*NETWATCH - Development of a Central Information Platform on Transnational R&D Programme Collaboration - Operational Phase*

# Deliverable 3.3.1

# Options for Assessing the Impact of the ERA-NET Scheme: an exploration of methodological approaches

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## Executive Summary

The NETWATCH on-line platform collects information in support of analysis of transnational research programme cooperation. Its content centres on ERA-NETs and ERA-NET Plus, however, information is also collected on Article 185s and networks that continue but no longer receive EU support (known as self-sustaining networks). The information collected is used to map and monitor the transnational research programme landscape and to produce policy briefs on issues pertinent to the policy debate, which are also published on the platform.

This report constitutes the first NETWATCH impact assessment and focuses on ERA-NETs and the development of an approach to assess their impact against the policy goals, including wider European Research Area (ERA) objectives.

### Rationale

The ERA-NET scheme started under the Sixth Framework Programme (FP6) and continued into the Seventh Framework Programme (FP7). There is now more than a decade of experience with the ERA-NET scheme.

Understanding the impact of the ERA-NET scheme is particularly important in light of its contribution within the evolving policy context. Under the Innovation Union flagship initiative, ERA-NET can be seen a part of a suite of transnational cooperation schemes within a broader innovation arch including research and innovation schemes focused further upstream. The ERA-NET scheme under Horizon 2020 will integrate ERA-NET and ERA-NET Plus. It is also envisaged to complement the activities of Joint Programming Initiatives (JPI).

Furthermore, the European Commission (EC) published a Communication in July 2012 that again gives renewed impetus to ERA with the stated aim of its completion by 2014. With this set of goals for ERA transnational coordination of research is prominent, a role for which ERA-NETs were designed.

All these developments highlight a need to understand better the impact of ERA-NETs. NETWATCH has already accumulated substantial information on transnational research programme collaboration. While data have been collected mainly to support mapping and monitoring of the European collaboration landscape, they also serve well the purpose of impact assessment (IA). This report therefore also assesses the relevance of the NETWATCH data in the context of an IA, proposes methodological approaches to make optimal use of the available data, proposes ways to complement it with other data and suggests some adjustments to optimise future data collection within NETWATCH. The results of pilot analysis to assess the utility of the methods for further assessment of the impact of the ERA-NET scheme are also presented.

### Context and evaluative questions

While the focus of this report is the ERA-NET scheme, account should be taken of the relative overall size of the scheme. Analysis presented in this report based on NETWATCH and EUROSTAT data shows that ERA-NETs account for a very limited proportion of national research budgets.

The EU objectives for the scheme have been consistent since the beginning of FP6. In essence, the high-level goals of the scheme are based on the ERA objectives of reducing fragmentation and increasing critical mass. Fragmentation is the consequence of research policies of Member States leading to unnecessary duplication of effort, while individual countries may not have the critical

mass of resources needed to address a particular issue. ERA-NETs were conceived to overcome this dilemma through close coordination between those national organisations that fund and manage research programmes. The mutual opening-up of research programmes to greater transnational cooperation was to be realised through a four-step process: mutual learning of the different national and organisational procedures and determination of best practices; analysis of common issues; development of joint activities; and greater coordination and the alignment of procedures during the implementation of joint transnational research activities.

To assess the impact of ERA-net schemes, various assessment dimensions need to be addressed, with different possible approaches for each dimension. Dimensions of assessment include: the level of impact (on policy, societal challenges or the research); the unit of analysis (the scheme, the network, the organisations or the researchers); and the dimensions of coordination that ERA-NETs address (systemic, horizontal, vertical and temporal[1]).

This first impact assessment exercise focuses on the policy level, essentially seeking to determine the extent to which actions have addressed policy objectives as intended. This is particularly pertinent in light of the evolution of EU policies with regard to the ERA and the Innovation Union, as outlined above.

On the basis of NETWATCH information (on participants, thematic dimensions, objectives and activities), the main focus of analysis is on the networks created by the instrument. There are two levels within the network dimension to be assessed:

- At the **network level** the network characteristics are addressed aim at answering how they are structured across the ERA, how they change over time (including from FP6 to FP7), and the differences evident between research areas.
- At the **implementation level** there is the assessment of the activities that have been undertaken and what have been the outputs and outcomes.

Overall a framework for the assessment has been created to guide the IA, inspired by an intervention logic. The framework includes the identification of the ERA objectives, the rationale for the ERA-NETs, and the objectives of the scheme. The principle task is then the identification of the resultant outputs and outcomes, the impact of which is to contribute to the realisation of the policy objectives. The experience gained by using the methods described below, with the results of some pilot analysis, will feed back into further refinement of the framework.

### Methodological Approach

In order to address the full complexity of the issues, a mixed method approach has been used, combining both quantitative and qualitative analytical approaches. The quantitative analysis is descriptive in character, but provides a starting point for further analysis of causal links between outputs and impacts to be addressed in later work. While the NETWATCH platform forms the basis for this analytical work it does not currently provide all the information required. Therefore, NETWATCH information is supplemented with information from other sources.

The information available on the NETWATCH platform can address issues such as participation in the networks and how this has changed over time (from FP6 to FP7). The structure of the information collected by NETWATCH also allows the identification and analysis of links based on

[1] NETWATCH Policy Brief No. 2.: http://netwatch.jrc.ec.europa.eu/-/netwatch-policy-brief-no-2-published

the participation of organisations in ERA-NETs. Network analysis is therefore proposed and tested in order to determine collaboration patterns between organisations, the evolution from FP6 to FP7, the key players in the networks beyond descriptive counting and ranking of frequency of participation.

Beyond NETWATCH data, it is proposed to use available data on envisaged and achieved outputs of ERA-NETs, such as the projects' Descriptions of Work (DoW), their Strategic Research Agendas and the final reports (for finished project). The information contained in NETWATCH on the continuation of networks, which can effectively be assumed as a proxy for sustainability, is combined with the DoW and final reports to analyse the dimensions of coordination and alignment that ERA-NETs can impact upon in networks that have the tendency towards sustainability.

This report also proposes a method and presents a pilot using the ERA-NET outputs (DoW and final reports) to determine progress along the four steps of the scheme[2], analysing whether or not the activities have actually been undertaken. This assumes that network participants undertaking activities in step four are more open to transnational cooperation activities (there is greater alignment that allow them undertake such activities). This degree of "maturity" towards the implementation of joint activities can be broken down into research areas to determine those areas in Europe demonstrating the greatest maturity, and where the organisation has the structures and procedures that allow the degree of openness to participate successfully in transnational programme cooperation.

**Main findings from pilot analysis**

The analysis of information collected by NETWATCH demonstrates that there is a greater spread of countries involved in ERA-NETs from FP6 to FP7 as number of countries from FP6 to FP7 increased at greater rate than the number of organisations. This is not unexpected, as several countries have joined the EU and become associated during this time frame. Participation of the larger countries dominates in FP6 and this is repeated in FP7, albeit with a slight decrease in the proportion of networks in which they are involved. For the self-sustained networks, the larger countries with more research resources dominate. This suggests that ERA-NETs do have a major impact on supporting transnational research programme cooperation, as without it organisations in many countries cannot participate in such activities.

The use of network analysis techniques suggests that there is a decrease in fragmentation from FP6 to FP7 according to the comparison of respective structural network measures. However, there are evident disparities between research fields. A case study of the health research field suggests ERA-NET participation improves the connectivity. Further analysis could determine whether the participants are representative of the major funding organisations in health research in Europe.

With regard to impacts beyond the core objectives of the instrument, a selected test analysis suggests that ERA-NETs can contribute to improving trust, confidence and skills of partners. They can also have impacts that go beyond research and support integration to a large extent in the innovation chain in a specific area, involving industry in priority setting, call preparation, proposal evaluations. Through the active involvement of SME's, ERA-NETs can also support entrepreneurship. The test study also indicates that ERA-NETs can have substantial impacts on the different dimensions of the European Research Area, e.g. with regard to training and mobility of researchers, alignment of international standards, and internationalisation in R&D&I.

[2] The four steps are; exchange of information and good practices; identification and analysis of common strategic issues; development of joint activities; and implementation of joint transnational research activities.

The implementation of joint calls and the exchange of information rank highly as important activities for ERA-NETs based on NETWATCH information. However, assessment of the extent to which activities have been undertaken and the precise nature of outputs and outcomes require supplementary information from the final reports. NETWATCH can be adapted to address this issue to improve both its utility as an "ongoing" impact assessment tool and the mapping and monitoring function.

**Conclusions**

The methodological approaches used in this study have produced initial results that suggest there is clearly potential for further work to study the impact of ERA-NETs. In light of the experiences from the work conducted for this report, the assessment framework and evaluative questions can be refined and the techniques used to answers the questions further developed.

Qualitative analysis on cases also suggests that there is impact beyond the core objectives of ERA-NETs. The pilot study suggests that there are links to innovation, involvement of private sector (esp. SME's), mobility and availability of researchers, etc.

This report has explored novel approaches within the context of this topic. Network analysis has exploited NETWATCH information and is a technique that can be further applied to analyse the type of networks.

The qualitative case study approach proposed and piloted in this report can also be further exploited to understand more precisely what ERA-NETs produce in terms of outputs and the degree to which they impact and support the various dimensions of transnational research programme cooperation.

With regard to data collection on NETWATCH, two important issues have emerged:

- There is a need to review data collection in NETWATCH: there are issues with regard to data quality (e.g. joint call budgets), with regard to the nature of the data collected (data on opinions could be replaced by data on activities), and with regard to the way data are collected (active data input versus passive data correction by co-ordinators).
- Proposal to adapt progressively some data fields to new data needs.

# 1. Introduction: Goals, Rationale and Content

This report is the formal deliverable D3.3.1 "First Impact Assessment Report" of Work Package 3 "Development and use of an analytical framework to map, monitor and assess transnational R&D programme collaboration across Europe" of the NETWATCH Operational Phase Specific Support Action. It has been prepared by the Institute for Prospective Technological Studies (IPTS), one of the seven scientific institutes of the European Commission's Joint Research Centre (JRC).

The work undertaken, and presented in this report, explores the methodological options for assessment of the impact of the ERA-NET scheme. The findings provide a basis for the design and implementation of the impact assessment exercise to be presented in the second impact assessment report (D3.3.2). This report defines and evaluates the prospective approach and its limits, assess the results of pilot actions to determine the utility of the approach in addressing the evaluative questions.

Through NETWATCH, JRC-IPTS aims to provide analysis relevant to the ERA-NET scheme, both with regard to monitoring and impact assessment. Only one comprehensive impact assessment of the ERA-NET scheme has so far been completed. The study focussed on 71 ERA-nets launched under FP6 (2002-2006)[3]. The overall conclusion of this study was that the scheme had been successful in relation to its original objectives of fostering the cooperation and coordination of national or regional research programmes. Currently (December 2012), the end of FP7 is approaching, and discussions are on going to finalise its successor, Horizon 2020. Through FP6 and FP7, there is over a decade of experience with the ERA-NET scheme and it is an appropriate time to consider again questions related to the impact of the scheme.

Based on relevant JRC-IPTS work[4], the assessment of the impacts of the ERA-NET scheme should ideally centre on the following tasks:

- Set the framework and the broad methodological approach of the analysis with the main evaluative questions;
    - Identification of relevant levels of analysis with respect to specific outcomes;
    - Highlight data gaps and supplementary data collection needs for the assessment and provide recommendations for the future development of the NETWATCH platform to address better the needs of an impact assessment on ERA-NETs (and other forms of transnational programme collaboration).
- Presentation and analysis of the ERA-NET network landscape, structure and participation patterns, i.e. *status quo*, and changes across time;
- Development of an overview of the "maturity"[5] of specific ERA-NETs and identifying the main patterns characterizing ERA-NETs in particular research fields or sectors;

[3] Matrix Insight & Rambøll (2009), "Evaluation and impact assessment of the ERA-NET scheme and the related ERA-NET actions under the 6th Framework Programme" [Volume 1] (Final Version, May 2009). Available at: http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/fp6_era-net_evaluation_-_final_report_-_volume_1.pdf.

[4] Cuntz, A. (2011), "*Evaluation of Socio-Economic impact in the EU: Evidence from ERAWATCH*", Luxembourg: EC-JRC-IPTS (JRC66340); available at http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=4659

[5] Maturity can be defined by the distance to a self-sustainable transnational programme. The less the distance is the more the ERA net is "mature". The ERA-nets scheme follows a four steps process until the launch of joint calls and the setting up of a transnational programme (meaning the alignment of national policies of a group of countries in specific research fields or sectors)

- Development of an overview of the main achievements of ERA-NETs and remaining barriers to transnational activities in each research fields or sectors.

Based on the background to the scheme, and the tasks outlined above, it is possible to formulate the following, broad, initial key evaluative questions:

1. How important is the ERA-NET scheme compared to other EU or national level funding activities? (the position of ERA-nets in the Research landscape)
2. What are the outputs and outcomes of the main ERA-NET activities?
3. Are there any significant, structural changes within and between ERA-NETS (particularly between FP6 and FP7)?
4. Are networks becoming more efficient in identifying and exploiting opportunities for information exchange and learning?
5. How does participation in a network promote transnational research cooperation?

The first of the above questions provides some context by assessing the position of the ERA-NET scheme within the broader European research landscape (Section 2.1). Questions two to five are further developed in Section 3.

An important element in the assessment of the impacts of the ERA-NET scheme is the degree to which they align and are consistent with the original objectives of the scheme. A framework for the assessment has therefore been devised on this basis[6]. The over-arching objective is the contribution to ERA (section 2): the reduction of fragmentation and increased coordination, to have a single more efficient area where there is no unnecessary duplication of effort of both policy initiatives and research activities. However, as national organisations are the principal actors in ERA-NETs, consideration also needs to be given to strategic policies of the Member States towards ERA-NET participation.

After describing the scope of the impact assessment analysis and the data sources (Section 3) the report sets out the broad methodological approach to be tested. Section 4 presents the methodological options in more detail, including network analysis based on NETWATCH data, as well as analysis of information obtained from complementary sources. Findings for each methodological approach are also presented together with an assessment of the approach in relation to the issues being investigated. The report concludes with the overall findings, this includes the results concerning the pilot analyses assessing the impact of the ERA-NETs, the evaluation of the methodological approaches used, and the lessons learned and considerations for a fuller impact assessment (Section 5).

[6] NETWATCH I: Deliverable 3.1, S.E. Perez and H.G. Schwarz (2008), "Developing an analytical framework for mapping, monitoring and assessing transnational R&D collaboration in Europe: The case of the ERA-NETs", JRC-IPTS (Version 15/12/2008).

# 2. Mutual learning, joint coordination, and opening up

The success of a policy intervention should to a large extent, but not exclusively, be measured against the degree to which the policy objectives have been realised. The ERA-NETs were designed to contribute to the construction of a European Research Area (ERA). The following *High-level* goals of ERA have been articulated:[7]

(1) The creation of an 'internal market' for research, involving the free movement of knowledge, researchers and technology;

(2) The development of a European research policy, taking into account other EU and national policies; and

(3) The restructuring of the fabric of research in Europe via the improved coordination of national and regional research activities and policies.

## *2.1. Objectives, activities undertaken and future developments of ERA-NETs*

In 2007 the European Commission revisited the ERA concept to assess progress and how it could be taken forward. The resulting Green Paper acknowledged achievements, with ERA-NETs noted as a start to address the coordination of national and regional programmes.[8] However it ultimately concluded that *"National and regional research funding (programmes, infrastructures, core funding of research institutions) remains largely uncoordinated*".[9] It is this lack of coordination that they ERA-NET scheme was developed to overcome and the need to increase coordination is accompanied by overcoming fragmentation at policy level and restructuring the fabric of research.

The conceptual framework developed under NETWATCH[10] outlines how these high-level goals correspond to the *intermediate goals* at the following application levels:

- joint coordination of programmes, calls and related activities;
- mutual opening of national and regional programmes; and lastly
- mutual learning.

These three *intermediate goals* are at the core of the ERA-NET scheme's objectives. Mutual learning is to be achieved through the networking of national and regional bodies responsible for research activities so as to learn about the potential for, and to implement, cooperation and coordination activities at the programme level. It should be noted that there can be different interpretations of the concept of mutual opening. Indeed the Impact Assessment of FP6 ERA-NETs distinguished between the two concepts of opening up as follows:

- Opening up of national programmes to fund non-residents.

[7] European Commission (2002), "Communication From the Commission – The European Research Area: providing New Momentum", Brussels, COM(2002)565 final; available at http://ec.europa.eu/research/era/docs/en/ec-understanding-era-7.pdf

[8] European-level coordination of national and regional research activities, programmes and policies is pointed out as crucial for realization of the ERA together with a European 'internal market' for research, where researchers, technology and knowledge can freely circulate (please see European Commission 2007, pp. 6).

[9] European Commission (2007), "The European Research Area: New Perspectives", Green Paper 04.04.2007, COM(2007)161, pp.7; available at http://ec.europa.eu/research/era/docs/en/understanding-era-european-commission-eur22840-161-2007-en.pdf.

[10] Perez, S.E. and H.G. Schwarz (2008) *op cit* p61. .

- Mutual opening up by aligning the rules and procedures for supporting joint activities between programmes from different countries[11].

There is not a requirement, in FP6[12] or FP7[13] ERA-NETs, that non-residents should be funded; however, a real common pot could effectively have such as outcome[14]. Therefore, mutual opening can be seen as a process putting the conditions in place for sustainable transnational cooperation between national research programmes. The programmes are designed, the rules and procedures aligned, and cooperation between national programmes in a given area becomes easier than before the ERA-NET project was undertaken. Therefore, within a given research area there are different programmes that are open in the sense that they can easily cooperate transnationally, implementing joint activities, due to their structural complementarity. This also means that there could be access to programme funds for non-residents (as could occur with a real common pot) but it is not core to ERA-NET scheme.

The ERA-NET four-step process can be seen as a way of progressing from autonomous programmes, through alignment to coordination and joint programmes. The four steps are:

1. Systematic exchange of information and good practices on existing programmes;
2. Identification and analysis of common strategic issues;
3. Development of joint activities between national or regional programmes;
4. Implementation of joint transnational research activities[12].

Following the Commission's 2011 "Partnering in Research and Innovation" Communication[15] it is intended that ERA-NETs and ERA-NET Plus will be merged and ERA-NETs and Article 185s will be used to support JPIs. The partnering communication will be built on under Horizon 2020 so that future coordination between the different forms of programme collaboration schemes is going to increase.

Further impetus was given to the ERA concept with the proposal of a deadline to complete ERA by 2014[16]. The EC Communication on "A Reinforced European Research Area Partnership for Excellence and Growth" points to the success of ERA-NETs and states that the EC will support Public-Public partnerships. The conditions that Member States should aim to create, and for which the impact of ERA-NETs could also be measured against, are:

- Defining common priorities and joint research agendas;

[11] Matrix-Rambøll –Final Draft Report – FP6 ERA-NET Evaluation – Volume 1 - May 2009. Available at: http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/fp6_era-net_evaluation_-_final_report_-_volume_1.pdf.

[12] 2005-2006 Work Programme – Strengthening the foundations of the ERA: 11. Support for the coordination of national, regional and European activities in the field of research and innovation (including ERA-NET).

[13] Work Programme 2013, Cooperation, Annexes 1-5, available at: http://ec.europa.eu/research/participants/portal/ShowDoc/Extensions+Repository/General+Documentation/All+work+programmes/2013/Cooperation/cooperation-general-annexes201301_en.pdf

[14] In a real common pot participants pool their money and the best projects are funded from the pot, irrespective of the country where the project participants are based.

[15] EC Communication on "Partnering in Research and Innovation" (2011). Available at: http://ec.europa.eu/research/era/pdf/partnering_communication.pdf.

[16] EC Communication on "A Reinforced European Research Area Partnership for Excellence and Growth" 17 July 2012. Available at: http://ec.europa.eu/research/era/pdf/era-communication/era-communication_en.pdf.

- Implementing joint research agendas, when possible, through joint or at least synchronised calls between Member States based on joint international peer reviews;

- Jointly implementing and/or financing calls and projects.

Lastly, it should be pointed out that the data-limits always define the research activities; this report therefore is limited by the data obtained/accessed, as will be described in this report when pertinent.

### *2.2. Relative importance of ERA-NET scheme as compared to other EU and MS STI schemes*

This assessment considers the role of ERA-NETs at the levels of the EU and Member States (MS) in relation to the allocation of funding and/or other non-financial, strategic means of cross-border cooperation of science, technology and innovation (STI) activities. This section therefore begins with a comparative analysis of the ERA-NET scheme at the level of the European Union (EU) and then moves on to MS-specific dedication to the ERA-NET scheme.

Table 1 uses data in the NETWATCH database[17] to calculate the proportion of national budget allocated to joint calls. The average national budget dedicated to joint calls is allocated between 0.3% (GBAORD) and 0.9% (GERD[18]). However, national shares vary quite significantly. Latvia, Denmark and Ireland are the highest, while Iceland and Czech Republic are the lowest (by GERD).

The results using NETWATCH data with GBAORD are significantly lower, for all countries with the available data, than the comparative and experimental data by EUROSTAT (see Table 1). This can be explained by the fact that the Europe-wide transnational public R&D programmes presented in the fifth column in Table 1 include not only ERA-NETs but also the funds related to EUREKA, COST, ESA, ERA-NET Plus, EFDA, EUROCORES, Article 185 initiatives (Europe Developing Countries Clinical Trials Platform, Eurostars and Ambient Assisted Living for the Elderly) and Joint Technology Initiatives (public funding part: ENIAC, ARTEMIS)[19]. However, NETWATCH data are limited to ERA-NETs, where the average national budget dedicated to joint calls is calculated to be 0.32%,

Given, the relative paucity of detailed information in NETWATCH related to call budget contributions, analyses undertaken should be viewed with some caution. Future data collection exercises of the platform will seek to improve coverage and quality.[20]

To sum up, it is found that the *average* of national funding dedicated to ERA-NETs is relatively small compared to the overall national funds dedicated to STI. This should lower general expectations regarding the ERA-NET scheme's national and EU-wide impacts. However, EUROSTAT has noted the *considerable importance of Europe-wide programmes in steering coordinated research in European countries. The use of Framework programme (FP) coordination instruments in particular (participation in ERA-NETs, European Technology Platforms, Joint Technology Initiatives) and coordination under the ESFRI Roadmap, are mentioned in all countries as major vehicles for implementing S & T and research coordination*".[21] Furthermore, while the average national funding of ERA-NETs is small compared to overall national funds, the leveraging

[17] http://netwatch.jrc.ec.europa.eu
[18] Gross Domestic Expenditure on R&D
[19] For details, please see European Commission (2011), ibid.
[20] The issue of data-limits has been discussed previously as part of earlier analytical work of IPTS (see the NETWATCH II Deliverables 3.4.1 " Policy Brief: ERA-NETs and the Realisation of ERA", 3.1.4 "Beyond Mapping: Monitoring and Impact Assessment" and 4.3.2 "First Report on the Future Development of NETWATCH").
[21] See http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/R_%26_D_budget_statistics_-_transnationally_coordinated_research

effect of EC funding leading to the national funding is considerable. Large amounts of funds are made available in a particular research area relative to the EC contribution. For example, overall in FP6 one Euro resulted in 5.6 Euros national and regional funding implemented by ERA-NETs, and this increased to 13.2 Euros for those networks that continued into FP7[22].

