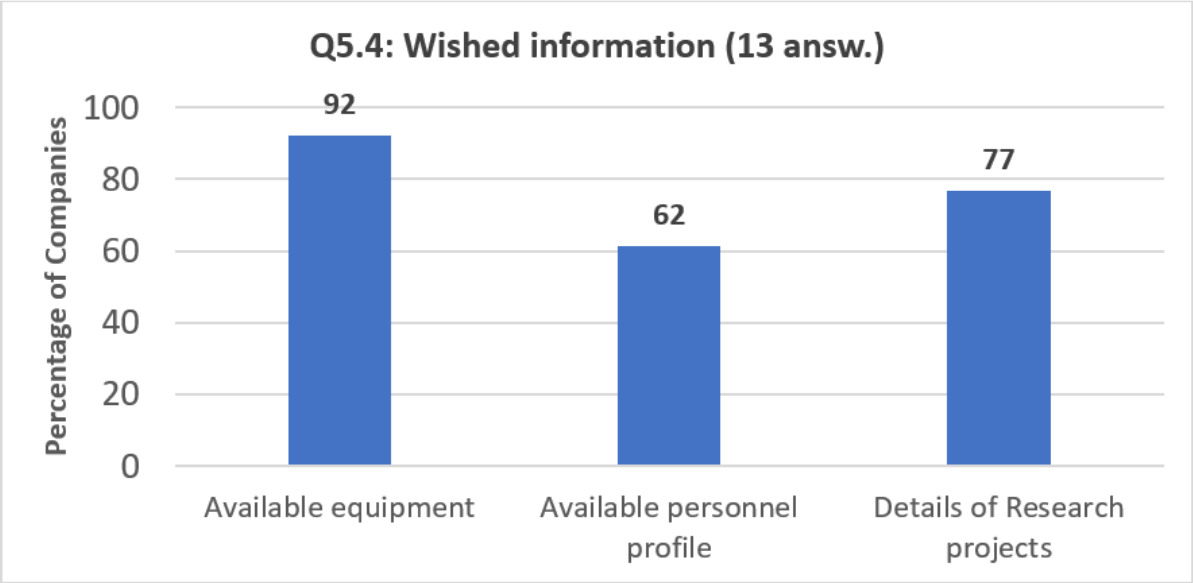

Q4.9: Did you partecipate to a European Call? (15 answ.)
53
47
Yes
No


Q4.10->12: European Call (9 answ.)
Percentage of Comapnies
0
13
25
50
13
30
0
20
40
10
30
10
20
20
20
Experience
Promotion
Clarity
1 (Bad)
2
3
4
5 (Good)


Q5.1: Do you know the TI of the RI?(18 answ.)
0%
19%
25%
31%
25%
5 (Good)
4
3
2
1 (Bad)


Q5.2: How did you know TI? (16 answ.)
Percentage of Companies
80
70
60
50
40
30
20
10
0
25
38
75
50
Seminars
Open day event
Personal relationship
Web Sites


Q5.3: The available information is satysfing (15 answ.)
0%
14%
20%
33%
33%
5 (Yes)
4
3
2
1 (No)


Q5.4: Wished information (13 answ.)
Percentage of Companies
100
80
60
40
20
0
92
62
77
Available equipment
Available personnel profile
Details of Research projects