**Table 1 Total ERA-NET joint call budgets (reserved) as compared to total intramural GERD and GBAORD 2009, and share of national public funding dedicated to EU-wide coordinated programmes**

| *Sample country* | *Overall MS budget reserved for joint calls (2007-2011), in €* | *Country's ERA-NET budget Share of total intramural R&D expenditure (GERD), 2009* | *Country's ERA-NET budget share of total GBAORD, 2009* | *Share of national public funding to EU-wide coordinated programmes in total GBAORD 2009** |
|---|---|---|---|---|
| Austria | 5 302 450 | 1.32% | 0.25% | 3.65% |
| Belgium | 1 652 102 | 0.29% | 0.07% | 6.56% |
| Czech Republic | 150 000 | 0.03% | 0.02% | 1.09% |
| Germany | 28 915 904 | 0.29% | 0.15% | 3.05% |
| Denmark | 3 948 500 | 2.05% | 0.18% | - |
| Estonia | 314 801 | 1.45% | 0.33% | 5.03% |
| Spain | 5 647 204 | 0.19% | 0.07% | 2.88% |
| Finland | 6 210 850 | 1.01% | 0.33% | 1.10% |
| France | 13 780 907 | 0.20% | - | - |
| United Kingdom | 22 624 000 | 0.84% | 0.25% | - |
| Ireland | 2 674 800 | 2.20% | 0.29% | 1.65% |
| Iceland | 66 400 | 0.12% | 0.09% | - |
| Italy | 8 320 001 | 0.31% | 0.09% | - |
| Lithuania | 173700 | 0.33% | 0.25% | 2.69% |
| Latvia | 1050000 | 5.01% | 2.78% | - |
| Netherlands | 6942450 | 0.52% | 0.14% | 1.79% |
| Norway | 6534552 | 0.84% | - | 1.81% |
| Poland | 2658550 | 0.37% | 0.25% | 0.20% |
| Portugal | 1414400 | 0.69% | 0.10% | 1.06% |
| Romania | 301000 | 0.16% | 0.06% | 0.05% |
| Sweden | 8382800 | 1.79% | 0.34% | - |
| Slovenia | 1547800 | 1.14% | 0.57% | 2.06% |
| Slovakia | 134000 | 0.13% | 0.07% | 0.65% |
| | | | | |
| *Average* | | 0.93% | 0.32% | 2.21% |

* Experimental EUROSTAT data[23]
Source: Calculated by NETWATCH database (2011) and EUROSTAT (2011)[24]

[22] The ERA-NET scheme under FP6 and FP7: STATISTICS ON ERA-NET AND ERA-NET PLUS ACTIONS AND THEIR JOINT CALLS (June 2012). Available at: http://netwatch.jrc.ec.europa.eu/documents/10412/10708/STATISTICS%20ON%20ERA-NET%20AND%20ERA-NET%20PLUS%20ACTIONS%20AND%20THEIR%20JOINT%20CALLS

[23] See for details European Commission (2011) "R&D Budget Statistics – transnational Coordination Research"; at http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/R_%26_D_budget_statistics_-_transnationally_coordinated_research .

[24] Please note the (limited) data coverage on some ERA-NET specific national budgets and as far as information indicated by ERA-NET coordinators.

# 3. Evaluative questions and scope for impact assessment through NETWATCH data and other available information

In this section outlines the initial framework for the assessment. The section begins with a brief review of the ERA-NET objectives, and their relation to the higher ERA objectives. In outlining the scope of the analysis the potential issues that could be addressed, from differing perspectives, will be described prior to an elaboration of the framework for the impact assessment, which is inspired by an intervention logic[25] approach.

This report will be followed by a second report, due in July 2013. The framework approach developed in this first report should be seen as a basis for the refinement of the approach and techniques used so as to lead to a more extensive NETWATCH impact assessment.. The approach outlined in the current report builds on the periodic NETWATCH Mapping and Monitoring reports (footnote) and also utilises more sophisticated methods (Network Analysis) as well as selected information supplementary to that collected by NETWATCH. Such supplementary information includes the description of work and final reports produced by the ERA-NET projects. In addition to the refinement of the techniques used, this report will highlight the potential for refining the information requested by NETWATCH. Some questions have been more appropriate for at the start of the NETWATCH project, but now with the greater emphasis on the analysis of the information, and the ongoing development of the ERA-NET scheme, this impact assessment will allow for a review of NETWATCH information collection activities.

At a general level, the impact assessment will clarify the policy goals against which the scheme is ultimately being assessed. The current landscape should be described, but importantly it should track changes in aspects such as the network structure and funding allocation, and relate this to the scheme objectives. Ultimately, the assessment will develop a set of *indicators* for policy-relevant outcomes, such as categorising outcomes into types and across time. These indicators will be coherent with the scheme objectives as well as allowing the analysis of unintended impacts. The ultimate aim should be to develop an advanced as well as feasible assessment methodology, dependent on the availability of relevant data. Ideally, this should utilise control groups, and determine whether *links*[26] can be identified between outcome measures and policy intervention.

It should also be noted that, from the policy perspective, there are three main sets of objectives to take account of, at two different levels. The first level is that of the EU, and it is at this level where this report is situated. The two sets of objectives (see Section 2), with the emphasis being on the first, are:

- the ERA objectives at the outset of the ERA-NET scheme providing the basis for an ex-post assessment, and
- the objectives related to Europe 2020, the Innovation Union and Horizon 2020[27] as a basis for an ex-ante assessment of ERA-NETs in the new policy context.

The second level is the Member State level, where the objectives towards participation in ERA-NETs, as presented in Section 2.2, are more diverse and harder to ascertain. Further impact assessment need to accommodate such objectives and they will require further validation

[25] For an explanation see: http://ec.europa.eu/europeaid/evaluation/methodology/methods/mth_log_en.htm.

[26] These links (i.e. likely effects of intervention) established will then allow for *deductions* of specific policy implications and adjustments. Note, however, that in the very particular case of ERA-NETs, EU level intervention is intended to have an impact on national level policy intervention and design, i.e. EU intervention likely shaping national intervention (*outcome*).

[27] For an overview see Deliverable 3.4.3 "NETWATCH Policy Brief: ERA-NETs and the Realisation of ERA: increasing coordination and reducing fragmentation", Seville: Institute for Prospect technological Studies (JRC-IPTS).

undertaken by stakeholders in Member States, including the NETWATCH Advisory Board, as appropriate.

### *3.1. Previous Assessments*

*Matrix-Rambøll FP6 ERA-NET evaluation*

One impact assessment of the ERA-NET scheme has so far been undertaken, which focussed on 71 ERA-NETs launched under FP6 (2002-2006)[28]. The study utilised quantitative and qualitative methods which aimed to answer the following questions:

- To which extent, and how, FP6 ERA-NET participation had an effect on the landscape of publicly funded national/regional research programmes in certain targeted EU countries?
- To which extent FP6 ERA-NETs had a structuring effect in certain targeted research fields that ERA-NETs addressed?
- Which direct benefits and indirect benefits have been generated through the ERA-NET scheme in FP6 and how can the impacts be measured for both types of benefits?
- Have FP6 ERA-NETs helped to mutually open up national programmes in ERA? If yes, to what extent and what is needed to assure that this result becomes a durable lasting effect within ERA?
- What are the lessons learned for all possible stakeholders and where can these lessons be traced?[29]

These questions are closely related to the ERA Rationale and the consequent goals of the ERA-NET scheme that have already been described (see Section 2). Overall, the study concluded that the scheme had been a success in relation to the original objectives to foster the cooperation and coordination and such activities would not have been funded at the national level and hence required EU funding. The identification and exchange of good practices was a key driver for participating in the ERA-NET scheme within the ERA-NETs practices such as international evaluation panels were adopted

The main impact was identified as being the creation of new opportunities to enable transnational R&D activities. There was limited evidence of an impact on duplication, increases in budgets for transnational R&D projects and influence on national policy and consequently progress towards the achievement of ERA objectives, such as reducing fragmentation. The study found that such objectives were limited by national R&D policies and structures, and the role assigned to ERA-NETs[30].

There was evidence of a strengthening of relationships and in some cases bilateral or trilateral cooperation agreements were signed resulting from participation in the ERA-NET scheme. However, the overall structuring effect of ERA-NETs could not be determined.

Interestingly, there was evidence of direct benefits from the activities of the four ERA-NET steps. These included that the participation in joint calls (and other joint activities) resulted in access to foreign research communities, new types of research projects, the inclusion of researchers with little previous international experience and improved project quality.

[28] Matrix-Rambøll –Final Draft Report – FP6 ERA-NET Evaluation – Volume 1 - May 2009. Available at: http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/fp6_era-net_evaluation_-_final_report_-_volume_1.pdf.

[29] Page 14 - Matrix-Rambøll –Final Draft Report – FP6 ERA-NET Evaluation – Volume 1 - May 2009. Available at: http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/fp6_era-net_evaluation_-_final_report_-_volume_1.pdf.

[30] ERA-NETs were often seen as a way to implement national policy rather than influence it.

*ERA-NET Review 2006 of the Expert Review Group*

The EC has also commissioned a major review of FP6 ERA-NETs by an Expert Group[31] with a particular focus on policy and strategic aspects. The review concluded that the ERA-NET scheme filled a real need and helped to overcome barriers to the coordination of national and regional research activities. Particular benefits being mutual learning, coordination of policy responses to shared problems, create critical mass in key areas, and the reduction of unnecessary duplication. However, in order to have greater impact emphasis should be placed on launching joint calls and programmes (step 4), an issue that was addressed under FP7[32].

While noting that the 'bottom-up' nature of the schemed was popular with the participants, and mechanisms to allow it should continue, the review identified a need to focus on strategically important areas, which requires a more directed 'top-down' approach.

### *3.2. Future scenarios*

The impact assessment framework should provide a robust evaluation of the impact of the ERA-NET scheme based on the original objectives the developments in European research and innovation. However, there is also a need to consider, and accommodate, the policy evolution represented by Europe 2020, Innovation Union and Horizon 2020.

The European Innovation Partnerships initiative (EIP) has been conceived as part of the Innovation Union. The rationale is that they will be challenge driven and operate across the whole research and innovation process. Rather than being established as yet another new instrument, they will aim to better coordinate existing instruments, including those related to joint programming. However, they will also coordinate tools and actions related to lead markets, joint pre-commercial and commercial procurement schemes, and regulatory screening. Therefore, future assessment will have to take into account more than just ERA-NETs to consider related schemes and how they can complement each other within the current and future developments.[33]

Horizon 2020 will encompass the EU2020 and Innovation Union initiatives, and include accommodate the proposal in the EC Communication on "Partnering in Research an Innovation", which includes the amalgamation of the ERA-NET and ERA-NET Plus schemes, and the use of ERA-NETs and Article 185 by JPIs to implement their activities when appropriate. Despite these substantial changes, elements from previous programmes remain, including the realisation of ERA, and therefore also the need for coordination and the potential for schemes such as ERA-NETs to play a role. This is emphasised by the ERA Communication[34], which outlines the aim to complete the ERA by 2014, and for which transnational cooperation, including ERA-NETs, is crucial.

### *3.3. Types of questions that can be assessed and different levels of assessment*

When considering the focus of the impact there are a variety of different approaches that can be taken. These approaches can be considered as different dimensions and are summarised in Table 2.

This impact assessment will consider the impact at the level of the policy by considering the initial objectives of the scheme. The level of the actor considered will be at the network level and all the levels of the coordination/alignment will be considered.

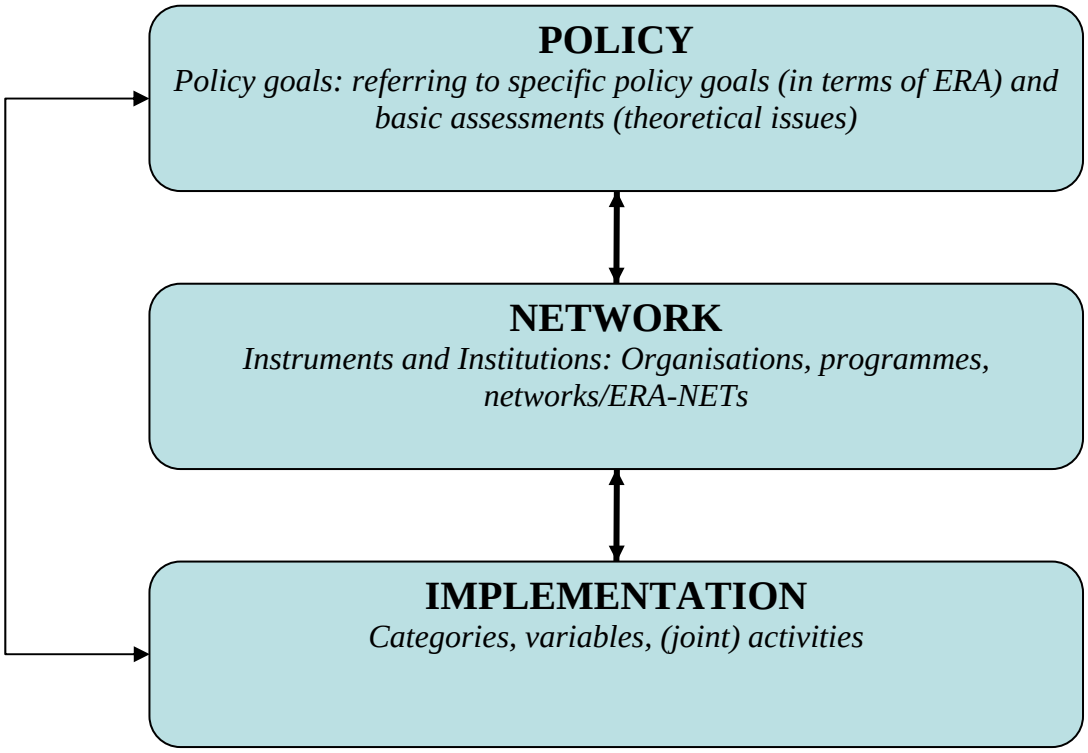
[31] Horvat et. al. "ERA-NET Review 2006: The Report of the Expert Review Group".
[32] Work Programme 2012: Cooperation – Annex 4.2
[33] See also EC Communication on "Partnering in Research and Innovation". Available at: http://ec.europa.eu/research/era/pdf/partnering_communication.pdf.
[34] European Commission, A Reinforced European Research Area Partnership for Excellence and Growth (COM(2012) 392 final)

Figure 1 below outlines the hierarchical structure of the assessment, which is based on the dimensions already outlined. There is a policy level the mechanisms and instruments used and the implementation of activities.

**Table 2 Variety of possible questions**

| **Dimension** | **Examples** | **Possible research questions** |
|---|---|---|
| Level of Impact | Policy level<br>Scientific level<br>Societal level | **Policy**<br>What are the policy objectives of ERA-NETs and what impact have they had on these objectives?<br>What are the barriers to the realisation of ERA?<br>What contribution have ERA-NETs made to reducing fragmentation of the European research system?<br>**Societal**<br>What societal challenges are addressed by ERA-NETs?<br>**Scientific**<br>What has been the impact of ERA-NETs on the science that is undertaken? |
| Level of actor | Researcher level<br>Actor/agency level<br>Programme<br>Network level<br>Instrument level | What is the added-value of ERA-NETs?<br>Would the activities be realised without ERA-NETs?<br>What makes the scheme original?<br>What is the importance of the ERA-NETs scheme compared to other EU or national level funding activities?<br>What other instruments support alignment-coordination more efficiently?<br>What are the barriers to coordination and cooperating between research programmes?<br>Why do networks continue without EU funding?<br>How do networks continue without EU funding?<br>Why do organisations/programmes participate in ERA-NETs<br>How do systems differ between different countries?<br>What activities are undertaken by networks?<br>What is the pattern of participation compared to network participation?<br>How do these activities contribute to the scheme objectives?<br>What is the effect on the researchers?<br>How do ERA-NETs affect the research being undertaken? |
| Dimension of policy co-ordination<br>- Alignment | Systemic<br>Horizontal<br>Vertical<br>Temporal | How has the European transnational RTD collaboration landscape been shaped or changed over time?<br>What influence have ERA-NETs had on this change?<br>What are the mandatory conditions for better alignment-coordination-collaboration-cooperation?<br>How do ERA-NETs help create such conditions?<br>How do systems differ between different countries?<br>How diverse are the national actors involved in ERA-NETs?<br>Do participants that are similar tend to be involved in the same networks?<br>What are the different national strategies in relations to transnational research programme cooperation? |
| Other dimensions | Thematic monitoring<br>Spatial<br>Internal vs external | How can the use of the instrument according the research area, the actors… be characterised?<br>What factors outside research area need determine the participant characterisation of a network (by geographic proximity, cultural similarity)? |

**Figure 1: Hierarchical structure of the assessment**

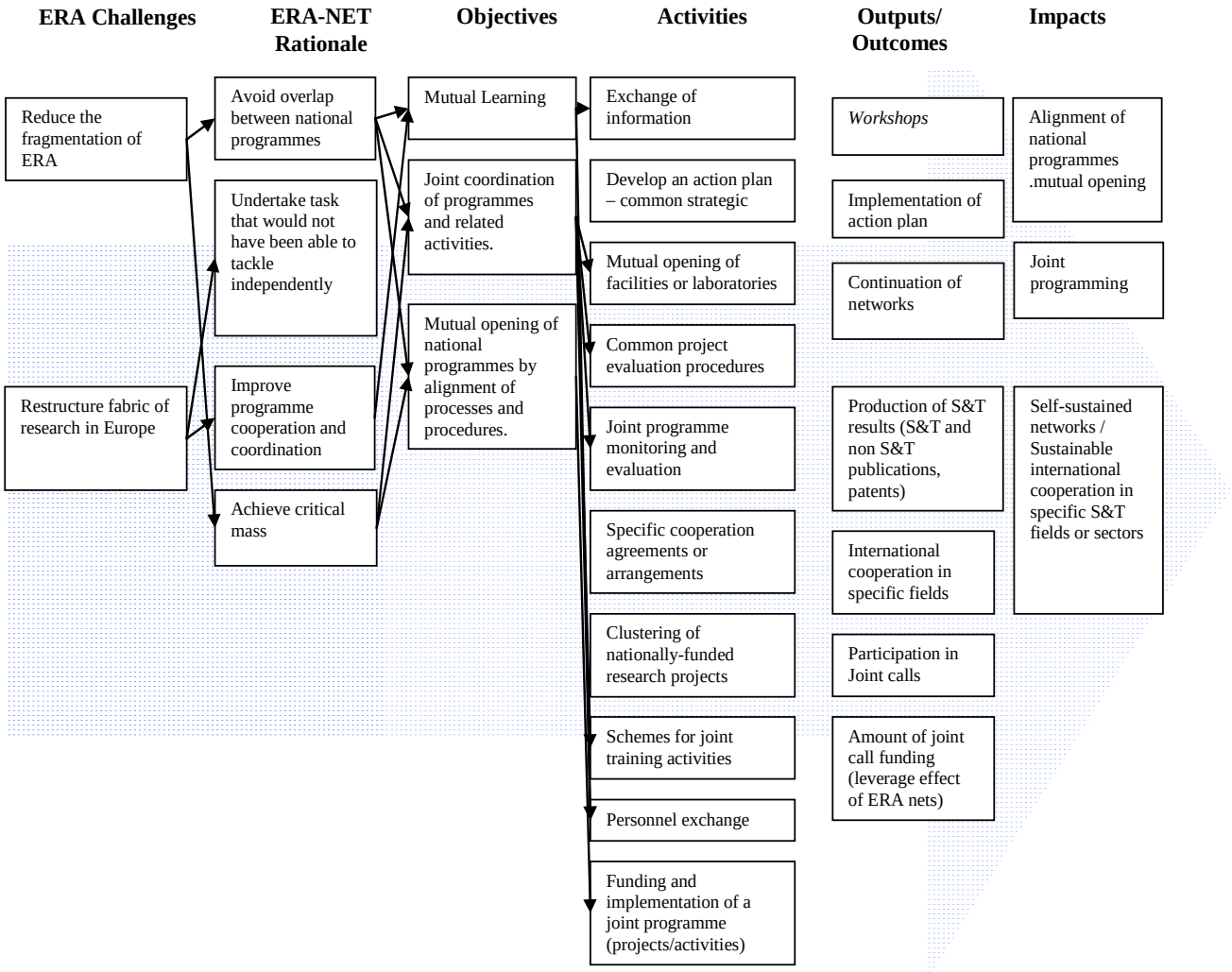



### *3.4. Conceptual framework*

In terms of the intervention logic of the ERA-NET scheme (Figure 2) the ERA challenges are the inputs at the policy level, the ERA-NET rationale and objectives (and other inputs) are the inputs at the mechanisms/instruments level and the activities are the inputs at the implementation level. The outputs are the results at the implementation level, the outcomes the results at the mechanism/instrument level and the impacts the results at the policy level.

The ERA-NET scheme aims at encouraging and facilitating the alignment of national programmes through mutual opening. Mutual opening is considered to be the process whereby programmes within an ERA-NET align their rules and procedures to open them up to transnational cooperation. While this could involve the reciprocal participation of non-residents in programmes of the ERA-NETs, this is not essential, and therefore this assessment is not concerned with the funding of non-residents.

**Figure 2 Intervention logic of ERA-net scheme**




### *3.5. Research Questions*

- **Policy issues**

1. What impact have ERA-NETs had in relation to the policy objectives to restructure the fabric of European research (at EU level) and Member State level objectives?

1a. How has the ERA-NETs scheme improved coordination of national and regional policies?

1b. How has the ERA-NETs scheme improved coordination and cooperation of research programmes?

- **Network issues**

2. What have been the changes to the ERA-NET landscape over time?

3. What dimensions of alignment/coordination do ERA-NETs have an impact on?

3a. What is the role of mutual learning with respect to alignment/coordination?

3b. What are the impacts of other instruments on the dimensions of alignment-coordination?

4. How does alignment affect the sustainability of transnational programme cooperation (continuation of networks with or without EC funding)?

- **Implementation issues**

5. What are the outputs and outcomes of the joint activities listed below?

- Information Exchange Common Strategic Agenda
- Mutually opening facilities
- Multinational project evaluation
- Joint programme monitoring and evaluation
- Cooperation agreements
- Clustering nationally funded projects
- Joint training and personnel exchange
- Joint Programmes

6. How do the outputs and outcomes contribute to the objectives of the scheme (policy impact)?

- **Other issues**

There are other issues that do not relate to the impact that ERA-NETs have, but how their impact can be better measured. Examples are the evidence available and also how NETWATCH could be configured to achieve the aims.

- What evidence exists, and what is required to demonstrate, that ERA-NETs have achieved the original policy objectives?
- How can NETWATCH better contribute to the realisation of the ERA?
- How can NETWATCH be adapted to improve its contribution to monitoring and ex-post assessment?

# 4. Methodological approaches

## *4.1. Methodological approach using NETWATCH data*

NETWATCH mainly collects information in cooperation with the network coordinators. The coordinators can access restricted areas of the website and are permitted to edit their network information. They can edit and update the content at any time, as and when it is necessary. However, to ensure that it is as up to date as possible for the analytical work, IPTS contacts coordinators at six-monthly intervals to proactively ensure that the information is updated. Following an initial email the coordinators are usually given one month to complete the information update. Reminder emails and telephone interviews complement the process.

NETWATCH has collected relevant data on ERA-NETs launched under FP6. The new ERA-NETs and ERA-NET Plus that have been developed under FP7 are also covered. In addition, the Article 185s and self-sustaining networks are included in the NETWATCH database.

The battery of indicators that were developed as the basis for the NETWATCH information collection aim to provide a comprehensive overview of transnational research programme cooperation in Europe. These indicators are based on three broad dimensions:

a) **Thematic dimension**: analysing the range of areas covered by the networks including the research field, type of research, and the sector targeted.

b) **Spatial or geographical dimension**: based on the network participation characteristics of Member States and other countries.

c) **Participant dimension**: allowing analysis of participation in the networks by different categories of actors[35]. This includes the type of organisations and also the affiliated research programmes.

It should be noted that the data derived from NETWATCH cover not only EU-27 but also countries associated to FP7 and participating "third" countries. Other variables taken into account are the **type of research** carried out by the consortium (distinguishing between frontier research, applied research and societal research) and the **funding mode** used by the networks (virtual pot, common pot or mix-mode).

Information is also sought on the strategic objectives of the network. Related to these objectives, information is also collected on NETWATCH related to the activities considered important by specific networks. The variety of *tasks and actions* documented and potentially undertaken within networks currently includes the following, categorised according to their main intermediate policy goals:

- Mutual Learning Goal
    - Work on benchmarking
    - Joint training activities
    - Personnel exchange
    - Mutual learning
- Mutual Opening Goal

[35] NETWATCH I: Deliverable 3.1 (Elena Pérez, S. and Schwarz, H-G. (2008), "Developing an analytical framework for mapping, monitoring and assessing transnational R&D collaboration in Europe. The Case of the ERA-NETs", Institute for Prospective Technological Studies (JRC-IPTS), VERSION: 15/12/2008)

    - The establishment of cooperation agreements or arrangements
    - The mutual opening of research facilities or laboratories
    - The mutual opening of programmes, i.e. making funds in national programmes available to researchers in other countries
- Joint Coordination Goal
    - The definition of common schemes for monitoring
    - The definition of common schemes for ex-post evaluation and impact assessment
    - The definition of common strategic agendas
    - The establishment of common, multinational proposal evaluation procedures
    - The establishment of cooperation agreements or arrangements
    - Coordination or clustering of on-going nationally funded research projects with similar projects in other countries
    - Design of joint calls
    - Implementation of joint calls
    - Design of joint R&D programmes
    - Implementation of joint R&D programmes)

Further information is collected in relation to the joint calls. This includes practical information that contributes to the call calendar. However, information is also requested on the organisations participating in the call and budget contribution, the overall budget and any external sources (European Commission or private sector), the funding mechanism used (common pot, virtual pot etc.) and the common evaluation procedures that may exist for the call.

There are various types of relationships between entities that can be analysed using data in NETWATCH, examples include: organisations are related to the networks in which they participate, organisations are related to countries and countries can be related to countries with which they cooperate in ERA-NETs as can organisations be related to each other. Distinguishing between these types of relations allow for greater granularity in the analysis as can the study of the characteristics of the networks formed (see Section 4.4 on network analysis).

This relational type of information also allows analysis of the evolution of networks. An interesting question is whether a network is a continuation of another network. This can therefore show a link from FP6 to FP7, or if another type of cooperation network was utilised, or if the participants continue activities without external support and become self-sustaining. Such information can help indicate incidences of sustainability and highlight cases for further analysis.

The information collected in NETWATCH can contribute to answering the evaluative questions described in Section 3 of this report. Table 2 presents the relationship between the questions and the information available on NETWATCH. It can be concluded from this table that available NETWATCH data addresses (partially) the evaluative questions 2 until 5, leaving the need for additional data sources for question 1, 6, other issues and for complementing the data on question 2 to 5.

The second evaluative question is directed at observing changes that can indicate that impact may have occurred, and where further investigation is required. For example, increasing numbers of

countries participating may indicate that there is greater coordination between European countries in certain research areas. The work for the impact assessment takes into consideration the changes from FP6 to FP7. However, a more appropriate assessment of the evolution of ERA-NET landscape would require a coherent time series of data. Mapping and monitoring is conducted as part of the NETWATCH[36] project. This work analyses a cohort of active networks at a specific point in time on a regular basis, but is only available from 2010 onwards. A more holistic view of the ERA-NET scheme is required that considers changes from the earliest networks to the more recent networks and so work was undertaken by IPTS based on the entire NETWATCH database of ERA-NETs (rather than focussing on active networks) to take account of this need. As the NETWATCH mapping and monitoring work continues it should have a more direct input to the impact assessment and issues around the evolution of the scheme.

[36] Please see http://netwatch.jrc.ec.europa.eu/strategic-analysis/mapping-and-monitoring for the mapping and monitoring reports of NETWATCH.

**Table 2: Potential NETWATCH contribution to answering evaluative questions**

| QUESTION | INDICATOR/ISSUE | EXPLANATION |
|---|---|---|
| 2. What have been the changes to the ERA-NET landscape over time? | Country participation to the networks | Countries involvement to the networks and roles (coordinator, participant, observer etc) over network type, years, funding etc.<br>Countries involvement to joint activities by responsibility (launching, administrating, funding etc) |
| | Organisation participation to the networks. | Participation according to the roles (coordinator, participant, observer etc) |
| | Programme participation to the networks | Programme participation according to network type and funding mode. |
| 3. What dimensions of alignment/coordination do ERA-NETs have an impact on? *3a. Role of mutual learning in alignment/ coordination?* | Differences between the structure of organisations and programmes | Simple presentation of the participation patterns (Mapping and Monitoring Reports) |
| | Different dimensions of coordination that ERA-NETs address | Identify outcomes from the ERA-NET activities that correlate with the dimensions identified in 2nd brief |
| | Increased awareness of different structures and procedures | Descriptive statistics on activities and qualitative information on common procedures |
| 4.How does alignment affect the sustainability of transnational programme | Composition of, and activities undertaken by, self-sustaining and continuation networks | Can identify participants and countries in the networks and the activities they rate highly. Can determine the evolution of the network participation from the initial funded network to the self-sustained network<br><br>Ultimately need to identify if dimensions of coordination/alignment have greater prevalence in continuation networks, which needs complementary information. |
| 5. What are the outputs and outcomes of joint activities? | Willing to participate to different types of joint activities | A ranking addressing to the willing to join different types of joint activities |
| | Asymmetric participation (at research level) | Comparison (measuring correlation) between the participants of network and call. Problem is that NETWATCH only has current network participation rather than network participants at the time of the call. |

### 4.1.1. Main Findings

NETWATCH provides descriptive statistics that can help determine the changes in the ERA-NET landscape. Table 3 below demonstrates that both the number of countries and organisations participating in ERA-NETs have increased from FP6 to FP7. However, the increase in countries is at a slightly higher rate than for organisations (particularly when considering the median). This suggests that a wider range of countries are participating in FP6 than FP7, with the only slightly larger networks. This is to be expected as countries joined the EU and associated to the Framework Programme from FP6 to FP7. While, this information contributes towards answering question two, Section 4.4 provides some additional conclusions using network analysis.

**Table 3: Number of Countries and organisations from FP6 to FP7**

| | **Number of countries per network** | | **Number of Organisations per network** | |
|---|---|---|---|---|
| | **FP6** | **FP7** | **FP6** | **FP7** |
| **Mean** | 11.83 | 14.19 | 16.29 | 17.95 |
| **Median** | 11.00 | 14.00 | 16.00 | 17.50 |
| **STDEV.S** | 3.39 | 5.18 | 4.90 | 6.15 |
| **Var** | 11.47 | 26.78 | 24.00 | 37.82 |

Based on the figures in Table 3, the mean numbers of organisations per country in were 1.38 in FP6 and 1.27 in FP7. This suggests that the number of multiple participants from one country has reduced for FP7.

Figure 3 shows that there has been little change from FP6 to FP7 in that the larger countries, or countries productive in research, dominate. It should be noted that there are currently only ten self-sustained networks in the NETWATCH database. However, with some exceptions it again appears that the larger countries dominate. This could imply that there are difficulties in achieving sustainability, but also reinforces the rationale for the ERA-NET scheme, providing support such for activities, which would otherwise be difficult to obtain and sustain.

However, the situation is more complex. If the participation in the initial network is compared to the self-sustaining network, the larger countries do dominate but they also drop out from more networks (see Appendix 1 on NETWATCH findings). Furthermore, while the networks generally get smaller, in terms of numbers of countries and participants, there are some incidences where self-sustained networks are larger than their predecessors (e.g. ECORD - European Consortium on Ocean Research Drilling - see Appendix 1 for further details). The case study approach outlined in Section 4.3.2 could provide further insights into this finding.

**Figure 3: Country participation in ERA-NETs and self-sustained networks (Member States and Associated Countries)**

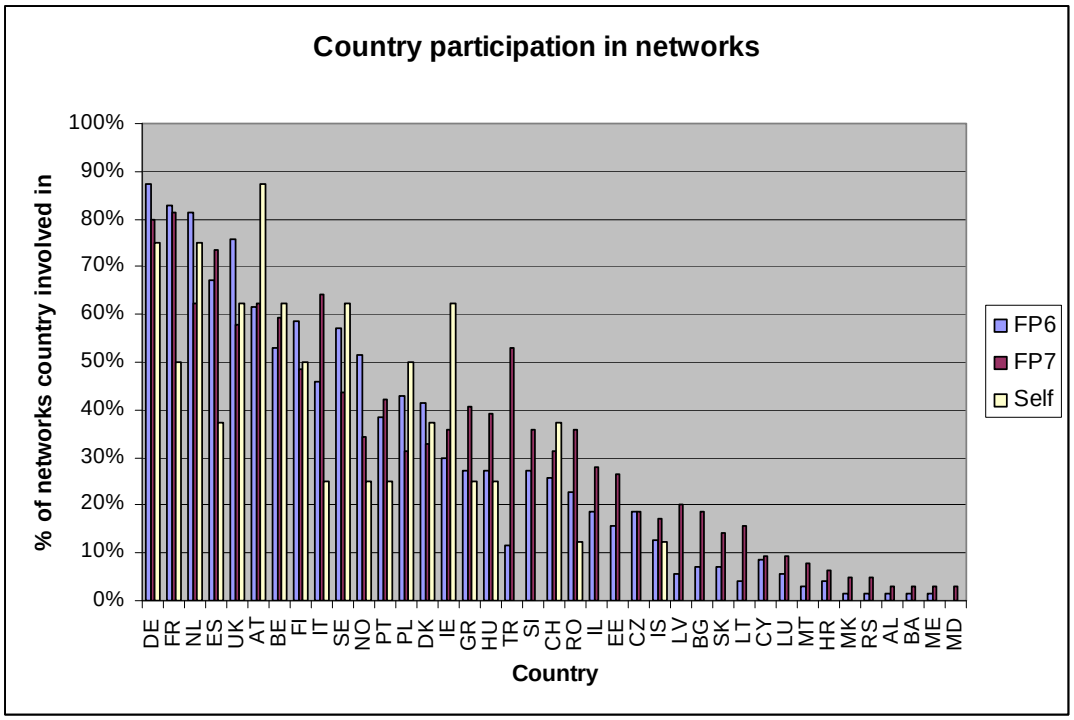



Table 4 demonstrates that the exchange of information and implementation of joint calls are the most important motivations for participation. The implementation of joint calls is also still important for self-sustained networks.

**Table 4: Strategic objectives of ERA-NETs**

| | Exchange of information and good practices | Definition of common research agendas | Coordination of national programmes | Implementation of joint calls | Implementation of joint research programmes |
|---|---|---|---|---|---|
| All | 4.4 | 3.5 | 3.5 | 4.6 | 3.5 |
| *FP6* | *4.6* | *4.1* | *3.5* | *4.5* | *3.3* |
| FP7 | 4.4 | 3.7 | 3.6 | 4.6 | 3.5 |
| Self | 4.9 | 4.3 | 3.3 | 4.5 | 3.7 |

The strategic objectives are coherent with the willingness to undertake certain activities (see Appendix 1) in that both the design and implementation of joint calls have highly weighted means. It is interesting to note that common strategic agendas and mutual learning are high for the self-sustained networks, which again highlights the need for greater understanding of such networks.

While the activity ratings provide an indication of what the networks expected to do, and while it can be assumed that they did undertake those activities given high ratings, this cannot be confirmed with NETWATCH information. Section 4.3.1 therefore presents an approach to address this issue, while consideration also needs to be given to the information collected on NETWATCH.

#### 4.1.2. Review of approach using NETWATCH and further requirements

The information currently in NETWATCH is suitable for addressing the issues of participation. NETWATCH can also identify continuing networks and their characteristics for question four (Section 4.2.2 addresses the issues of alignment). In this context, NETWATCH information can fully address the evaluative question two and it can contribute to the questions three, four and five. On the other hand, there are several aspects of the way the information is collected on NETWATCH, or the low response for certain questions, that are limiting with respect to questions of impact.

There are three dimensions that NETWATCH information can be used for. Firstly, the data on the country/organisation participation and the landscape of ERA-NETs can to address the evaluation questions. Secondly, the data collected on the activities the networks undertake, which can support to address evaluative question three (a) and five, utilises a five-point Likert scale. It is uncertain as to whether activities rated high are those that are actually implemented. Thirdly, the information on the joint calls, which generates much interest and can support analysis on the questions five and six, is still limited especially regarding to joint call budget figures.

The use of complementary data to enhance NETWATCH information is clearly advantageous. On the one hand, related to second dimension, there is a need for further evidences on network activities that have actually taken place.

The self-sustaining networks can be identified as interesting cases to study with respect to alignment and sustainability issues due to the fact they can easily cooperate without external funding. However, it should be noted that there is a need to check whether or not NETWATCH currently covers all the self-sustaining networks as it is not certain that all such networks have been captured.

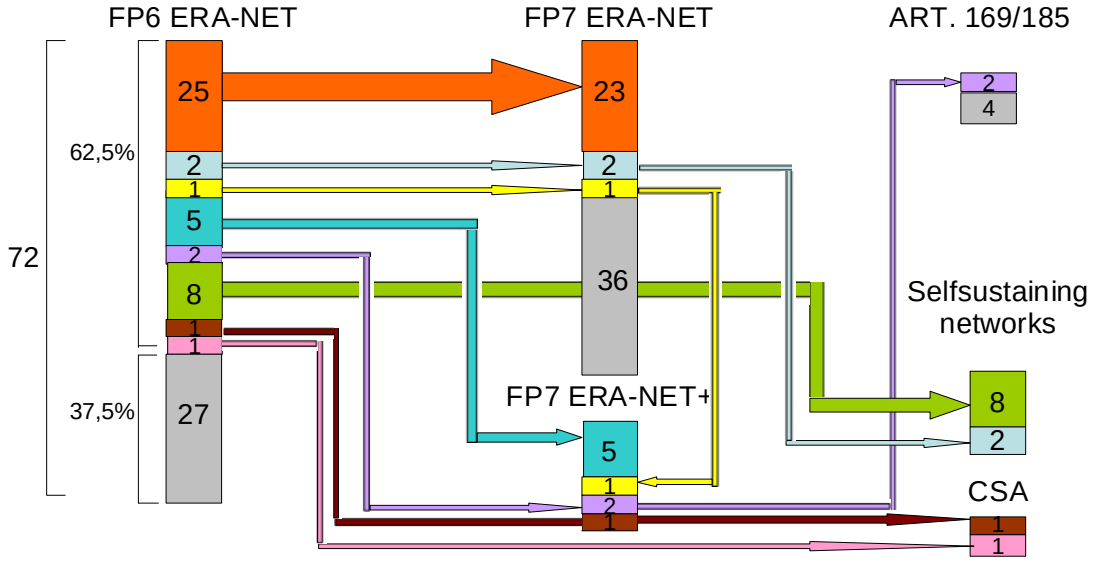
Information obtained by NETWATCH and analyses based on this information provide a good basis for the impact assessment. In some instances it provides background information on the evolution of the ERA-NET landscape, which may require additional information to fully address more substantive impact questions (see methods used in following sections). Other aspects can provide important information for the impact assessment, especially regarding the outcomes of joint activities and evaluations on the financial dimensions, but for which a new approach to the collections of the information may be required.

### *4.2. Methodological approach using ERA-nets outputs*

In the context of assessing the impacts of ERA-NET actions, it is interesting to look at whether, and how, ERA-NET actions continue once the EC funding ends. The graph below shows that 62.5% of all actions under FP6 experienced some form of continuation. The majority of those continuations were funded through FP7 (ERA-NET and ERA-NET Plus). In total eight different ways of continuation are being used. Among FP7 ERA-NET actions (62 in total), 42% of them form some sort of continuation of FP6 ERA-NET, and 58% are 'new' initiatives.

Among the self-sustaining networks (10), 8 of them stem from an FP6 ERA-NET directly, and 2 were funded before under both FP6 and FP7.

**Figure 4 Overview of continuation modes of European transnational collaboration networks in research programming**




This diversity of ways to continue transnational collaboration in research programming offers a wider context for analysing potential impacts of those collaborations. Impact analysis could look at the diversity of continuations, and at the differences between them. Or focus on one specific type of network continuation for a more in-depth analysis. In the following sections an approach is proposed to look at some specific networks with regard to 'alignment' and 'maturity'.

### 4.2.1. Methodological approach to measure the maturity of actions among research fields

Each ERA-NET is designed according the objectives and expectations listed in Annex 4 of the Cooperation Work Programme[37] and related documents[38].

The aim of this section is to give a methodological approach to get a clear indication about the maturity of ERA-NET actions in each research field (or sector). A direct comparison between expectations of the EC along the four methodological steps of ERA-NET actions and the deliverables of each action could reveal some disparities that can help explain the impact the ERA-NETs have had on the policy objectives.

The term "maturity" can define the closeness of an ERA-NET action to a full self-sustained transnational programme. It can also reflect the "propensity to cooperate" of national organisations on specific topics. The approach should encompass as best as possible the instrument intervention logic (see Figure 4 in section 4.3).

Activities supported within ERA-NET follows a process in which the coordination element gradually deepens, depending on the degree of maturity of the network. In this section, we propose an approach to measure this degree of maturity, culminating in a typology according to research fields.

[37] Work Programme 2013, Cooperation, Annexes 1-5. Available at: http://ec.europa.eu/research/participants/portal/download?docId=32919.

[38] Provision for the preparation of ERA-NET actions and their practical implementation. An issue paper serving as background document1 Version: 30 June 2010, DG RTD B1

ERA-NET actions should follow a four-step approach covering the following activities:

1. Systematic exchange of information and good practices on existing programmes
2. Definition and preparation of common strategic activities
3. Implementation of joint activities between national or regional programmes
4. Funding of joint transnational research

In order to better measure the degree of maturity and because of the difference between ERA-NET actions, we propose to add the following "extra" analytical step:

5. Progress towards self sustained network

According to official guidelines "*ERA-NET actions should be ambitious and result in concrete progress towards the opening up of, or cooperation between, the participating research programmes. The cooperation should be sustainable beyond the duration of the ERA-NET action itself.*"[39]

Although not explicitly formulated, the ERA-NET scheme follows an intervention logic approach formulated in official background documents as follows: "*ERA-NETs launched under FP6 wishing to submit a fully new proposal under FP7 have to propose a strong coordination action directly and exclusively focusing on steps 3 and 4 alone…The proposal should include a clear description of activities and achievements of the FP6 ERA-NET and demonstrate an ambitious set of activities going far beyond what has been achieved so far…New ERA-NETs, which address new topics and without any previous experience from FP6, should address at least the first three steps, but are encouraged to aim at the four step approach.*"[40]

The process to measure the maturity of ERA-NETs proceeds as follows:

1. Assessment of the production of outputs of each ERA-net according to available documents (description of work, final report) (see Table 1);
2. Scoreboards for each research field;
3. Vertical and horizontal analysis according research fields and achievements.

ERA-NET actions have to fulfil a set of specific objectives towards the opening up of, or cooperation between, participating national research programmes. The main idea is to compare specific objectives listed in official documents defining the ERA-NET scheme with outputs and deliverables of each network (see Table 5 Specific objectives and achievements of ERA-NET actions related to a "5 step" approach).

The measure of the maturity of ERA-NET actions (aggregated at the level of the research field) is the main objective of this approach and particular attention will be addressed to step 4 and the new step 5 where disparities can appear among research fields.

As an example, the following table shows the outputs to be delivered by the FP7 action NEURON II according to information appearing in the project description of work (the FP7 project NEURON II is the continuation of an FP6 ERA-NET in the Health theme called NEURON). When available,

[39] Work Programme 2013, ibid.

[40] Work Programme 2013, ibid.

information from the final reports and other sources are used in order to have as complete and accurate information as possible.

When completed for all the ERA-NET actions, a horizontal analysis can be realized in order to generate a profile of ERA-NET achievement in each research field. For example, in a given research field it will be possible to determine the proportion of networks that have designed a proposal for a future European programme beyond the lifetime of the ERA-NET.

**Table 5 Specific objectives and achievements of ERA-NET actions related to a "5 step" approach**

| **Specific objectives** | **Achievements/deliverables** | **(FP7) NEURON 2** |
|---|---|---|
| **STEP 1- Systematic exchange of information and good practices on existing programmes** | | |
| fora of research programme makers and programme managers; | Report including workshops conclusions for RTD and Innovation and policy makers; Updated project data base; Report on common interests; Generation and analysis of a questionnaire | 1 |
| short-term exchanges of programme managers; | Exchange of National information: initiation of regularly updated inventories of the characteristics and processes of the programmes of partner organizations; Updated and extended report on collected information | 1 |
| benchmarking and dissemination of good practice; | | 1 |
| use of electronic communication tools, including the use of common portals. | Joint electronic communication tool | |
| **STEP 2 - Definition and preparation of common strategic activities** | | |
| identification of mutual complementarities between the programmes of the ERANET partners; | Report including the inventory and classification of stakeholders on European level ; Elaboration of a strategic agenda for joint activities ; Feasibility study for a European Database; Delivery of a comprehensive plan to the development of a strategic roadmap (Proposals for transnational activities ) ; Work on benchmarking (and inventory) | |
| identification and analysis of research activities carried out by different programmes that have similar goals and that could lead to the design of future multinational schemes; | Report on the state of the art and needs in regarding the topic and existing tools to manage them | |
| identification and analysis of practical and concrete networking activities and mutual opening mechanisms; | Action plan for joint activities | 1 |
| identification and analysis of barriers that hinder transnational cooperation activities such as, for example, administrative and legal barriers; | Report on possible schemes and barriers for the joint activities ; Identification of the technological barriers (by calling of an expert workshop and by collaborative work with stakeholders and other organizations) ; benchmark the joint trans-national calls used in other ERA-NETS ; Implement a Market-oriented Survey on the same subfield to suggest options to overcome the barriers | |
| identification of new opportunities and gaps in research and stimulation of new interdisciplinary work on the basis of technology assessment and foresight analysis carried out at regional, national and European level; | Definition of the strategic priorities for the joint transnational calls for applications; | 1 |
| design of common evaluation systems; | Implementation of the common international peer reviewed evaluation procedure | 1 |
| **STEP 3 - Implementation of joint activities** | | |
| Clustering of nationally funded research projects: | Workshops and reports contributing to focus of each joint call for proposals and developing the Strategic Research Agenda | |
| Systematic use of multinational evaluation procedures: | | |
| Common schemes for programme monitoring and evaluation, including joint monitoring or evaluation. | Report on common indicators for joint call monitoring | 1 |
| Developing schemes for mutual opening of facilities or laboratories: | Mutual opening/experience of research infrastructure | |
| Specific cooperation agreements or arrangements between participating programmes, preparing the ground for further transnational research programmes and assuring that legal barriers are removed. | Model Consortium Agreement for trans-national collaborative research projects ; Mutual opening of programmes (Co-operation agreement on a joint call) | |
| Schemes for personnel exchange in the context of the above activities. | Report with an inventory of existing mobility and programmes; Recommendations/propositions for collaboration in the area of Human resources, mobility and training; Developing the mechanisms for transnational funding targeted to young researchers ; Report from expert exchange scheme, including rules and guidelines | 1 |
| Developing joint training schemes: | Personnel exchange; Various Mutual opening/experience of programmes | 1 |
| *Communication about opening* | Reports to scientific community and general public (newsletters, press releases) on joint calls, status seminars, and best paper awards; Video clips | 1 |
| *Joint activities management* | Set up and activation of a dedicated Call office, secretariat, electronic | 1 |

| | | |
|---|---|---|
| | submission tool | |
| **STEP 4 - Funding of joint trans-national research** | | |
| *Implementation of the common joint trans-national Call for project proposals according to the roadmap and framework adopted* | joint call with a virtual common pot<br>joint call with a common pot;<br>A mix of common pot and virtual common pot;<br>Other forms of joint research funding, not necessarily based on joint calls. | |
| *Self-learning process : Analysis of the feed back from the first joint trans-national Call, to be used as an input for the planned second Call.* | questionnaire to users, evaluation | 1 |
| **STEP 5 - Progress towards sustainability** | | |
| *Design of joint R&D programmes* | Design a proposal for a future European programme beyond the lifetime of the ERA net, taking advantage of the experience and lessons learned ; | 1 |
| | Report on common vision regarding a sustainable cooperation ground for funding RTD and innovation; | |
| | Action plan for further activities ; Business plan on a common sustainable funding framework | |
| | Recommendation for further transnational research strategy; Analysis report with proposals on future programme collaboration (incl. stakeholder collaboration) | |
| *Implementation of joint R&D programmes* | ERA-NET (FP7); ERA-NET +; JPI ; other | |
| | Overall maturity Score | |

The aim of this approach is get a differentiated overview among research fields of the maturity of ERA-NETs by identifying what they have produced and assigning it to ERA-NET objectives that act as indicators of the progress towards sustainability (or continuity). This methodological approach aims at using project outputs to answer the following questions:

- What activities are important for ERA-NETs to progress towards sustainable transnational research programme cooperation?
- How do specific research fields, within the scope of the ERA-NET scheme, compare in their degree of sustainability?

### 4.2.2. Review of approach to measure maturity

An overview of the achieved by ERA-NETs in order to progress towards common activities, with or without an EC contribution, offers the opportunity to measure the improvement in terms of the reduction of fragmentation of the ERA.

The assumption is the following: the activities achieved by ERA-NET actions give information about their readiness (or maturity) to initiate and support common research activities independently. This approach aims at positioning the ERA-NET scheme among European funding instruments. The ERA-NET scheme is in fact somewhere between simple coordination actions and Joint programming initiatives coming from Member States. The expected results of these investigations are to collect evidence of the progress of networks towards self sustainability. Self-sustainability can take various forms. Only the later steps of the traditional "ERA-NET four steps approach" are relevant to gauge "maturity". The three first steps do not vary a lot between actions which have to follow the same process. A "fifth step" can be added in order to complement the analysis. This "fifth step" covers all activities ERA-NETs actions are engaging in order to prepare the future of the network (development of a common vision regarding a sustainable cooperation, action plan for further activities, etc).

This methodological approach requires comprehensive information on the outcomes of ERA-NET activities. The availability and the quality of the final reports are crucial to build a strong and consistent approach assessing the progress towards self-sustainability. Different ways to collect

information are envisaged. These include a survey targeting coordinators, requests for full final report from coordinators, and selected case study interviews with coordinators.

#### 4.2.3. Contributions of ERA-NETs to alignment: use of case-studies

ERA-NETs may have impacts that go beyond the core objectives of the instrument, and relate to other challenges with regard to transnational collaboration in research programming. In order to capture potential additional added value from ERA-NETs, the use of the following three frameworks are proposed:

- The four dimensions of policy co-ordination with regard to transnational research programme collaboration: Systemic, Horizontal, Vertical, Temporal (see also NETWATCH Policy Brief N$^{O}$ 2)
- The five generic programming functions: scoping and initial commitments; calls, proposals and peer review; running and monitoring; IP and use of results; and evaluation (see Könnölä & Haegeman, 2012)[41].
- The six ERA dimensions: People, Infrastructure, Organisations, Funding, Knowledge circulation, Global cooperation. However, this is being updated to reflect the five priorities[42] of the 2012 ERA Communication, as well as to include additional aspects as part of Europe 2020[43] with regards to the completion of the ERA.

Below the methodology is tested with the pilot case of WoodWisdom-NET and WoodWisdom-NET2[44]. For the selection of additional cases, it is proposed to focus on those that have experienced some continuation. In particular, it is proposed to select one case from each type of continuation (see graph under section 4.3). As eight different types of continuation are identified, eight cases need to be selected.

[41] T. Könnölä 6 K. Haegeman, Embedding foresight in transnational research programming, Science and Public Policy (2012) 39 (2): 191-207.

[42] The five priorities are 'More effective national research systems', 'Optimal transnational co-operation and competition', 'An open labour market for researchers', 'Gender equality and gender mainstreaming in research' and 'Optimal circulation, access to and transfer of scientific knowledge including via digital ERA' (COM(2012) 392 final - "A Reinforced European Research Area Partnership for Excellence and Growth" 17 July 2012. Available at: http://ec.europa.eu/research/era/pdf/era-communication/era-communication_en.pdf).

[43] The ERA Fabric Map identifies a set of additional aspects with regard to ERA that are part of the Europe 2020 strategy. Examples are RDI state aid, standardisation, support to SMEs, etc. See http://www.eravisions.eu/attach/0_D6.1_-_ERA_Fabric_Map.pdf.

[44] Analysis based on the following reports: Evaluation of the WoodWisdom-Net research programme, Phase 1, WoodWisdom-Net 2 - Report No. 2/2012; Handbook of the WoodWisdom-NET research programme, WoodWisdom-Net 2 - Report No. 1/2012.

**Table 6 How are dimensions of policy co-ordination addressed? The case of WoodWisdom-NET(2)**

| Dimension of policy coordination | Concrete problems detected | WoodWisdom-NET(2) Results – what is achieved? | WoodWisdom-NET(2) Actions – How is it achieved? |
|---|---|---|---|
| Alignment of research systems (Alignment of structural and systemic differences in national research systems) | Geographical distribution of the R&D activity uneven, in terms of quality of financing, organization, and scientific and technical excellence.<br>Differences in the level of overview, organization and focus of the R&D activity in the Forest Based Sector among MSs<br>Extent and dynamics of building competencies (or lack thereof) varied among countries. | FBS research visible in the European Science Community<br>Transnational research is being stimulated.<br>Confidence and trust is established between different funding partners for future joint activities.<br>Multinational composition of the consortium is required. | |
| Vertical co-ordination (Co-ordination between local, regional and (inter-) national levels) | Lack of skills with regard to networking, communication, marketing. | Co-ordination of priorities with the ETP and with the WPs of FP7.<br>Improvement of the communication and marketing skills within the science community | Active presence of programme managers at all important conferences and meetings within the sector.<br>Officials[45] in funding organisations became more aware and able to shape RD&I activities in the sector at the national level and to harmonise them at the EU level.<br>Researchers and managers from academic institutions and industry became more aware of the need to and benefits of promoting and implementing their knowledge in the international setting (conferences, meetings, and collaborative project applications)<br>In general: basic understanding was developed that getting the information on the latest challenges and opportunities in the sector, and active participation of academia and industry in shaping RD&I policy is crucial for transforming the sector.<br>Priority setting in coordination with ETP (and their SRA) and the WPs of FP7. |
| Horizontal co-ordination (Co-ordination between research, innovation and other policy areas, such as competition, regional, financial, employment and education policies). | Need to address wood related research in an interdisciplinary way | Wood related research has been opened-up to other domains (biorefinery, nanotechnology, biotechnology)<br>Findings and instruments of other domains are being used within the FBS<br>Researchers and research managers developed competences in collaboration and leadership of medium-sized projects (between 0.5 and 2 M euro per project)<br>Communication between industrial partners and researchers from academic institutions not optimal. | Multidisciplinary call topics, e.g. Call title: "Sustainable forest management and optimized use of lignocellulosic resources - Bridging gaps between research disciplines, producers, consumers and society"<br>WoodWisdom ERA-NET established open communication among project managers and organized starting, mid-term and final conferences for the project teams for each call for proposal. Aim: networking and evaluating the scientific and industrial competence and reliability of the involved partners.<br>Close collaboration and involvement in the FBS Technology Platform activities. |
| Temporal co-ordination (Ensuring that policies continue to be effective over time and that short term decisions do not contradict longer-term commitments ("dynamic efficiency") | Need for flexibility over time | Flexibility to adapt the variable geometry over time | Workshop to ensure alignment between future calls and the academic, industrial, health and clinical needs, aiming to identify strategic priorities for actions, training and research.<br>Future call frameworks and guidelines for setting up project consortia agreements should better encourage opening up projects for joining of new partners (see excellent experience from the HEMIPOP project). |

[45] Often those officials represent the ministries overseeing S&T and/or Forestry; therefore they are e.g. able to better inform their respective Programme Committee Members for the preparation of Work Programmes in the FP.

**Table 7 How does alignment take place in each of the programming functions? The case of WoodWisdom-NET(2)**

| Function | WoodWisdom-Net(2) |
|---|---|
| Scoping and initial commitments<br>Scoping is initiated by the systematic analysis and sense-making of the context, and followed by the identification of research/innovation topics and societal challenges. The programme design and initial funding commitments are made, appropriate processes for transnational programming are initiated. | Co-ordination of priorities with the WPs of FP7 and with the ETP.<br>Basic understanding was developed that getting the information on the latest challenges and opportunities in the sector, and active participation of academia and industry in shaping RD&I policy is crucial for transforming the sector. |
| Calls, proposals and peer-review<br>Calls for proposals are prepared and disseminated in order to receive project proposals, which becomes a subject of peer-review and finally selection of projects to be funded with a transnational programme. | Higher involvement needed of industry in preparing future calls.<br><br>Evaluation of proposals should receive a bigger industrial input.<br><br>Use of trial-and-error (e.g. with regard to basic vs applied research focus, 1 vs 2-step decision process, funding modes) helps to build good decision-making capacity among participating funding partners.<br><br>Best practice examples in project preparation and evaluation procedures were used to harmonise and simplify them. |
| Running and monitoring<br>Running a transnational programme is a subject of effective administration and execution of projects. Monitoring refers to on-going control and evaluation of the project performance. | Good and fast communication channels between project managers were established.<br><br>Open communication among project managers through starting, mid-term and final conferences for the project teams for each call for proposal. |
| IP and use of results<br>Intellectual property (IP) issues are addressed within the transnational framework in order to have mutual agreement on the use of results. | Develop examples/templates of IPR issues resolution in project consortia.<br>Close collaboration and involvement in the FBS Technology Platform activities.<br><br>For calls that are relevant for industry, and esp. SME's: Increasing participation cn be achieved e.g. through simplification of rules and 1-step selection procedure, active help in project proposal development and project administration (offer training, write guidance notes, prepare templates, etc.) |
| Evaluation<br>Evaluation of the transnational programme refers to appropriateness, effectiveness and efficiency in the execution of the whole programme and its parts. | Project is evaluated on the following topics:<br>Organizational and administrative issues of the (1st) joint call; impact of the research projects on the transnational science community; impact on the development of the European innovation environment (competences developed; transnational added value; impacts on networking in and outside the sector; industry involvement; support to innovation); findings supporting future calls.<br><br>Improvement needed in building competences from the evaluation of the projects deliverables' impact on the economy and the environment |

**Table 8 How does alignment take place in each of the ERA dimensions? The case of WoodWisdom ERA-NET**

| ERA dimensions | WoodWisdom ERA-NET results | WoodWisdom-NET(2) Actions |
|---|---|---|
| People: Realising a single labour market for researchers | Very good involvement of early stage researchers (many MSc and PhD theses were completed in the duration of the projects). This enhances the future research activities of the sector and guarantees further strengthening of the ERA. Alternative, non-formal educational activities were important, as well as the RECELL summer school. | |
| Infrastructure: World-class research infrastructures (RIs) | Identify and support the most promising project outcomes for their application to the EC-supported financing of demonstration activities. | |
| Organisations: Excellent research institutions | | |
| Funding: Well-coordinated research programmes and priorities | Transnational added value: National research programmes have been adapted to close gaps and to avoid overlaps<br>Integration of funding organisations creates a possibility for larger projects and for the integration of RD&I along the innovation chain and for minimising unnecessary duplication. The same is true for the integration along the value chain of the FBS. | |
| Knowledge circulation: Effective knowledge sharing | Very good industry participation<br>Very good publication record | Guidance for the preparation of proposals indicates that proposals should bring together partners along the whole innovation chain from basic and applied research to industrial development.<br>Priority setting in coordination with ETP (and their SRA) and the WPs of FP7.<br>Good involvement in the set up and improvement of international standards and norms (see FireInTimer and GRADEWOOD) |
| Global cooperation: A wide opening of the European Research Area to the world | Degree of international cooperation: good overall, esp. from Brazil and Canada. | Guidance for the preparation of proposals indicates that proposals should promote the participation of researchers outside the EU |

### 4.2.4. Review of case study method and further requirements

The analysis of the case presented above suggests that the impacts of ERA-NETs can be much wider than the core objectives of the ERA-NET scheme. For instance, the case suggests that ERA-NETs can have more intangible impacts, such as establishing confidence and trust between national partners of different countries, improving skills of ERA-NET partners (with regard to networking, marketing, etc), increasing the understanding that research programming should be multidisciplinary and connected to the latest developments in the sector.

The case also shows an important role for the private sector, both in research and in innovation. WoodWisdom-Net collaborates closely with the relevant European Technology Platform (e.g. on IP and the use of research results), and proposes to further increase this collaboration in the future. It is also suggested that industry takes a bigger role in both preparing future calls and in evaluating project proposals. In the case studied a very high level of attention was paid to the participation of SME's, with specific measures (such as simplification of procedures, active support in project proposal development and project administration, dedicated trainings, etc) to facilitate their participation and to support entrepreneurship.

Finally, the case indicates that ERA-NETs can have impacts that relate to the different dimensions of ERA. In terms of supporting Human Resources in S&T (HRST) the case showed a high involvement of early stage researchers, enhancing future research activities of the sector and strengthening researchers' mobility in the ERA. Also non-formal educational activities and a summer school contribute to HRST in the sector. In the case studied, projects with impact on demonstration were connected to research infrastructures. With regard to avoiding duplication and building critical mass, the case reports the possibility of building larger projects and integrating R&D&I, so not only research, but supporting integration along the whole innovation chain. Also, involvement in the design of international standards and norms is an example of integration further

down the innovation chain. Finally, the ERA-NET case analysed promotes the participation of researchers outside the EU, thus supporting global cooperation through the ERA-NET instrument.

A selection of additional cases will be needed, preferably from networks with a significant duration, in order to refine and substantiate this type of analysis.

## *4.3. Methodological approach using Network analysis*

### 4.3.1. Introduction to network analysis and definitions

The ERA-NET scheme was launched at the beginning of the FP6, in 2002. For 10 years, the ERA-NET principle has remained essentially the same but the research environment has changed in terms of funding mechanisms, organisational aspect and also researcher's behaviour. This methodological approach proposes to explore the different possibilities to use network analysis tools with information provided by the NETWATCH database. Network analysis provides structural parameters and graphs to measure changes and modifications occurred in networks between FP6 and FP7.

The analysis follows work underpinned by JRC-IPTS analysing networks in the European Framework Programmes (1984-2006) using social network analysis[46]. Network analysis can be used to demonstrate links between entities, and also to quantify and to qualify the position of entities among each other. These entities are named "nodes" or edges, and they are linked by lines called also "ties". Concretely, in the case of ERA-NET analysis, a node can represent a country, an organisation, and an S&T field.

In this analysis, we assume full connectedness between participants within an ERA-NET, that is to say we consider that all partners in the project collaborate with each other with equal intensity, although this may not always be the case in reality especially for large-scale research projects.

Network analysis can bring added value to the impact assessment if it reveals a change from a starting point or a reference (date, period…). This type of analysis allows key players in a network to be revealed[47], those who are the more connected or those playing a particular role. This type of analysis can enlighten changes in a network according different criteria with limit for each ones.

The NEMO project was a three-year project supported by the New and Emerging Science and Technology programme of the sixth Framework Programme of the European Commission. NEMO described ways to optimise the structure of R&D collaboration networks for creating, transferring and distributing knowledge using social network analysis. In empirical determinations of the network properties, characteristics similar to those of other collaboration networks have been observed, including scale-free degree distributions, small diameter, and high clustering. Some plausible models for the formation and structure of networks with the observed properties have been presented[48].

Indicators can be calculated either at node or at network level. The position and the role of each node are measured with centrality indicators representing a family of concepts of characterizing the

[46] Heller-Shuh et al (2011) "Analysis of networks in European Framework Programmes (1984-2006)"JRC-IPTS, Luxembourg: Publications Office of the European Union (EUR 24759 EN-2011)

[47] Borgatti, S.P. 2006. Identifying sets of key players in a network. Computational, Mathematical and Organizational Theory. 12(1): 21-34

[48] Barber, M., A. Krueger, T. Krueger and T. Roediger-Schluga (2006), The network of EU funded research & development projects, Phys. Rev. E, 73: 036132.

structural importance of a node's position in a network (see definitions of concepts in Section 6.2 – Annex 2). The coherence of a network can also be measured allowing the characteristics of a network (density, clustering, compactness, etc) (see Box 1).

#### 4.3.2. Evaluative questions for network analysis

Network analysis can be useful to answer evaluation questions assessing the change between periods, the stakeholder's behaviour or revealing key players. The analysis results from an interpretation of graphs and figures that need to be complemented with other investigations.

The network analysis aims at providing answers (partial or complete) to the following questions:

- What are the main collaborations links between countries according research fields?
- What are the main key players in the networks according research?
- What are the main patterns of collaborations between organisations?
- What is the evolution of networks pattern between FP6 and FP7?

We examine the relevance for using network analysis for selected evaluation questions (see box below) anticipating the results given at different levels. The availability of data enables the treatment of the first two questions. The NETWATCH database is the source of information to achieve network analysis. Nodes represent, in this case, organisations, ministries, funding agencies and the links between nodes represent collaboration in ERA-NETs.

ERA-NETs have been distributed among 12 research fields in order to deliver and compare sound network analyses for each of them (see Box 2). It should be noted that an ERA-NET with a large scope can be assigned to several research fields.

**Box 1 List of impacts possibly investigated through network analysis**

i. Does ERA-net scheme have an impact on ERA fragmentations?

Hypothesis: ERA-NETs contribute to bridge the gap in terms of country participation in FP7.

Social Network Analysis (SNA) relevance:

ii. Does the ERA-NET scheme have an impact on countries' participation in European collaborative research?

Hypothesis: ERA-NETs contribute to bridge the gap in terms of country participation in FP7.

SNA relevance: network analysis can be used by comparing FP6 with FP7 ERA-NET networks (the evolution of the collaboration between countries or funding organisations).

iii. Does the ERA-NET scheme have impact on Research organisations?

Hypothesis: ERA-NETs contribute to bridge the gap in terms of organisation participation in FP7 by helping research organisations to participate to collaborative project with less constraint and competition than normal FP7 calls.

The ERA-NET scheme helps at bridging the gap in terms of participation of research organisations in international collaborative research project in joint calls (ERA-NETs considered as a first step towards collaborative project at international level). The joint calls of ERA-NETs give the opportunity to countries and research organisations to participate in transnational projects.

SNA relevance: Analysis comparing the organisations networks created by FP calls and ERA-NET joint calls could be interesting in order to know if the key players are the same and if newcomers could emerge from joint calls. This type of analysis could be achieved at S&T level. Although the relevance of the network analysis, it is not possible to perform because NETWATCH does not provide the beneficiaries of joint calls launched by ERA-NETs.

iv. Does the ERA-NET scheme have an impact on science production

Hypothesis: ERA-NETs contribute to bridge the gap in terms of science and research by covering scientific topics not covered by the FP7. Requires a comparison between publications and patents produced in collaborative projects funded by joint calls.

SNA relevance: Network analysis is not relevant and NETWATCH does not provide the information.

### 4.3.3. Main findings through network analysis

Several indicators can be used to describe the characteristics of a network (size, coherence, density, etc).The objective here is to describe network profiles for FP6 and FP7 and to assess the difference between the two periods and the consequent impact that can be elucidated.

In order to realise the most relevant analysis as possible, ERA-NET actions have been distributed into 12 research fields and one "box" dedicated to transversal ERA-NET. Mean values encompassing all ERA-NET actions gives a general overview about the trend between FP6 and FP7 (see Table 9).

Table 9 reveals that the mean indicators have increased between the FP6 and FP7. The average number of participants per ERA-NET, which has a direct positive influence on the number of connections by organisations, has increased. The density indicators which represent the ratio of the numbers of links in the networks over the total number of possible links and the clustering coefficient (see definition in **Error! Reference source not found.**) has also increased between the two periods.

The overall increase in structural indicators reveals changes in networks funded by the ERA-NET Scheme. More organisations are participating in FP7 and they appear more collaborative because they are more connected to others. These observations regarding structural changes in networks between FP6 and FP7 indicate an increase in coordination of European research over the time

period with some variation between the research fields (see Section 4.3.4 for a detailed analysis of Health and Annex 2 for data related to the other fields).

According to the research fields, those appearing less fragmented than in the FP6 are health, environment, industrial production processes and the social sciences and humanities. The food research field, despite a significant increase in the average number of connections by organisations, shows a slight decrease in the other indicators due to large FP7 ERA-NETs with participants that are less well connected with the rest of the network. This situation can be explained as the research field encompasses more transversal ERA-NETs not specifically dedicated to the field but which contains a component related to health (RURAGRI, ICT-AGRI, EMIDA, EUROTRANSBIO, ARIMnet).

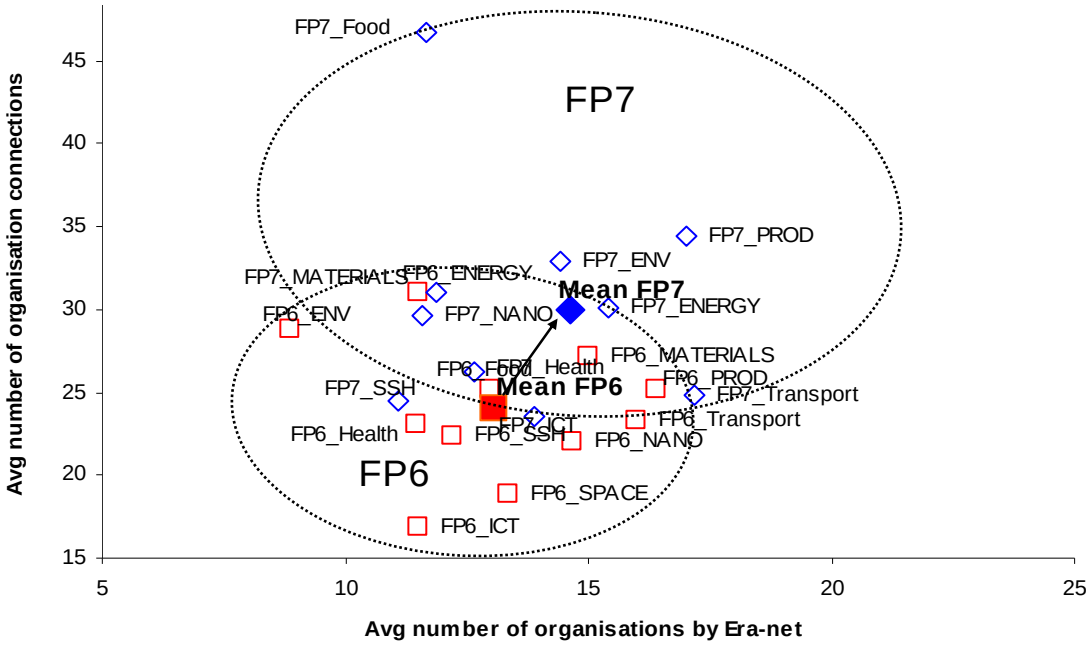
Indicators concerning space and security research fields are difficult to interpret due to the low number of ERA-NETs.

**Table 9 Structural indicators in research fields**

| | FP | Health | Food, Agriculture and fisheries | Information and communication technologies | Environment | Energy | Nanosciences,nanotechno | New materials | Industrial production processes | Transport | Social sciences and humanities | Space | Security | *No specific thematic focus/transversal ERAnet* | **Mean** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| numbers of ERA-net | FP6 | 15 | 9 | 2 | 17 | 10 | 3 | 4 | 5 | 4 | 11 | 3 | 1 | *7* | **7,5** |
| | FP7 | 12 | 12 | 8 | 12 | 7 | 5 | 7 | 6 | 5 | 10 | 1 | | *9* | **7,7** |
| number of nodes (participants) | FP6 | 172 | 117 | 23 | 151 | 115 | 44 | 60 | 82 | 64 | 134 | 40 | 12 | *89* | **91,1** |
| | FP7 | 152 | 140 | 111 | 173 | 108 | 58 | 83 | 102 | 86 | 111 | 24 | | *103* | **104,4** |
| Number of ties (links) | FP6 | 3965 | 2943 | 389 | 4350 | 3573 | 968 | 1629 | 2067 | 1490 | 3003 | 756 | 144 | *2262* | **1.800,4** |
| | FP7 | 3982 | 6533 | 2612 | 5693 | 3247 | 1717 | 2572 | 3515 | 2134 | 2722 | 625 | | *2861* | **2.671,6** |
| Avg Number of organisations by ERA net | FP6 | 11,5 | 13,0 | 11,5 | 8,9 | 11,5 | 14,7 | 15,0 | 16,4 | 16,0 | 12,2 | 13,3 | 12,0 | *12,7* | **13,1** |
| | FP7 | 12,7 | 11,7 | 13,9 | 14,4 | 15,4 | 11,6 | 11,9 | 17,0 | 17,2 | 11,1 | 24,0 | | *11,4* | **14,6** |
| Avg number of connections by organisations | FP6 | 23,1 | 25,2 | 16,9 | 28,8 | 31,1 | 22,0 | 27,2 | 25,2 | 23,3 | 22,4 | 18,9 | 12,0 | | **24,0** |
| | FP7 | 26,2 | 46,7 | 23,5 | 32,9 | 30,1 | 29,6 | 31,0 | 34,5 | 24,8 | 24,5 | 26,0 | | | **30,0** |
| Clustering coefficient | FP6 | 0,736 | 0,699 | 0,465 | 0,77 | 0,809 | 0,889 | 0,849 | 0,834 | 0,82 | 0,702 | 0,94 | | | **0,774** |
| | FP7 | 0,787 | 0,687 | 0,866 | 0,79 | 0,845 | 0,883 | 0,792 | 0,861 | 0,792 | 0,778 | | | | **0,826** |
| Density | FP6 | 0,118 | 0,19 | 0,091 | 0,16 | 0,229 | 0,471 | 0,419 | 0,28 | 0,368 | 0,151 | 0,44 | | | **0,264** |
| | FP7 | 0,152 | 0,173 | 0,201 | 0,17 | 0,256 | 0,46 | 0,333 | 0,316 | 0,278 | 0,187 | | | | **0,321** |
| Compactness | FP6 | 0,353 | 0,479 | 0,305 | 0,49 | 0,583 | 0,736 | 0,71 | 0,589 | 0,674 | 0,451 | 0,47 | | | **0,531** |
| | FP7 | 0,461 | 0,45 | 0,519 | 0,45 | 0,578 | 0,73 | 0,666 | 0,486 | 0,492 | 0,438 | | | | **0,570** |

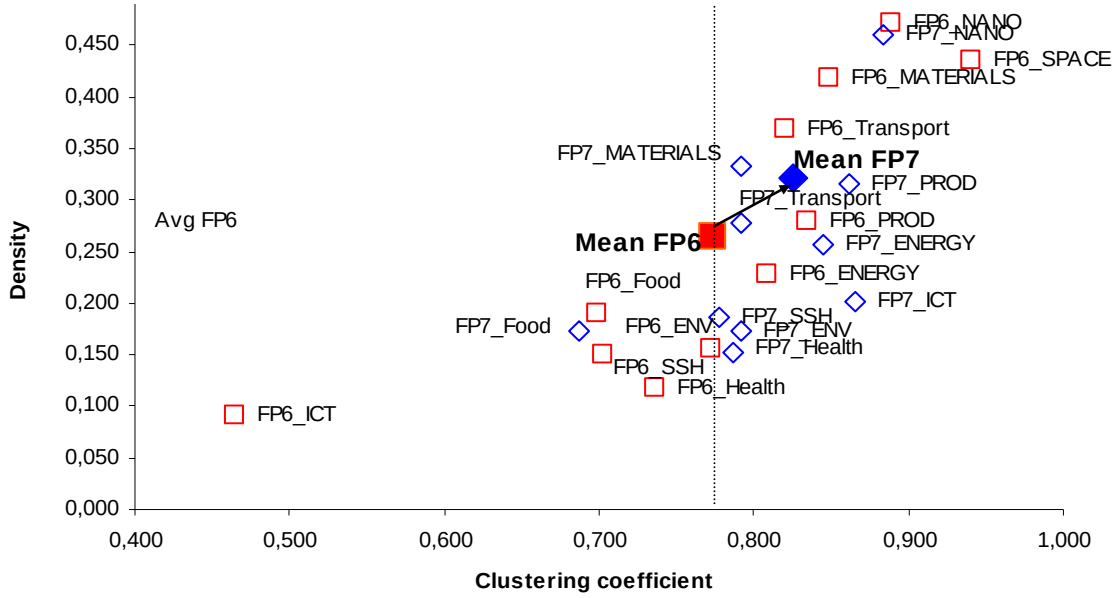
The change between the FP6 and FP7 in terms of network structure does not reveal strong disparities between research fields (see Figure 5) but mean values have drastically increased. The following figure show a correlation between the number of organisations participating in ERA-NETs and the number of connections by organisation, which has increased at a faster rate.

**Figure 5 Evolution of ERA net profiles according research fields**




Density and the clustering coefficient are correlated, meaning that the more a network has a high density then usually the more its cluster coefficient is high (see Figure 5). For a vast majority of fields the trend is towards a higher density combined with a higher cluster coefficient between FP6 and FP7, except the field of transport for larger extent and Nanosciences for a lesser extent. This general trend shows an increase in collaboration between organisations participating in ERA-NETs between the FP6 and the FP7 with some disparities between research fields.

**Figure 6 Structural evolution of FP6 and FP7 research fields**




### 4.3.4. The case of the health research field

15 FP6 ERA-NETs[49] and 12 FP7 ERA-NETs[50] are focused on aspects of health research. Among the 15 FP6 ERA-NETs, five of them have continued under FP7 either through an ERA-NET Plus scheme or a traditional ERA-NET instrument[51] (for the data relating to the other research fields see Annex 2).

Figure 7 shows the position of ERA-NETs in networks according to the links between participants. The more central position a participant has the more it is connected to others who have a central position themselves.

Most ERA-NETs occupying a central position in FP6 have continued under FP7 (ERA-NET or ERA-NET Plus). That is the case for EUROTRANSBIO, E-RARE, ERAsysBIO and ERA AGE. If we consider core and periphery areas of the graphs, it is interesting to note that ERA-NETs situated in the core of the network in FP6 are situated in the periphery in FP7. This means that the FP6 key players have changed (at least partially) in FP7. The group of organisations constituting the core of the network under FP6 moved partially in several groups to the periphery to leave the central space to other organisations. The main explanation for this change would be the introduction of new topics in the FP7 work programme attracting FP6 participants but also new organisations.

Project labels in the following figures have been placed manually according the position of nodes representing organisations involved in ERA-NETs. Further development of network analysis could be to consider groups of nodes as project and examine their evolution over time (see Box 3 Further possible Development).

[49] ALLIANCE-0; ERASysBio; NEW OSH ERA; CoCanCPG; E-Rare; ERA-AGE; ERA-PG; EUROTRANS-BIO - FP6; HESCULAEP; NET-BIOME; NEURON; PathoGenoMics; PRIOMEDCHILD; SAFEFOODERA; SPLASH - EUWI ERA-NET

[50] ERASysBio+; E-Rare-2; EMIDA; ERA-AGE 2; ERA-ENVHEALTH; ERA-Instruments; ERA-NET NEURON II (under preparation); EUROCOURSE; EuroNanoMed; EUROTRANSBIO (ETB-PRO); HIVERA; LEAD ERA; TRANSCAN

[51] It should be noted that the ERA-NEURON II (which is the following of the FP6 ERA-NET NEURON) is considered under preparation by the Netwatch platform and cannot be integrated in the network analysis.

**Figure 7 Position of ERA-NETs according links between participants in the FP6**

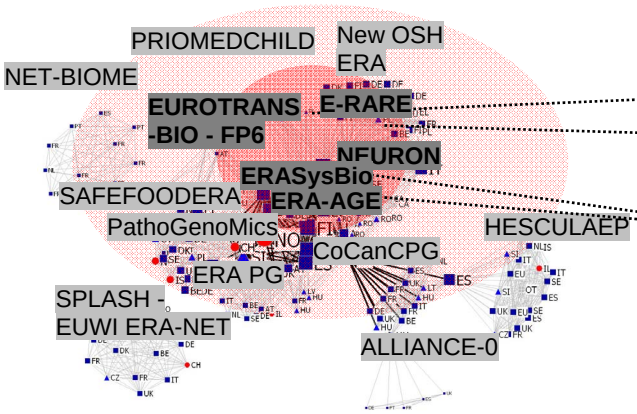
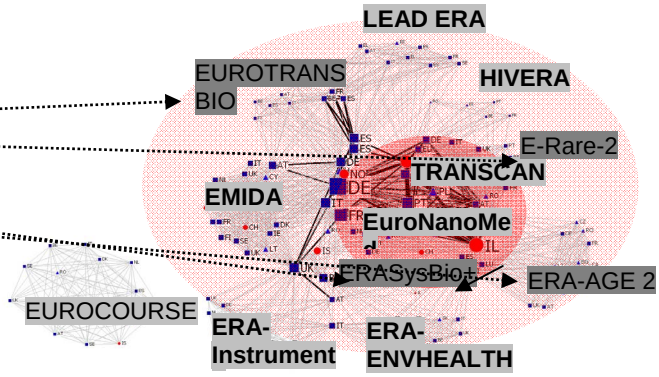



**Figure 8 Position of ERA-NETs according links between participants in the FP7**




A key player can be defined as an entity that holds a central position in a network. The entity is well connected to other well-connected entities. This "status" is also directly influenced by the organisation of research in participating countries. The more a system is centralised the less the number of participating entities. The consequence is that the first key players do not always come from the countries with the largest countries in ERA-NETs. A comparison between the FP6 and the FP7 in the ranking (see Table 10 and Table 11) reveals newcomers.

In the field of health research, organisations from Associated Countries are particularly well ranked (i.e. Israel Ministry of health, the research council of Norway in the FP6) in terms of number of connections with other organisations but also in terms of other centrality indicators. In our case, a centrality indicator is closeness centrality. The Turkish public agency Tubitak appears as a new comer in this top 10. Further investigations regarding key players could reveal different strategies among countries.

**Table 10 Ranking of the 10 first key players in the FP6**

| ID | label | Country | Degree | Closeness |
|---|---|---|---|---|
| CSO_MOH_IL | Ministry_of_Health | IL | 56 | 4.847.000 |
| RCN_NO | Research_Council_of_Norway | NO | 56 | 4.871.000 |
| AKA_FI | Academy_of_Finland | FI | 53 | 4.874.000 |
| DLR_DE | German_Aerospace_Center | DE | 49 | 4.878.000 |
| ANR_FR | National_Research_Agency | FR | 47 | 4.880.000 |
| MHEST_SI | Ministry_of_Higher_Education_Science_and_Technology | SI | 45 | 4.901.000 |
| MICINN_ES | Ministry_of_Science_and_Innovation | ES | 45 | 4.882.000 |
| FCT_PT | Foundation_for_Science_and_Technology | PT | 44 | 4.906.000 |
| MR_DR_FR | Ministry_of_Research | FR | 43 | 4.907.000 |
| PTJ_FZJ_DE | Project_Management_Juelich_Research_Centre_Juelich | DE | 43 | 4.903.000 |

**Table 11 Ranking of the 10 first key players in the FP7**

| ID | label | Country | Degree | Closeness |
|---|---|---|---|---|
| BMBF_DE | Federal_Ministry_of_Education_and_Research | DE | 87 | 2.465.000 |
| CSO_MOH_IL | Ministry_of_Health | IL | 76 | 2.476.000 |
| ANR_FR | National_Research_Agency | FR | 64 | 2.488.000 |
| TUBITAK_TR | The_Scientific_and_Technological_Research_Council_of_Turkey | TR | 63 | 2.489.000 |
| FCT_PT | Foundation_for_Science_and_Technology | PT | 50 | 2.502.000 |
| ISS_IT | National_Institute_of_Health | IT | 50 | 2.514.000 |
| MOH_MDS_IT | Ministry_of_Health | IT | 48 | 2.504.000 |
| RCN_NO | Research_Council_of_Norway | NO | 48 | 2.504.000 |
| BBSRC_UK | Biotechnology_and_Biological_Sciences_Research_Council | UK | 47 | 2.515.000 |
| ISCIII_ES | Institute_of_Health_Carlos_III | ES | 45 | 2.507.000 |

The structural indicators of networks show that participants are more and better connected in FP6 than FP7. Participants with multiple collaborations with others constitute the core group of a network (i.e. participation to more than one ERA-NET with the same partner). We note that for 172 distinct participants in FP6 (for the health research field), only 12 (6,9%) are involved in a multiple collaboration with other participants (see Figure 9). Under FP7 (see Figure 10), the shape of the

core group changes drastically with more repeated connections and newcomers (i.e. Tubitak etc). Of 152 participants, 14 entities are involved in networks implying more than two connections with other participants. These observations lead to the conclusion that, while there are fewer ERA-NETs in FP7 than FP6 (12 versus 15), the core group of the network in the filed of health research appears larger and stronger in FP7.

**Figure 9 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

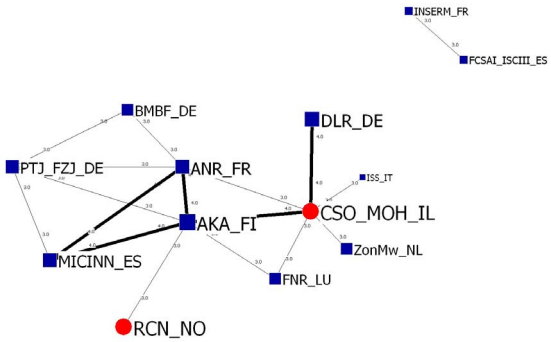



**Figure 10 Strongest collaborations between organisations in the FP7 (more than TWO collaborations)**

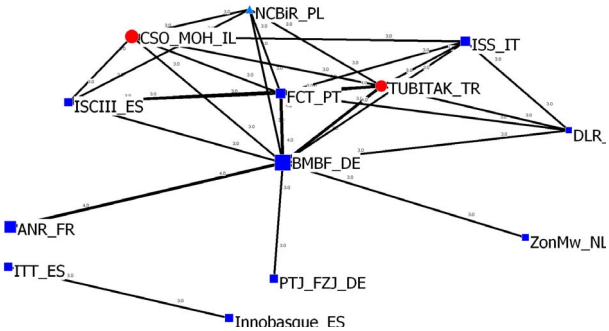


**Figure 11 Links between organisations in ERA-NETs in the Health research field in the FP6**

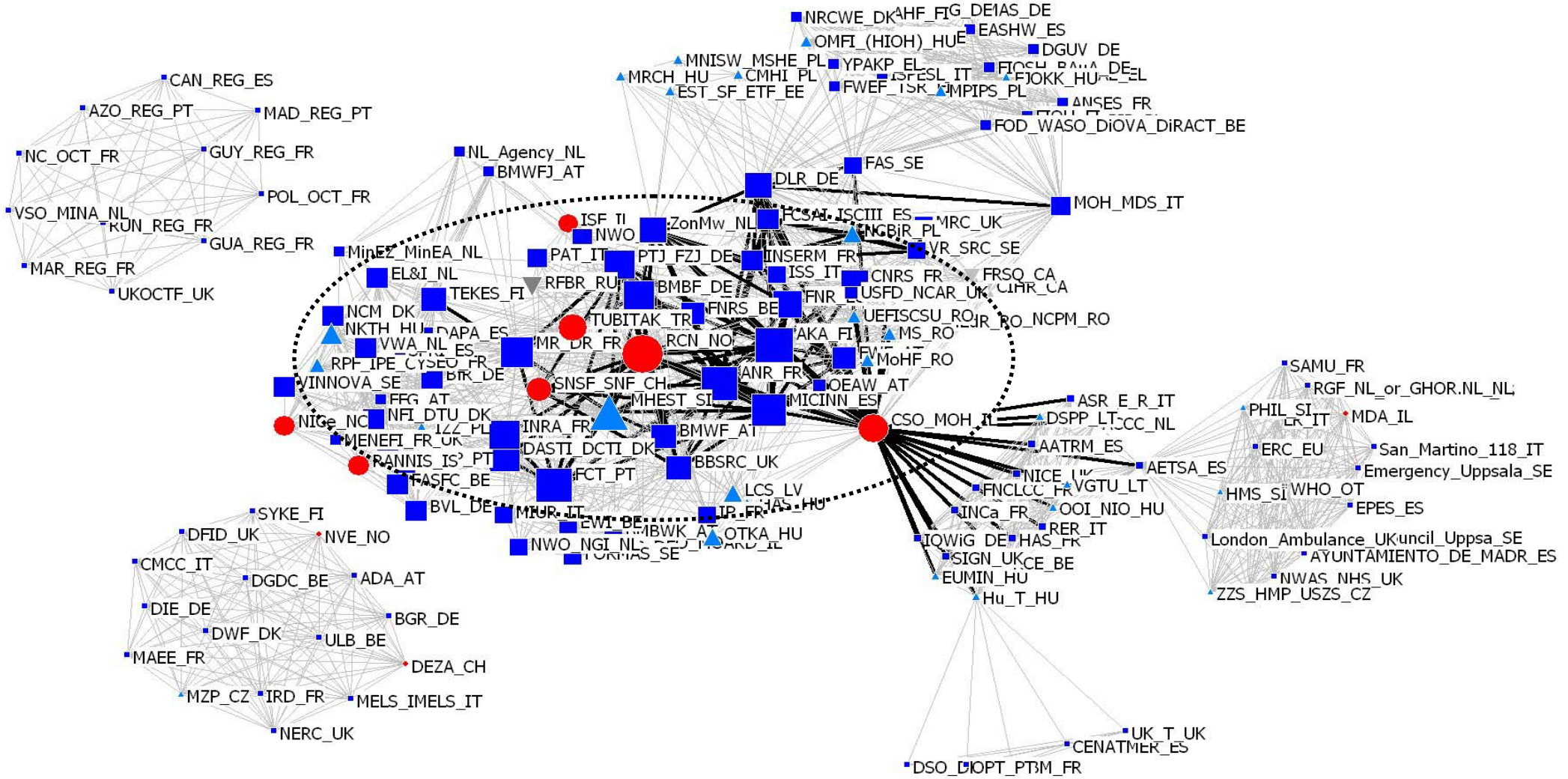
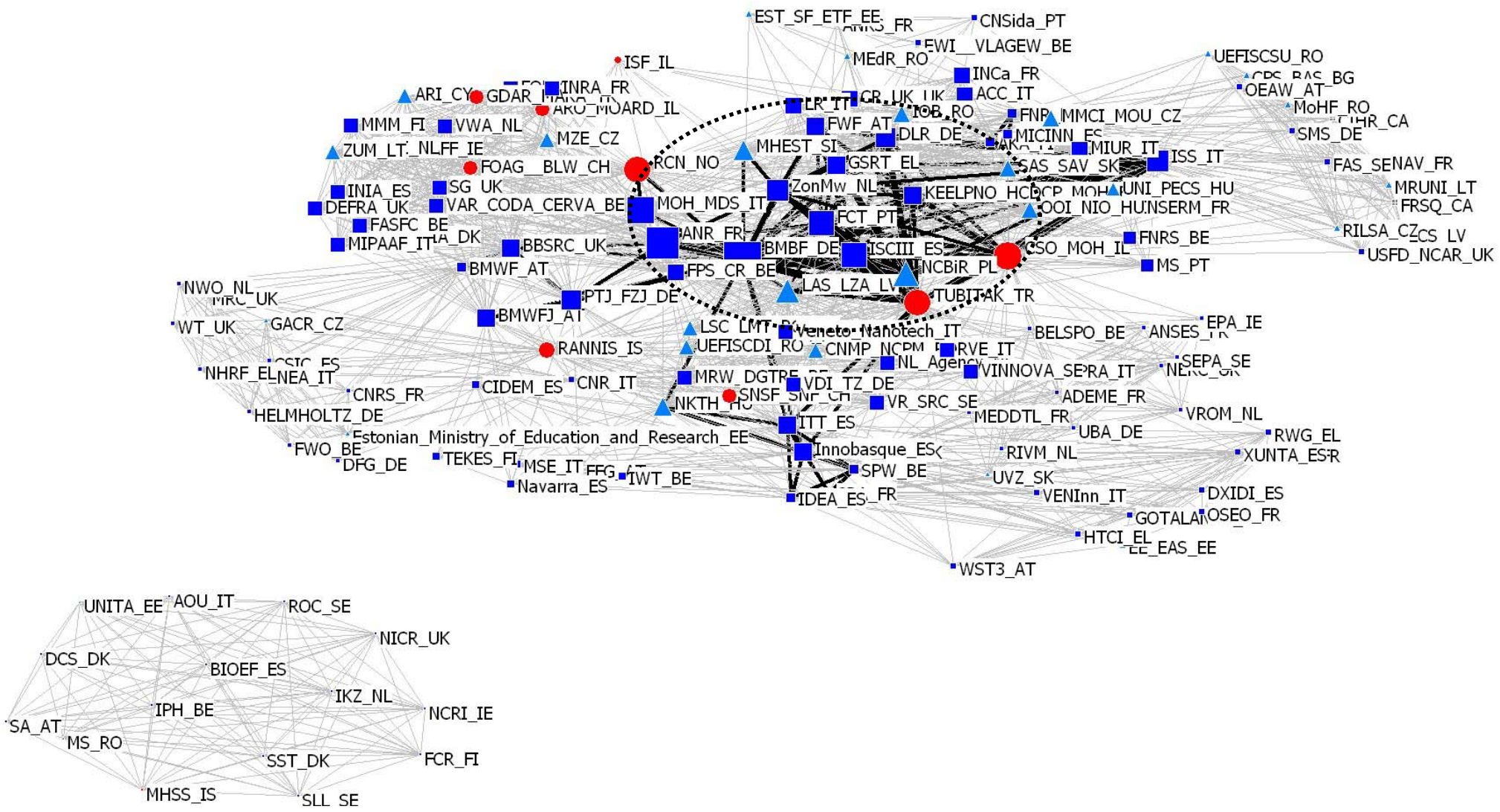


**Figure 12 Links between organisations in ERA-NETs in the Health research field in the FP7**



This section on network analysis shows that it can be a relevant tool to assess the structuring effect of the ERA-NET scheme on building ERA. It can reveal the changes in the pattern of collaboration over the time (by diachronic[52] analysis) and also the main collaboration axes between stakeholders, the groups of participants (clusters) and the main key players around the whole network is structured (by synchronic analysis). Further development of the use of network analysis can be envisaged in order to better assess the structural change of a network.

**Box 2 Further possible development though network analysis**

So far, the network analysis has observed structuring effects of ERA-NET actions on participating organisations. Indicators have been provided at network level (i.e. clustering coefficient, coherence measures) and at organisation level (centrality indicators). Group level has been considered only in the analysis discussion.

Instead of organisations taken individually, further development could consider groups of participants formed by projects in order to observe how they are evolving over time. Concretely, indicators and centrality measure would be calculated for a starting period and the evolution of the indicators would be observed over time.

The measure of the structuring effect of ERA-NET actions on ERA building could be achieved by using participant centrality measures **as a proxy to** consider groups of participants as evolving entity. The objective would be to answer to the following questions :

- How are networks evolving over time?
- How to follow a group of participants in a global network?
- How to measure the structuring role of actions in a global network?
- etc

### 4.3.5. Review of network analysis method

One of the primary objectives of the ERA-NET scheme is to encourage collaboration between stakeholders in charge of the programming and funding research activities at national level in order to create synergies at European level and reduce the fragmentation of the ERA.

Network analysis revealed some important issues for the impact assessment by showing the change over time in patterns of network structures. Between FP6 and FP7, participants are better connected and networks more concentrated.

Another aspect revealed by network analysis is the stakeholder's behaviour in terms of collaboration. Key players are revealed not only by the extent of their participation in ERA-NETs but also by their position in the network (centrality).

Network analysis combines elements of both quantitative and qualitative analysis. The interpretation of graphs and figures needs to be complemented with the results of other research. Further investigation would show the evolution of networks between FP6 and FP7 by considering group of stakeholders instead of stakeholders one by one. This hypothesis comes from the assumption that a network built for the first time keeps its core of participants in the following projects. Strong and relevant networks are usually sustainable for other ERA-NET but also for other instruments such as JPI.

[52] Analysis relating to, or dealing with phenomena as they occur or change over a period of time. In our case it would be two periods : the first period covered by FP6 and the other by FP7

# 5. First conclusions and future development

## *5.1. Overall findings*

Three distinct methodological approaches have been assessed in this report (see section 4) in order to determine their appropriateness in responding to a set of evaluative questions (see section 2).

Initial results from the methodological approaches proposed provide a basis for assessing the merits of utilising the approach further. The overall findings may then help determine whether such a combination of approaches is appropriate and to assess the future data collection needs of the NETWATCH platform.

The maturity of ERA-NET networks, defined by the progress towards self-sustaining networks indicated by the activities that they have undertaken (proxy to indicate the relative capacity of organisations to cooperate between each other on a precise or broad topic), was examined. The overall scheme centres on the four-step ERA-NET process, with a fifth step added to better measure the transition between EU-supported and self-sustaining networks. This approach should be as exhaustive as possible, although is highly dependent on the availability of information produced, in most cases, by ERA-NETs themselves (descriptions of work and full final reports).

ERA-NETs may have impacts that go beyond the core objectives of the instrument. Analysis of specific ERA-NETs can reveal impacts of a different nature. A test analysis based on an initial case study suggests that ERA-NETs can contribute to improving trust, confidence and skills of partners. In specific areas, they may also have impacts that go beyond research, along the innovation chain, involving industry in priority setting, call preparation, proposal evaluations. By actively involving SMEs, ERA-NETs can also support entrepreneurship. ERA-NETs can also have substantial impacts on the different dimensions of the European Research Area, e.g. with regard to training and mobility of researchers, alignment of international standards, and internationalisation in R&D&I.

Network analysis has also been used in order to explore, predominately, the change in network structures between FP6 and FP7. The overall increase of structural indicators reveals changes in networks funded by the ERA-NET scheme. At the level of the participant organisation, more organisations are participating in FP7. Participating organisations appear more collaborative in FP7 than in FP6 because they are more connected to others according network indicators. These observations regarding the structural change of networks between FP6 and FP7 reveal an increase in European coordination over the time period, although with evident disparities between research fields.

With regard to NETWATCH data collection and the descriptive statistics that are presented, some important issues have become apparent during the course of investigating an approach to the impact assessment of ERA-NETs. There is a need to improve the information related to joint activities. There are issues with regard to data quality. Consistent and comprehensive information on joint call budgets and participants, is lacking and could provide important information in relation to impact. With regard to the nature of the data collected there is a need to better understand what joint activities are actually undertaken and the outputs of such activities. Currently there is data on opinions about the importance of joint activities whereas more information is needed on activities actually undertaken

### *5.2. Discussion*

In complement to these main findings, the following remarks can be made with regard to the context of the impact assessment proposed in this report.

- The approach proposed focuses on ERA-NETs. Obviously, ERA-NETs are part of a wider set of instruments (such as Joint Programming). The relationship between ERA-NETs and this wider context needs to be considered to understand fully their impacts. Also the impacts of non-EU instruments, such as bilateral agreements between different countries, should be better taken into account.
- The focus of the impact assessment is on EU level ERA objectives. As the ERA is composed of a set of different national and regional research systems, the objectives at national level with regard to participation in ERA-NETs should also be considered as they can have considerable impact on the success of the ERA-NET instrument.
- One indicator of success of the ERA-NET scheme could be the degree of continuation of ERA-NET actions. From a first analysis it appears that there are many different ways of continuation. We observe that a vast majority (62.5%) of networks formed with FP6 ERA-NET continue their activities with various funding schemes. Among those ERA-NETs most are funded through FP7 (ERA-NET and ERA-NET Plus). Among FP7 ERA-NET actions 42% comes from FP6 ERA-NETs, and the rest are 'new' initiatives. The self-sustaining networks registered in NETWATCH come mainly from FP6 ERA-NET actions directly, and the others were previously funded under both FP6 and FP7. What to conclude from this with regard to the success of FP7 with regard to continuation? At first sight it seems that FP7 succeeds in both offering support to continuation to existing networks and initiating new networks. A deeper analysis on continuation would however be needed to analyse why the different modes of continuation are chosen, why participants drop out or join, and so forth.

### *5.3. Future developments*

This report explored different ways to assess impacts of the ERA-NET scheme. The initial results suggest that there is further scope for the development in our methodological approaches. In brief, it is proposed to adapt and refine the methodology in preparing the next impact assessment report, with a particular focus on the following issues:

- The framework and evaluative questions will be revisited and refined. For example, question number two on the evaluation landscape could be considered as background and not really an impact question.
- The analysis of the maturity of ERA-NET in terms of distance to self-sustaining networks will be done in an exhaustive manner to obtain a more complete view of which type of ERA-NETs, in which research fields, are converging towards ERA building.
- This diversity of ways to continue programme collaboration in research programming offers a wider context for analysing potential impacts of those collaborations. Impact analysis could look at the diversity of continuations, and at the differences between them, as well as more focused examination of one specific type of network continuation format. Eight to ten ERA-NET actions could be selected according to specific criteria (origin, continuation, research field). These case studies would explore the four transnational research programme coordination dimensions (horizontal, vertical, systemic and temporal).

- Network analysis has shown interesting results and covered all ERA-NETs but a different and novel approach could be explored to observe groups of organisations evolving over time. The groups are based on organisations that cooperate in networks. This could help assess the impact of ERA-NETs in structuring the organisational relationships between European research funders.
- More detailed analysis of the joint activities, particularly outputs and outcomes, with an analysis of participations and funding contributions to joint calls.
- Optimisation of data collection, and integration of selected data on Joint Programming Initiatives.

# 6. Annexes

## *6.1. Annex 1 – NETWATCH information*

***Continuation to Self-sustaining***

| Country | Initial Network | Self-Sustained Network | Change |
|---|---|---|---|
| DE | 9 | 6 | -3 |
| NL | 9 | 7 | -2 |
| AT | 8 | 7 | -1 |
| FR | 8 | 4 | -4 |
| GB | 7 | 5 | -2 |
| PL | 7 | 5 | -2 |
| BE | 6 | 6 | 0 |
| SE | 5 | 5 | 0 |
| ES | 5 | 3 | -2 |
| DK | 4 | 3 | -1 |
| FI | 4 | 4 | 0 |
| IE | 4 | 5 | 1 |
| NO | 4 | 2 | -2 |
| PT | 4 | 2 | -2 |
| GR | 3 | 2 | -1 |
| CH | 3 | 3 | 0 |
| IT | 3 | 2 | -1 |
| HU | 2 | 2 | 0 |
| RO | 2 | 1 | -1 |
| IS | 1 | 1 | 0 |
| CY | 1 | 1 | 0 |
| LU | 1 | 0 | -1 |
| SI | 1 | 0 | -1 |
| TR | 1 | 0 | -1 |
| CZ | 0 | 1 | 1 |
| EU | 0 | 1 | 1 |

Note – does not include ERASME as participants not known. CORNET added directly from NETWATCH 28/10/2012. CZ, HU and IS added to CORNET II.

| | Number of Countries | | |
|---|---|---|---|
| | **Initial network** | **Continuation network** | **Self-sustained network** |
| BIOENERGY (Under Preparation) | 10 | | 7 |
| CORNET | 15 | 15 | 5 |
| CRUE | 12 | | 13 |
| ECORD | 10 | | 16 |
| ERA-CHEMISTRY | 12 | | 10 |
| EraSME (Under Preparation) | 19 | 16 | Only 2 Coordinators on NW |
| FENCO-NET | 11 | | 7 |
| PV-ERANET 2 | 12 | | 8 |
| SKEP | 13 | | 8 |
| SNOWMAN | 7 | | 4 |

| | Number of Participants | | |
|---|---|---|---|
| | **Initial network** | **Continuation network** | **Self-sustained network** |
| BIOENERGY (Under Preparation) | 15 | | 7 |
| CORNET | 30 | 21 | 6 |
| CRUE | 20 | | 17 |
| ECORD | 12 | | 20 |
| ERA-CHEMISTRY | 14 | | 11 |
| EraSME (Under Preparation) | 21 | 18 | Only 2 coordinators on NW |
| FENCO-NET | 16 | | 8 |
| PV-ERANET 2 | 21 | | 12 |
| SKEP | 17 | | 10 |
| SNOWMAN | 7 | | 7 |

**Activities**

| | *Work on benchmarking* | *Definition of common schemes for monitoring* | *Definition of common ex-post evaluation schemes* | *Common strategic agendas* | *Establishment of common evaluation procedures* | *Establishment of cooperation agreements* | *Establishment of cooperation agreements* | *Joint training activities* | *Personnel exchange* | *Mutual opening of research facilities* | *Mutual opening of programmes* | *Mutual learning* | *Design of Joint Calls* | *Implementation of Joint Calls* | *Design of joint R&D programmes* | *Implementation of joint R&D programmes* | *Other* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **All** | 2.9 | 3.3 | 3.2 | 3.8 | 3.9 | 3.6 | 3.3 | 2.6 | 2.4 | 2.5 | 2.7 | 4.0 | 4.5 | 4.6 | 3.3 | 3.1 | 4.7 |
| **FP6** | 3.4 | 3.4 | 3.2 | 3.9 | 4.1 | 4.0 | 3.5 | 2.4 | 2.2 | 2.3 | 2.8 | 3.9 | 4.7 | 4.7 | 3.4 | 3.2 | 4.5 |
| **FP7** | 2.8 | 3.4 | 3.3 | 3.7 | 3.9 | 3.4 | 3.2 | 2.6 | 2.5 | 2.6 | 2.6 | 4.0 | 4.4 | 4.6 | 3.4 | 3.1 | 4.6 |
| **Self** | 2.8 | 2.8 | 3.0 | 4.3 | 3.3 | 3.5 | 3.3 | 3.7 | 2.5 | 2.5 | 3.0 | 4.5 | 4.2 | 4.6 | 2.8 | 2.8 | 5.0 |

Note – the response rate for FP6 was too low for meaningful deductions to be made.

## *6.2. Annex 2 Network analysis*

**Definitions**

***Density*** is ratio of number of edges in the network over the total number of possible edges between all pairs of nodes. Density is useful in comparing networks against each other.

***Distance*** is the shortest path between 2 nodes. The average distance is the average of the total possible shortest paths in a network.

***Diameter*** is the longest geodesic distance (geodesic distance means the shortest path between two nodes) within the network (unless infinite). .

A ***component*** is a sequence of nodes and lines that are internally connected, but externally unconnected. .

The ***clustering coefficient*** of an actor is the density of its open neighbourhood. The overall clustering coefficient is the mean of the clustering coefficient of all the actors. The weighted overall clustering coefficient is the weighted mean of the clustering coefficient of all the actors each one weighted by its degree[53].

***Degree centrality*** is the number of links that lead into or out of the node. It is used as measure of connectedness and hence also influence and/or popularity. Degree centrality is useful in assessing which nodes are central with respect to spreading information and influencing others in their immediate "neighbourhood".

***Betweeness centrality*** is the number of the shortest paths that pass through a node divided by the total possible number of shortest path in the network. This indicator shows which nodes are more likely to be in communication paths with the other nodes. This indicator is useful to determine nodes where the network would break apart.

***Closeness centrality*** is the mean length of all shortest paths from one to all other nodes in the network. It is a measure of reach, i.e. how long it will take to reach other nodes from a given starting node. This indicator is useful in cases where speed of information dissemination is main concern. Lower values are better when higher speed is desirable.

***Eigenvector Centrality*** is proportional to the sum of the eigenvector centralities of all nodes directly connected to it. In other words, a node with a high eigenvector centrality is connected to other nodes with high eigenvector centrality. This indicator is similar to how Google ranks the webpages: links from highly-linked-to pages count more. This indicator is useful to determine who is connected to the most connected nodes. Eigenvector centrality indicator is the most relevant to rank the key national organisation participating to ERA-net.

ERA-NETs have been distributed among 12 research fields in order to deliver and compare sound network analyses for each of them. It should be noted that an ERA-NET with a large scope can be assigned to several research fields.

**List of research fields taken into account:**

1.Health
- Biotechnology for health
- Others

2. Food, agriculture and fisheries
- Biotechnology for food ...
- Other...

3. Information and communication technologies
4. Environment (including climate change)
5. Energy
6. Nanosciences, nanotechnologies
- Chemistry
- Other...

7. Materials
8. Industrial production processes
9. Socio-economics sciences and humanities
- Government and social relations

10. Transport
11. Space
- Astronomy
- Others

12. Security and defence

[53] Watts, D. J. (1999). Networks, dynamics, and the small-world phenomenon. The American Journal of Sociology, 105(2), 493-527

**Table 12 General overview of the network indicators among research fields and Framework programmes**

| | numbers of ERA-net actions | number of nodes (organisations) | Number of ties (excl mult) | Avg Number of organisations by ERA net | avg number of connection by organisations | Clustering coeffncentration | Density |
|---|---|---|---|---|---|---|---|
| FP6_Health | 15 | 172 | 3965 | 11,5 | 23,1 | 0,736 | 0,118 |
| FP7_Health | 12 | 152 | 3982 | 12,7 | 26,2 | 0,787 | 0,152 |
| FP6_Transport | 4 | 64 | 1490 | 16,0 | 23,3 | 0,82 | 0,368 |
| FP7_Transport | 5 | 86 | 2134 | 17,2 | 24,8 | 0,792 | 0,278 |
| FP6_Food | 9 | 117 | 2943 | 13,0 | 25,2 | 0,699 | 0,19 |
| FP7_Food | 12 | 140 | 6533 | 11,7 | 46,7 | 0,687 | 0,173 |
| FP6_ICT | 2 | 23 | 389 | 11,5 | 16,9 | 0,465 | 0,091 |
| FP7_ICT | 8 | 111 | 2612 | 13,9 | 23,5 | 0,866 | 0,201 |
| FP6_ENVIRONMENT | 17 | 151 | 4350 | 8,9 | 28,8 | 0,772 | 0,155 |
| FP7_ ENVIRONMENT | 12 | 173 | 5693 | 14,4 | 32,9 | 0,792 | 0,173 |
| FP6_ENERGY | 10 | 115 | 3573 | 11,5 | 31,1 | 0,809 | 0,229 |
| FP7_ENERGY | 7 | 108 | 3247 | 15,4 | 30,1 | 0,845 | 0,256 |
| FP6_NANO | 3 | 44 | 968 | 14,7 | 22,0 | 0,889 | 0,471 |
| FP7_NANO | 5 | 58 | 1717 | 11,6 | 29,6 | 0,883 | 0,46 |
| FP6_MATERIALS | 4 | 60 | 1629 | 15,0 | 27,2 | 0,849 | 0,419 |
| FP7_MATERIALS | 7 | 83 | 2572 | 11,9 | 31,0 | 0,792 | 0,333 |
| FP6_PRODUCTION | 5 | 82 | 2067 | 16,4 | 25,2 | 0,834 | 0,28 |
| FP7_PRODUCTION | 6 | 102 | 3515 | 17,0 | 34,5 | 0,861 | 0,316 |
| FP6_SSH | 11 | 134 | 3003 | 12,2 | 22,4 | 0,702 | 0,151 |
| FP7_SSH | 10 | 111 | 2722 | 11,1 | 24,5 | 0,778 | 0,187 |
| FP6_SPACE | 3 | 40 | 756 | 13,3 | 18,9 | 0,941 | 0,436 |
| FP7_SPACE | 1 | 24 | 625 | 24,0 | 26,0 | 1 | 1 |
| FP6_SECURITY | 1 | 12 | 144 | 12,0 | 12,0 | 1 | 1 |
| FP7_SECURITY | | | | | | | |
| FP6_NO_SPEC | 7 | 89 | 2262 | 12,7 | | | |
| FP7_NO_SPEC | 9 | 103 | 2861 | 11,4 | | | |

### 6.2.1. Health

#### a. Main network characteristics

**Table 13 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_Health | 15 | 172 | 3965 | 11,5 | 23,1 | 0,736 | 0,118 |
| FP7_Health | 12 | 152 | 3982 | 12,7 | 26,2 | 0,787 | 0,152 |

**Figure 13 Position of ERA-nets according links between participants in the FP6**

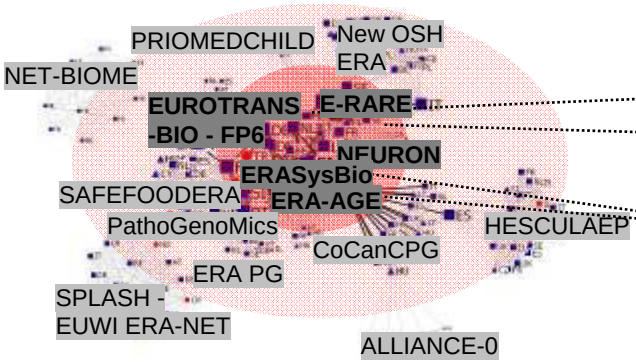
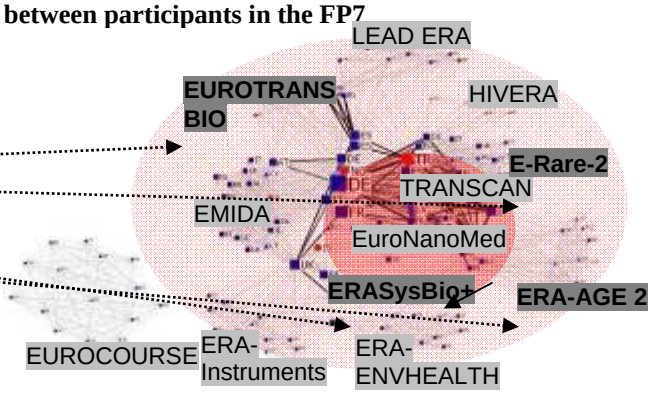



**Figure 14 Position of ERA-nets according links between participants in the FP7**




## b. Network Key players

**Table 14 Ranking of the 10 first key players in the FP6**

| ID | label | Country | Degree | Closeness |
|---|---|---|---|---|
| CSO_MOH_IL | Ministry_of_Health | IL | 56 | 4.847.000 |
| RCN_NO | Research_Council_of_Norway | NO | 56 | 4.871.000 |
| AKA_FI | Academy_of_Finland | FI | 53 | 4.874.000 |
| DLR_DE | German_Aerospace_Center | DE | 49 | 4.878.000 |
| ANR_FR | National_Research_Agency | FR | 47 | 4.880.000 |
| MHEST_SI | Ministry_of_Higher_Education_Science_and_Technology | SI | 45 | 4.901.000 |
| MICINN_ES | Ministry_of_Science_and_Innovation | ES | 45 | 4.882.000 |
| FCT_PT | Foundation_for_Science_and_Technology | PT | 44 | 4.906.000 |
| MR_DR_FR | Ministry_of_Research | FR | 43 | 4.907.000 |
| PTJ_FZJ_DE | Project_Management_Juelich_Research_Centre_Juelich | DE | 43 | 4.903.000 |

**Table 15 Ranking of the 10 first key players in the FP7**

| ID | label | Country | Degree | Closeness |
|---|---|---|---|---|
| BMBF_DE | Federal_Ministry_of_Education_and_Research | DE | 87 | 2.465.000 |
| CSO_MOH_IL | Ministry_of_Health | IL | 76 | 2.476.000 |
| ANR_FR | National_Research_Agency | FR | 64 | 2.488.000 |
| TUBITAK_TR | The_Scientific_and_Technological_Research_Council_of_Turkey | TR | 63 | 2.489.000 |
| FCT_PT | Foundation_for_Science_and_Technology | PT | 50 | 2.502.000 |
| ISS_IT | National_Institute_of_Health | IT | 50 | 2.514.000 |
| MOH_MDS_IT | Ministry_of_Health | IT | 48 | 2.504.000 |
| RCN_NO | Research_Council_of_Norway | NO | 48 | 2.504.000 |
| BBSRC_UK | Biotechnology_and_Biological_Sciences_Research_Council | UK | 47 | 2.515.000 |
| ISCIII_ES | Institute_of_Health_Carlos_III | ES | 45 | 2.507.000 |

**Figure 15 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

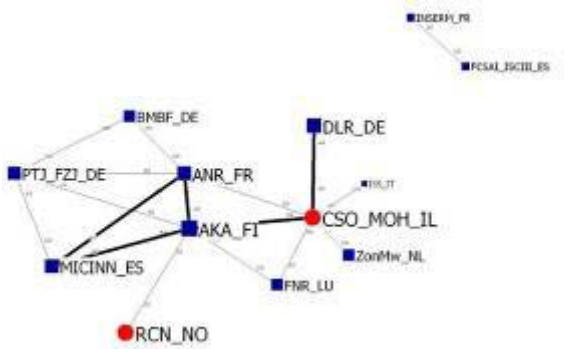



**Figure 16 Strongest collaborations between organisations in the FP7 (more than TWO collaborations)**

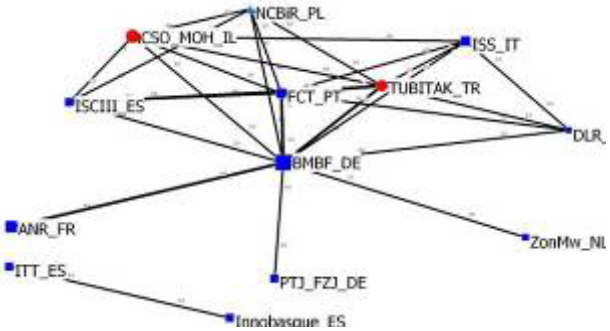


**Figure 17 Links between organisations in ERA-nets in the Health research field in the FP6**

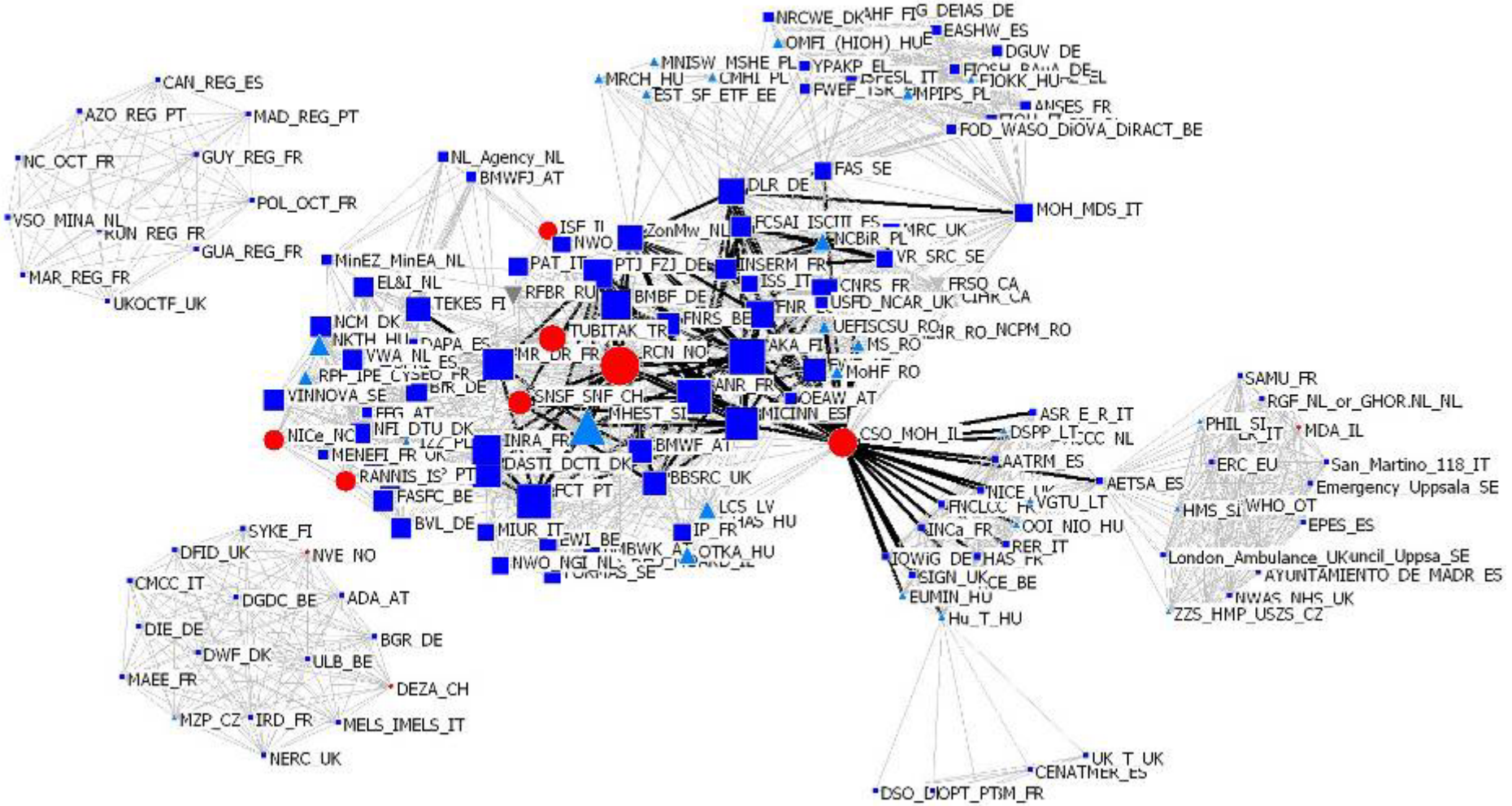
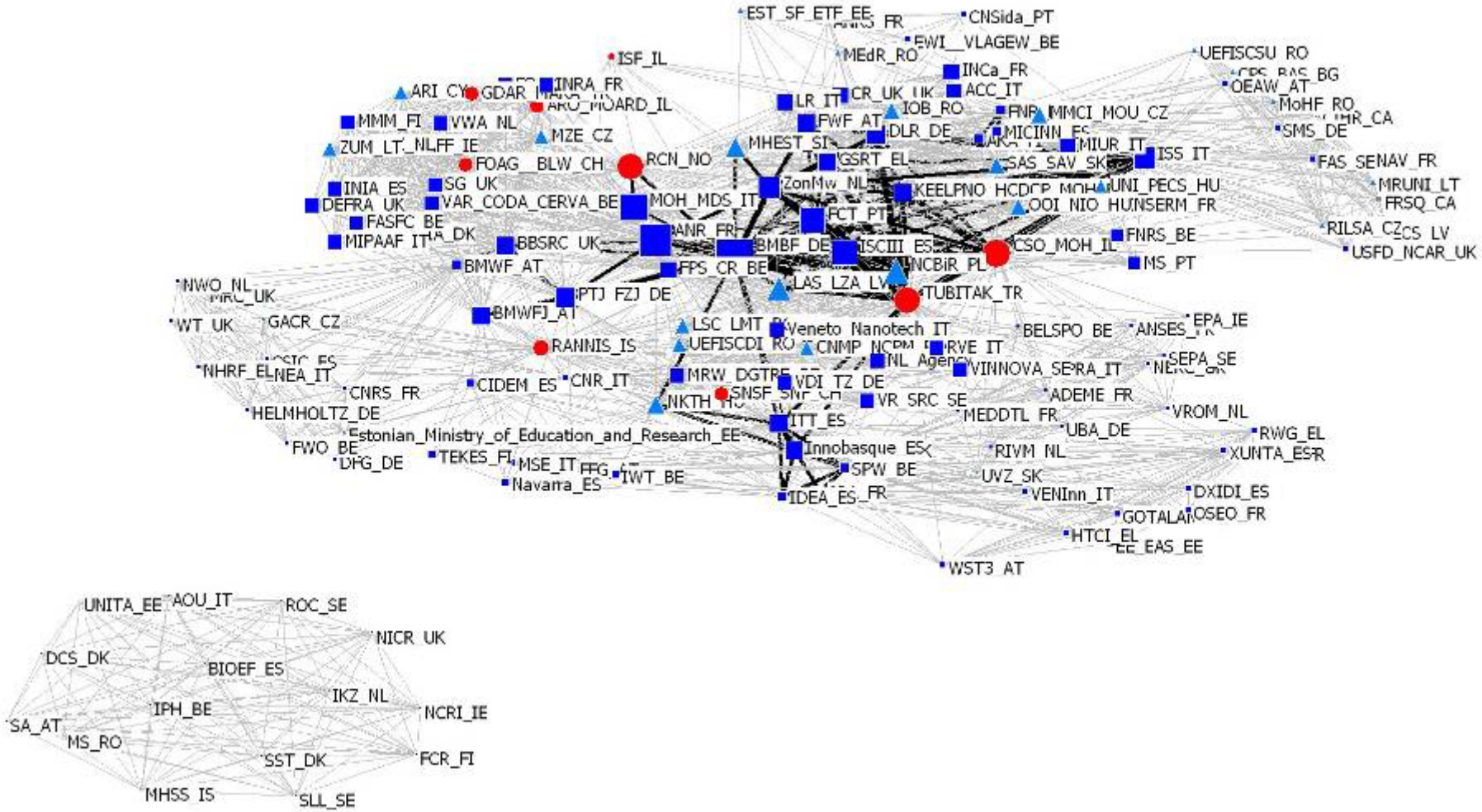


**Figure 18 Links between organisations in ERA-nets in the Health research field in the FP7**



### 6.2.2. Food, agriculture and fisheries

#### c. Main network characteristics

**Table 16 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_Food | 9 | 117 | 2943 | 13,0 | 25,2 | 0,699 | 0,19 |
| FP7_Food | 12 | 140 | 6533 | 11,7 | 46,7 | 0,687 | 0,173 |

**Figure 19 Position of ERA-nets according links between participants in the FP6**

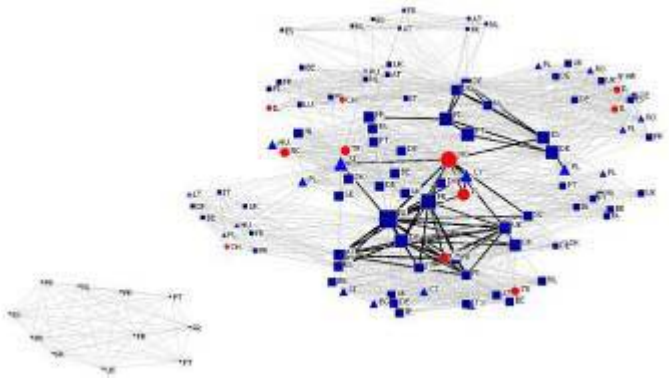
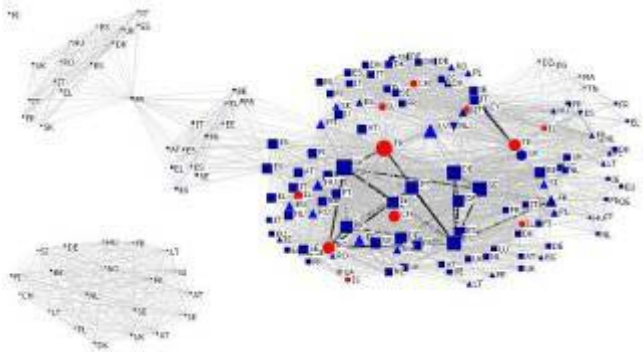


**Figure 20 Position of ERA-nets according links between participants in the FP7**



#### d. Network Key players

**Table 17 Ranking of the 10 first key players in the FP6**

| ID | label | country | Closeness |
|---|---|---|---|
| MHEST_SI | Ministry_of_Higher_Education_Science_and_Technology | SI | 1265000 |
| RCN_NO | Research_Council_of_Norway | NO | 1271000 |
| EL&I_NL | Ministry_of_Economic_Affairs_Agriculture_and_Innovation | NL | 1275000 |
| MICINN_ES | Ministry_of_Science_and_Innovation | ES | 1280000 |
| BMBF_DE | Federal_Ministry_of_Education_and_Research | DE | 1283000 |
| DASTI_DCTI_DK | Danish_Agency_for_Science_technology_and_Innovation;_Danish_Research_Agency | DK | 1289000 |
| FCT_PT | Foundation_for_Science_and_Technology | PT | 1289000 |
| TEKES_FI | Finnish_Funding_Agency_for_Technology_and_Innovation | FI | 1289000 |

**Table 18 Ranking of the 10 first key players in the FP7**

| ID | label | country | Closeness |
|---|---|---|---|
| MIPAAF_IT | Ministry of Agricultural food and Forestry Policies | IT | 450000 |
| GDAR_MARA_TR | Ministry of Agriculture and Rural Affairs General Directorate of Agricultural Research | TR | 466000 |
| INRA_FR | National Institute for Agricultural Research | FR | 467000 |
| MMM_FI | Ministry of Agriculture and Forestry | FI | 468000 |
| ARI_CY | Agricultural Research Institute Ministry of Agriculture National Resources and Environment | CY | 478000 |
| INIA_ES | National Institute for Agricultural and Food Research and Technology | ES | 478000 |

**Figure 21 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

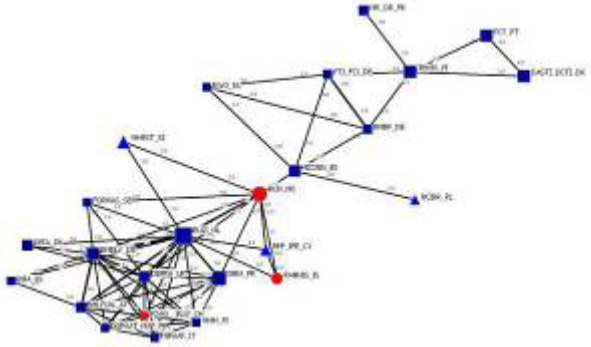


**Figure 22 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**

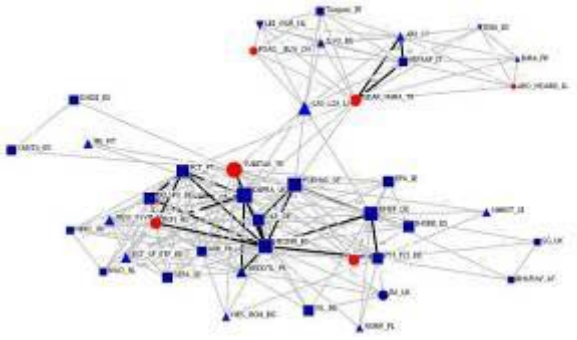


**Figure 23 Links between organisations in ERA-nets in the Food research field in the FP6**

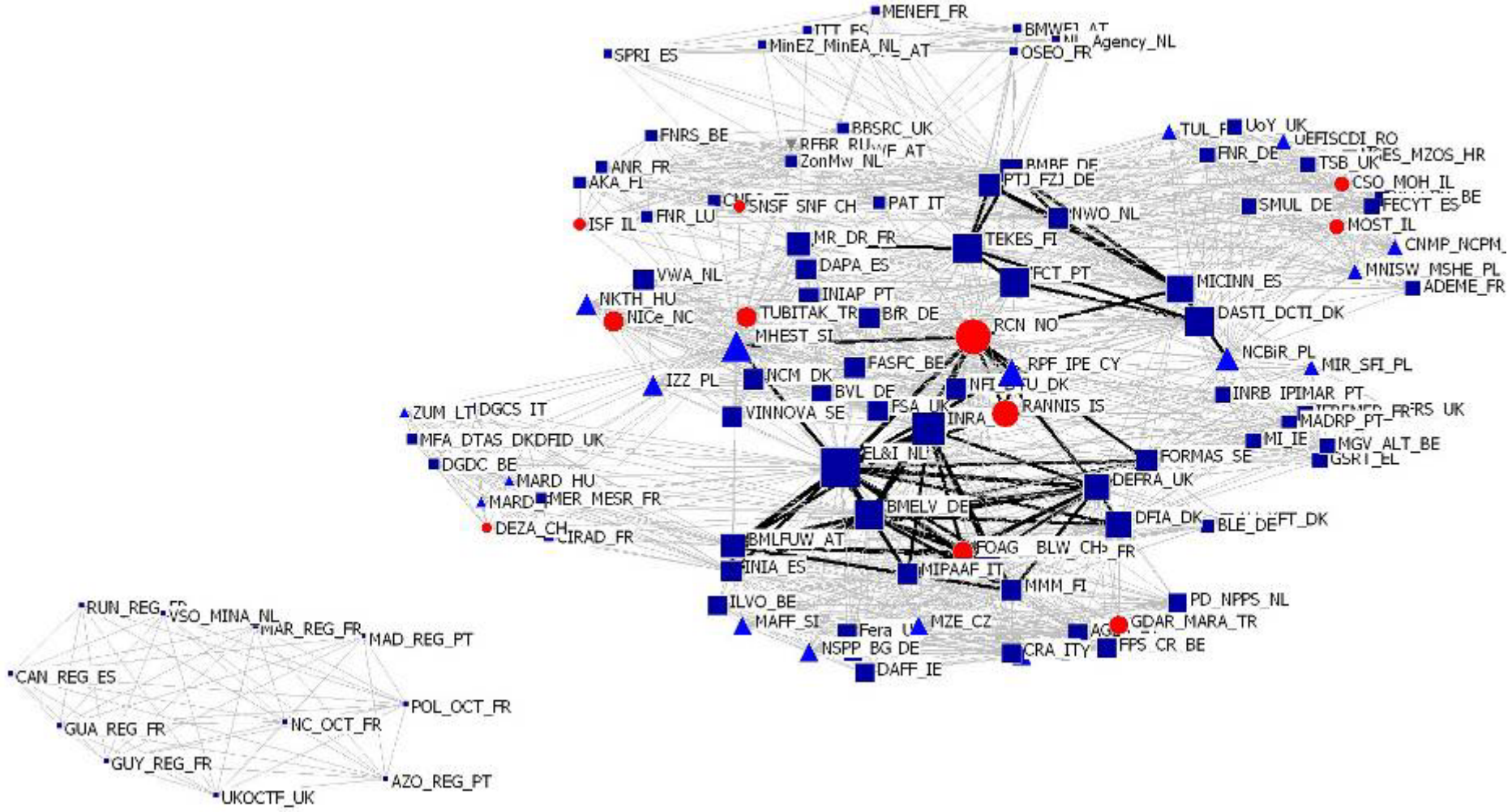
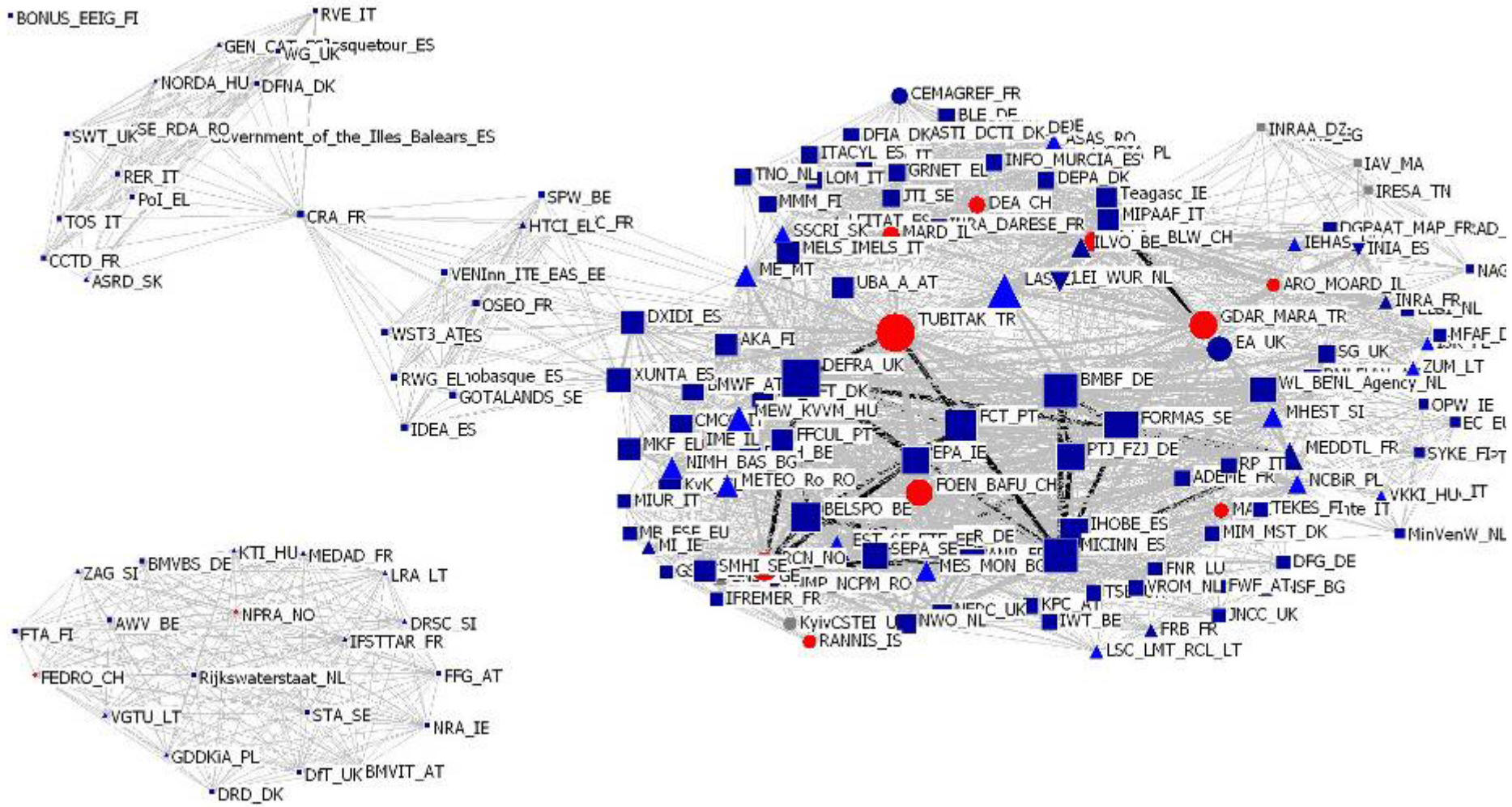


**Figure 24 Links between organisations in ERA-nets in the Food research field in the FP7**



### 6.2.3. Information and communication technologies

#### e. Main network characteristics

**Table 19 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_ICT | 2 | 23 | 389 | 11,5 | 16,9 | 0,465 | 0,091 |
| FP7_ICT | 8 | 111 | 2612 | 13,9 | 23,5 | 0,866 | 0,201 |

**Figure 25 Position of ERA-nets according links between participants in the FP6**

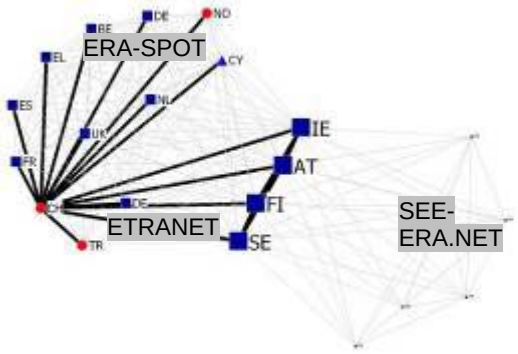
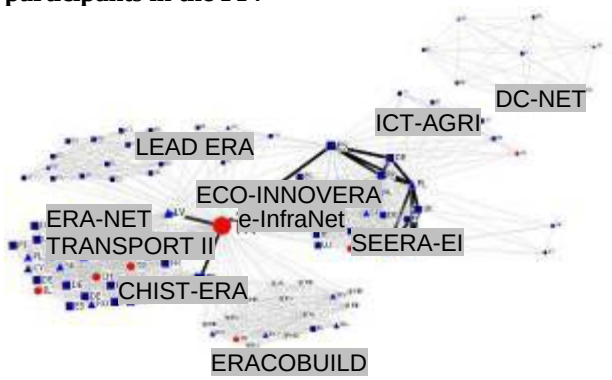



**Figure 26 Position of ERA-nets according links between participants in the FP7**




#### f. Network Key players

#### g.

**Table 20 Ranking of the 10 first key players in the FP6**

| ID | label | country | Degree |
|---|---|---|---|
| GSRT_EL | General Secretariat for Research and Technology | EL | 32 |
| BMBF_DE | Federal Ministry of Education and Research | DE | 24 |
| CNRS_FR | National Center for Scientific Research | FR | 24 |
| MHEST_SI | Ministry of Higher Education Science and Technology | SI | 24 |
| EI_IE | Enterprise Ireland | IE | 21 |
| FFG_AT | Austrian Research Promotion Agency | AT | 21 |
| TEKES_FI | Finnish Funding Agency for Technology and Innovation | FI | 21 |
| VINNOVA_S | Swedish Governmental Agency for Innovation Systems | SE | 21 |

**Table 21 Ranking of the 10 first key players in the FP7**

| ID | label | country | Degree |
|---|---|---|---|
| TUBITAK_TR | The Scientific and Technological Research Council of Turkey | TR | 94 |
| NCBiR_PL | National Centre for Research and Development | PL | 69 |
| MICINN_ES | Ministry of Science and Innovation | ES | 64 |
| GSRT_EL | General Secretariat for Research and Technology | EL | 53 |
| TSB_UK | Technology Strategy Board | UK | 53 |
| FORMAS_SE | Swedish Research Council for Environment Agricultural Sciences and Spatial Planning | SE | 52 |
| IWT_BE | Agency for Innovation by Science and Technology | BE | 52 |
| NL_Agency_NL | Agentschap NL | NL | 52 |
| TEKES_FI | Finnish Funding Agency for Technology and Innovation | FI | 52 |
| VROM_NL | Ministry of Housing Spatial Planning and the Environment | NL | 52 |

**Figure 27 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

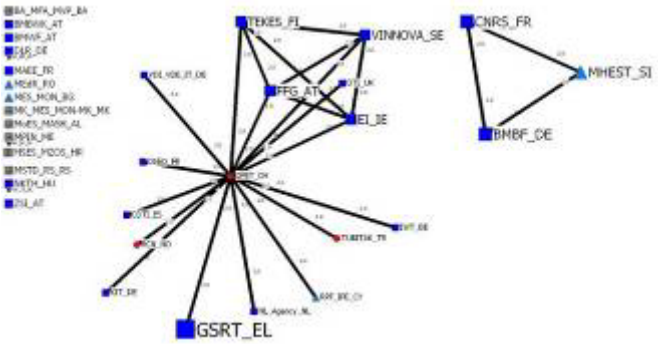



**Figure 28 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**

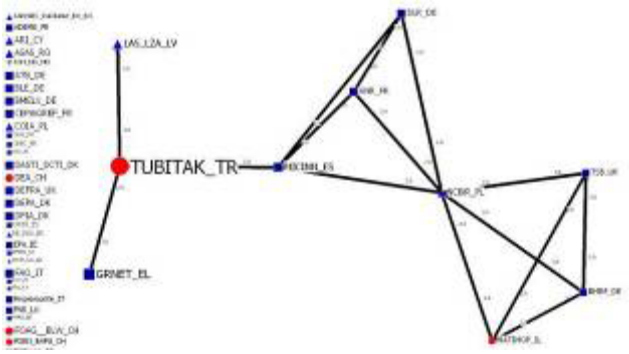


**Figure 29 Links between organisations in ERA-nets in the ICT research field in the FP6**

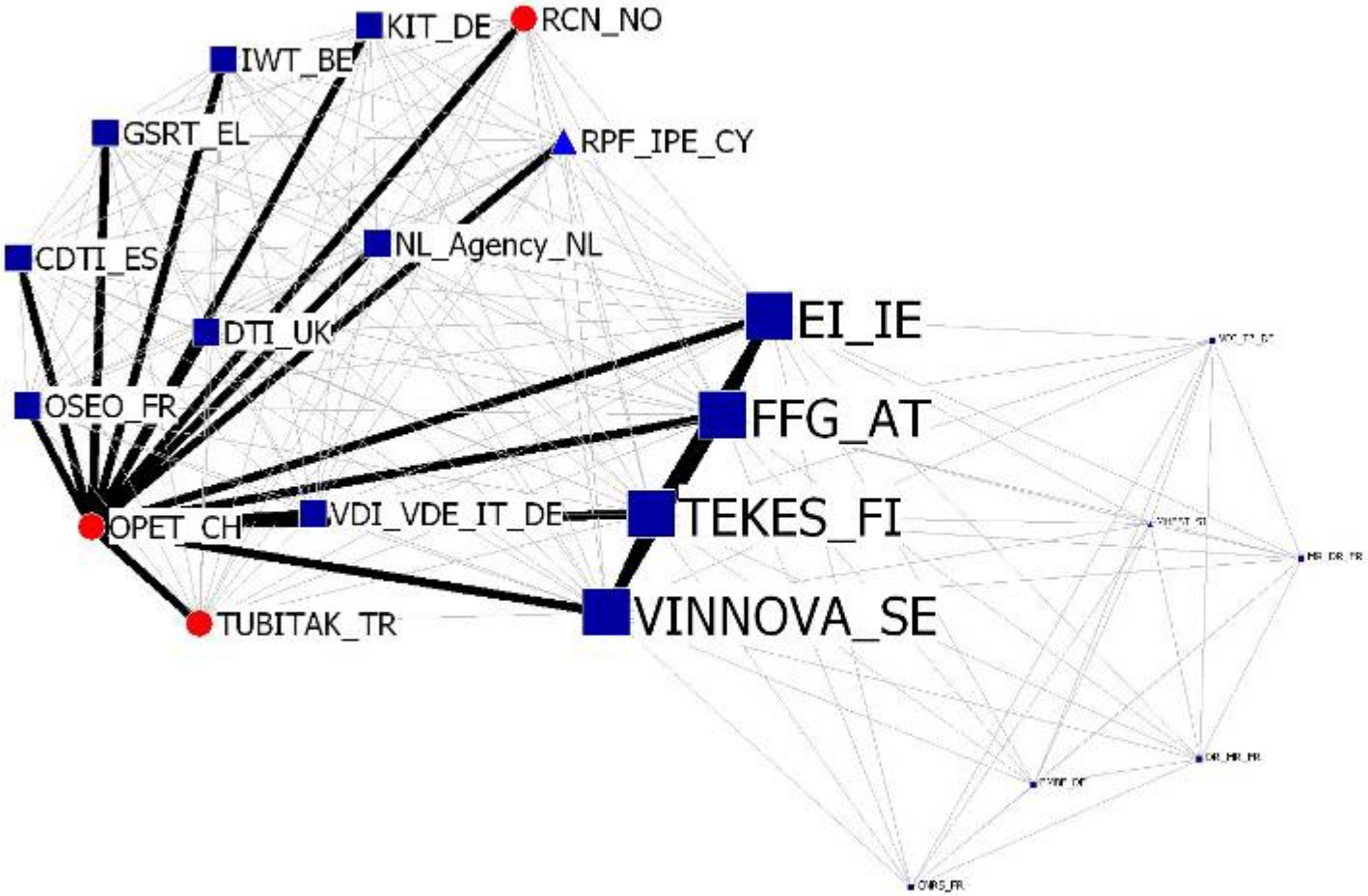
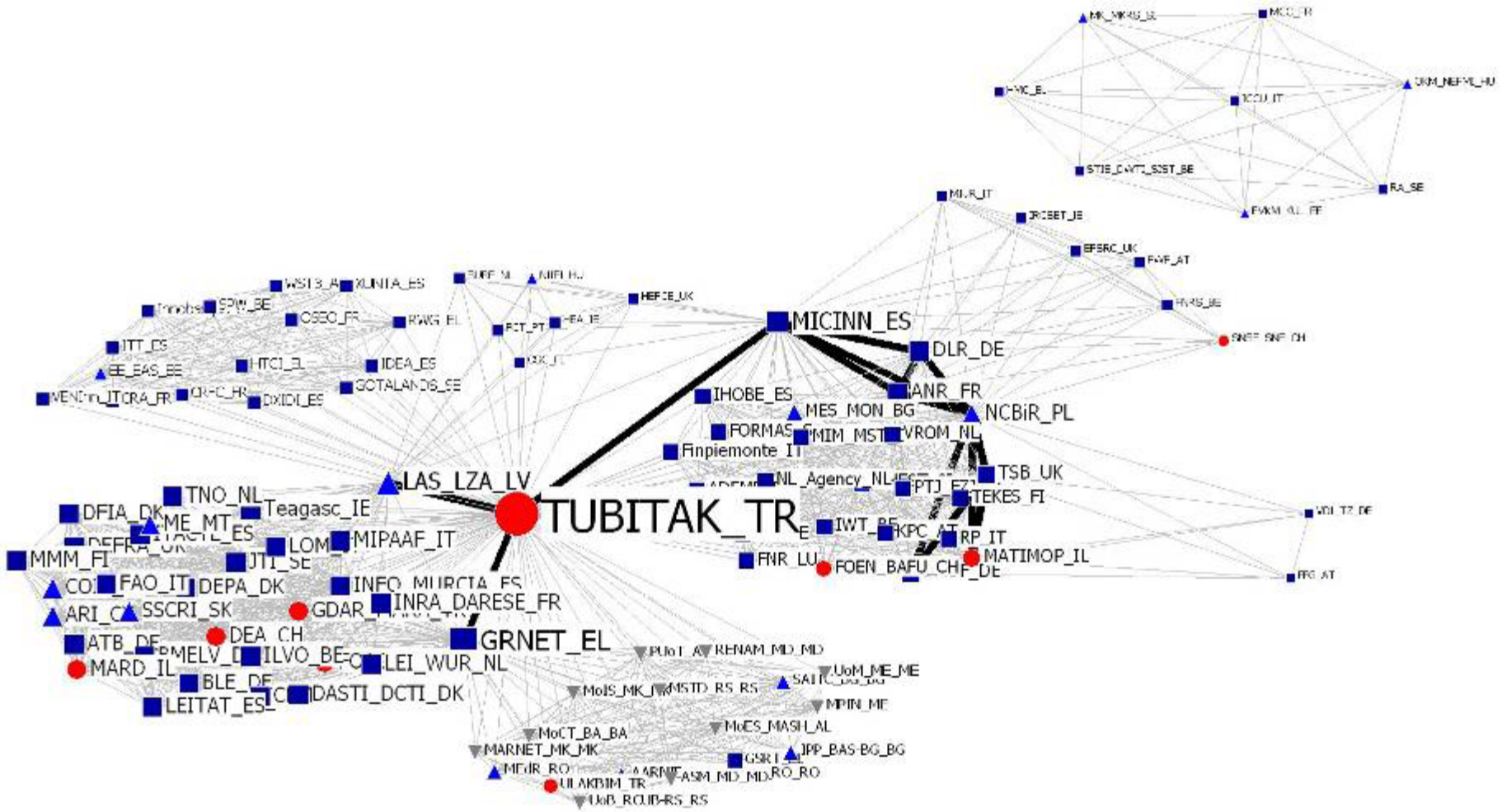


**Figure 30 Links between organisations in ERA-nets in the ICT research field in the FP7**



### 6.2.4. Environment (including climate change)

#### h. Main network characteristics

**Table 22 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_ENV | 17 | 151 | 4350 | 8,9 | 28,8 | 0,772 | 0,155 |
| FP7_ENV | 12 | 173 | 5693 | 14,4 | 32,9 | 0,792 | 0,173 |

**Figure 31 Position of ERA-nets according links between participants in the FP6**

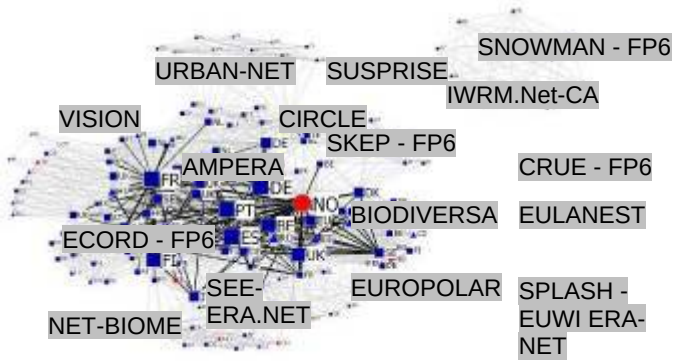
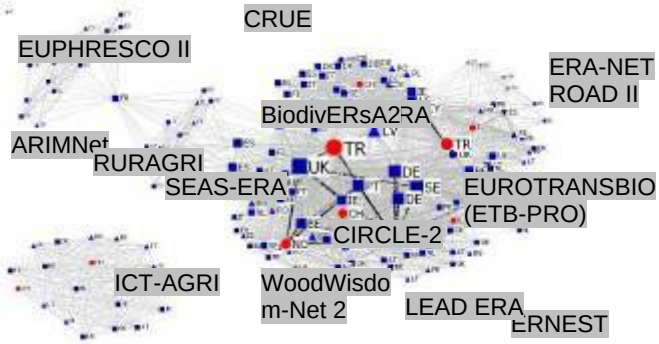



**Figure 32 Position of ERA-nets according links between participants in the FP7**




#### i. Network Key players

**Table 23 Ranking of the 10 first key players in the FP6**

| ID | label | country | Degree |
|---|---|---|---|
| BMBF_DE | Federal Ministry of Education and Research | DE | 86 |
| RCN_NO | Research Council of Norway | NO | 80 |
| MICINN_ES | Ministry of Science and Innovation | ES | 71 |
| MEDDTL_FR | Ministry of Ecology Sustainable Development Transport and Housing | FR | 70 |
| FCT_PT | Foundation for Science and Technology | PT | 68 |
| SYKE_FI | Finnish Environment Institute | FI | 66 |

**Table 24 Ranking of the 10 first key players in the FP7**

| ID | label | country | Degree |
|---|---|---|---|
| DEFRA_UK | Department for Environment Food and Rural Affairs | UK | 128 |
| TUBITAK_TR | The Scientific and Technological Research Council of Turkey | TR | 114 |
| BMBF_DE | Federal Ministry of Education and Research | DE | 94 |
| PTJ_FZJ_DE | Project Management Juelich Research Centre Juelich | DE | 89 |
| FORMAS_SE | Swedish Research Council for Environment Agricultural Sciences and Spatial Planning | SE | 114 |
| GDAR_MARA_TR | Ministry of Agriculture and Rural Affairs General Directorate of Agricultural Research | TR | 101 |

**Figure 33 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

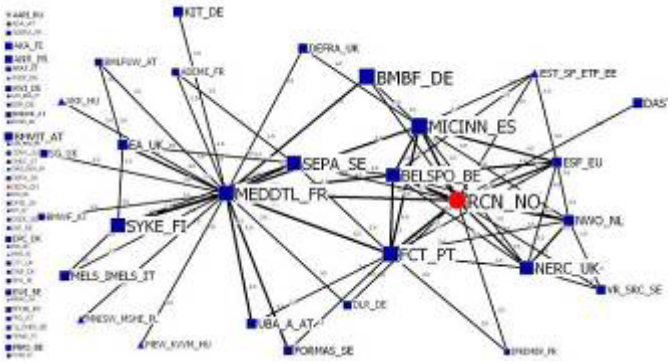



**Figure 34 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**

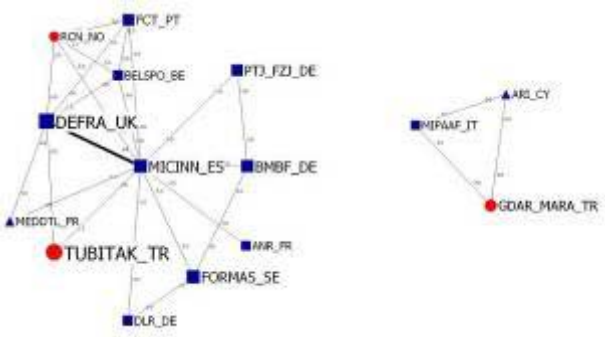


**Figure 35 Links between organisations in ERA-nets in the Environment research field in the FP6**

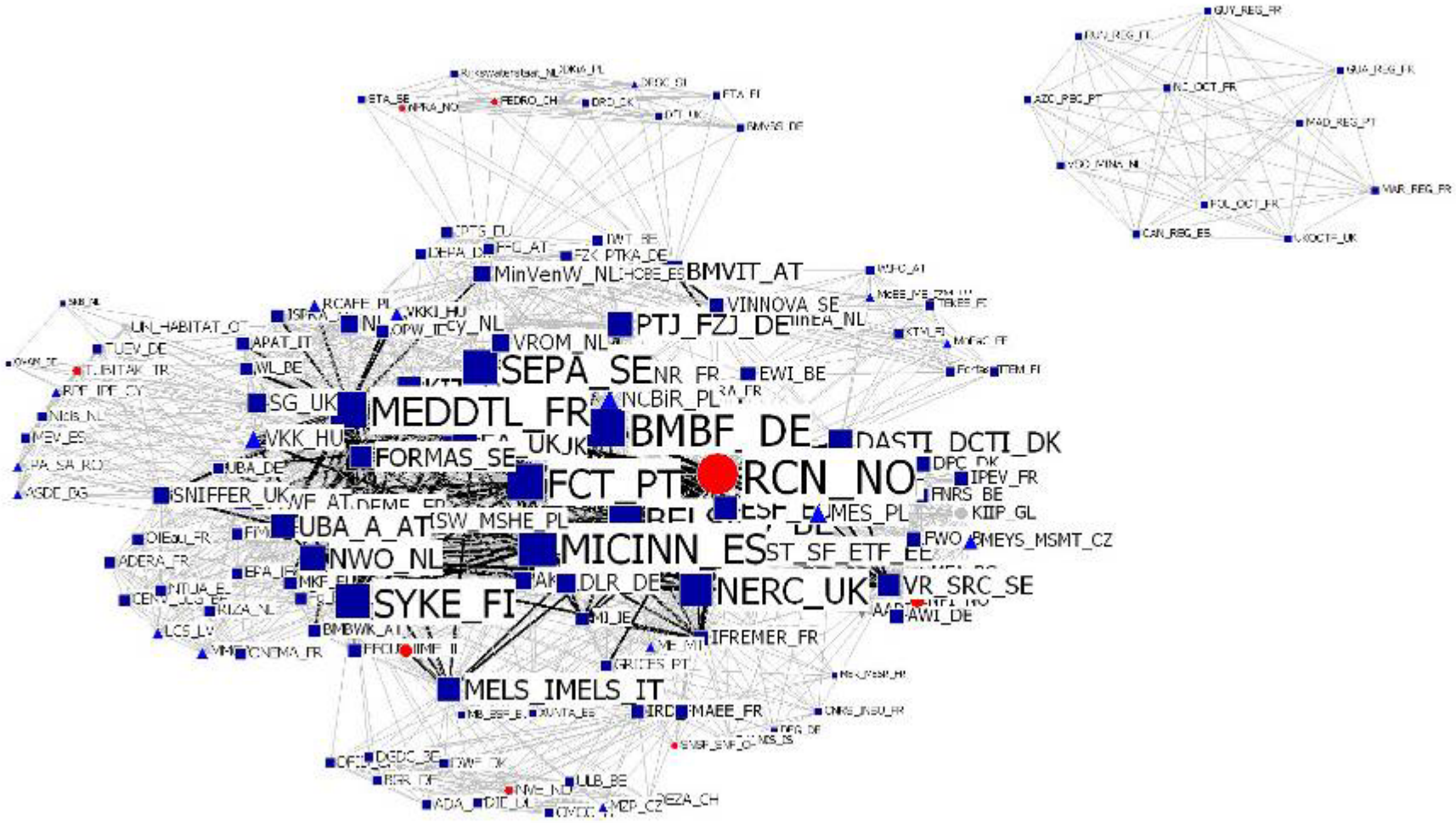
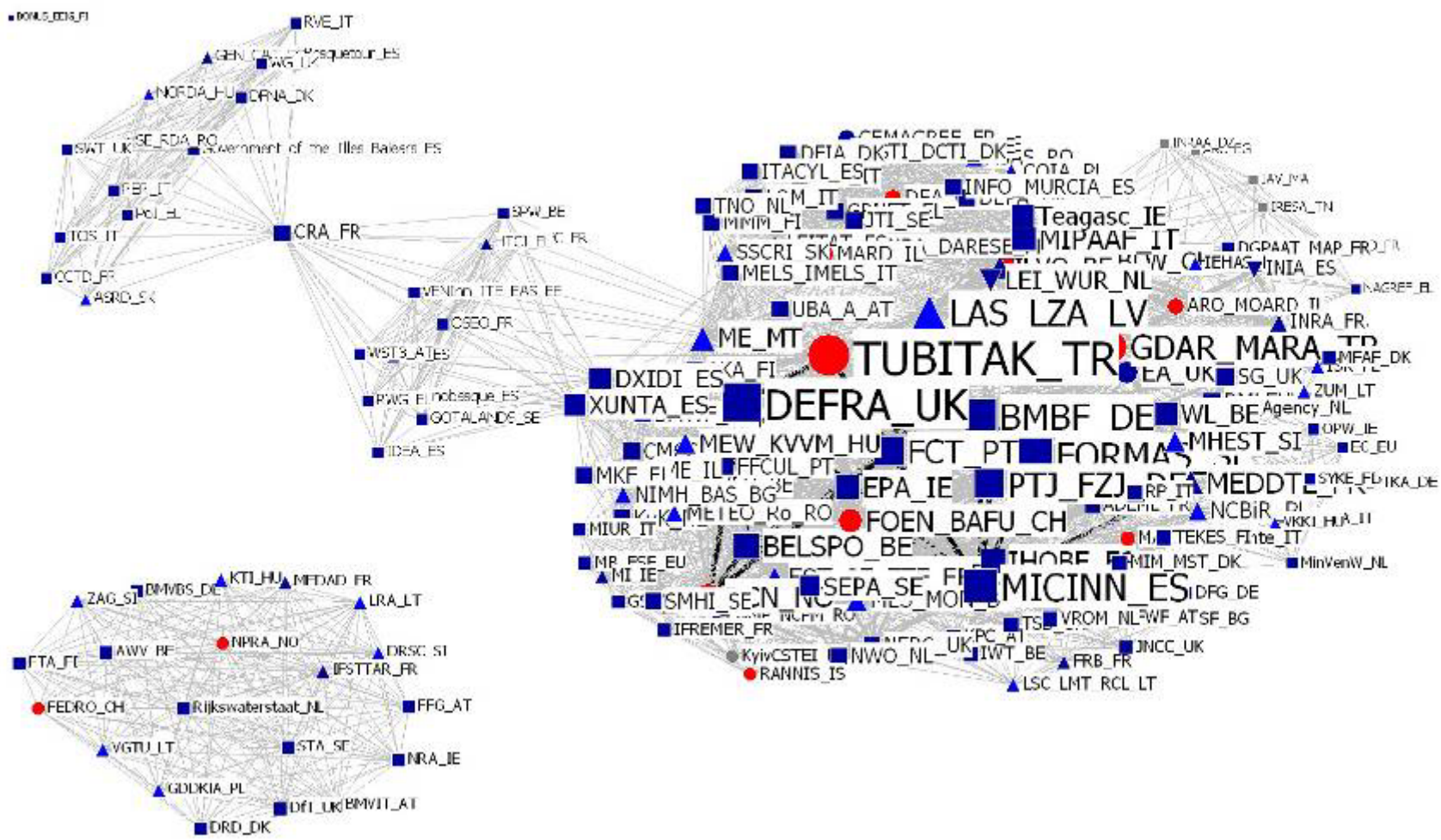


**Figure 36 Links between organisations in ERA-nets in the Environment research field in the FP7**



### 6.2.5. Energy

#### j. Main network characteristics

**Table 25 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_ENERGY | 10 | 115 | 3573 | 11,5 | 31,1 | 0,809 | 0,229 |
| FP7_ENERGY | 7 | 108 | 3247 | 15,4 | 30,1 | 0,845 | 0,256 |

**Figure 37 Position of ERA-nets according links between participants in the FP6**

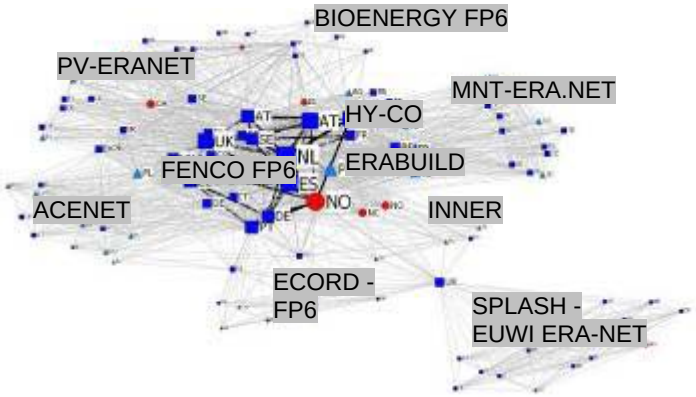
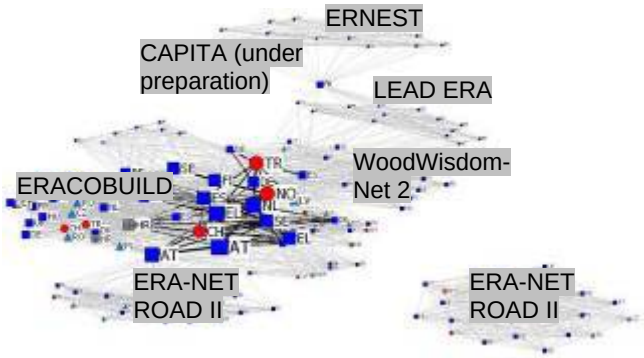



**Figure 38 Position of ERA-nets according links between participants in the FP7**




#### k. Network Key players

**Table 26 Ranking of the 10 first key players in the FP6**

| ID | label | country | Closeness |
|---|---|---|---|
| NL_Agency_NL | Agentschap NL | NL | 138000 |
| RCN_NO | Research Council of Norway | NO | 143000 |
| MICINN_ES | Ministry of Science and Innovation | ES | 148000 |
| MNISW_MSHE_PL | Ministry of Science and Higher Education | PL | 166000 |
| FCT_PT | Foundation for Science and Technology | PT | 169000 |
| FFG_AT | Austrian Research Promotion Agency | AT | 169000 |

**Table 27 Ranking of the 10 first key players in the FP7**

| ID | label | country | Closeness |
|---|---|---|---|
| TUBITAK_TR | The Scientific and Technological Research Council of Turkey | TR | 3419000 |
| BMVIT_AT | Austrian Federal Ministry of Transport Innovation and Technology | AT | 3422000 |
| GSRT_EL | General Secretariat for Research and Technology | EL | 3432000 |
| NL_Agency_NL | Agentschap NL | NL | 3432000 |
| RCN_NO | Research Council of Norway | NO | 3432000 |
| MICINN_ES | Ministry of Science and Innovation | ES | 3439000 |

**Figure 39 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

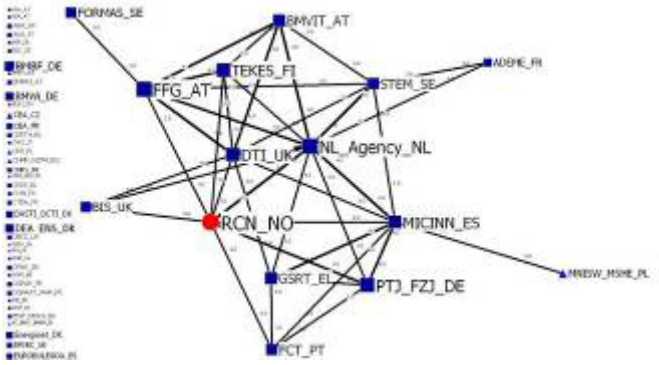



**Figure 40 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**

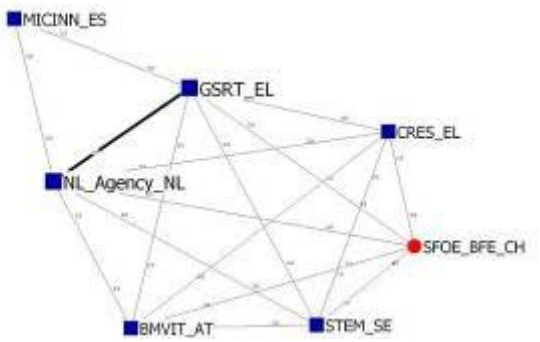


**Figure 41 Links between organisations in ERA-nets in the Energy research field in the FP6**

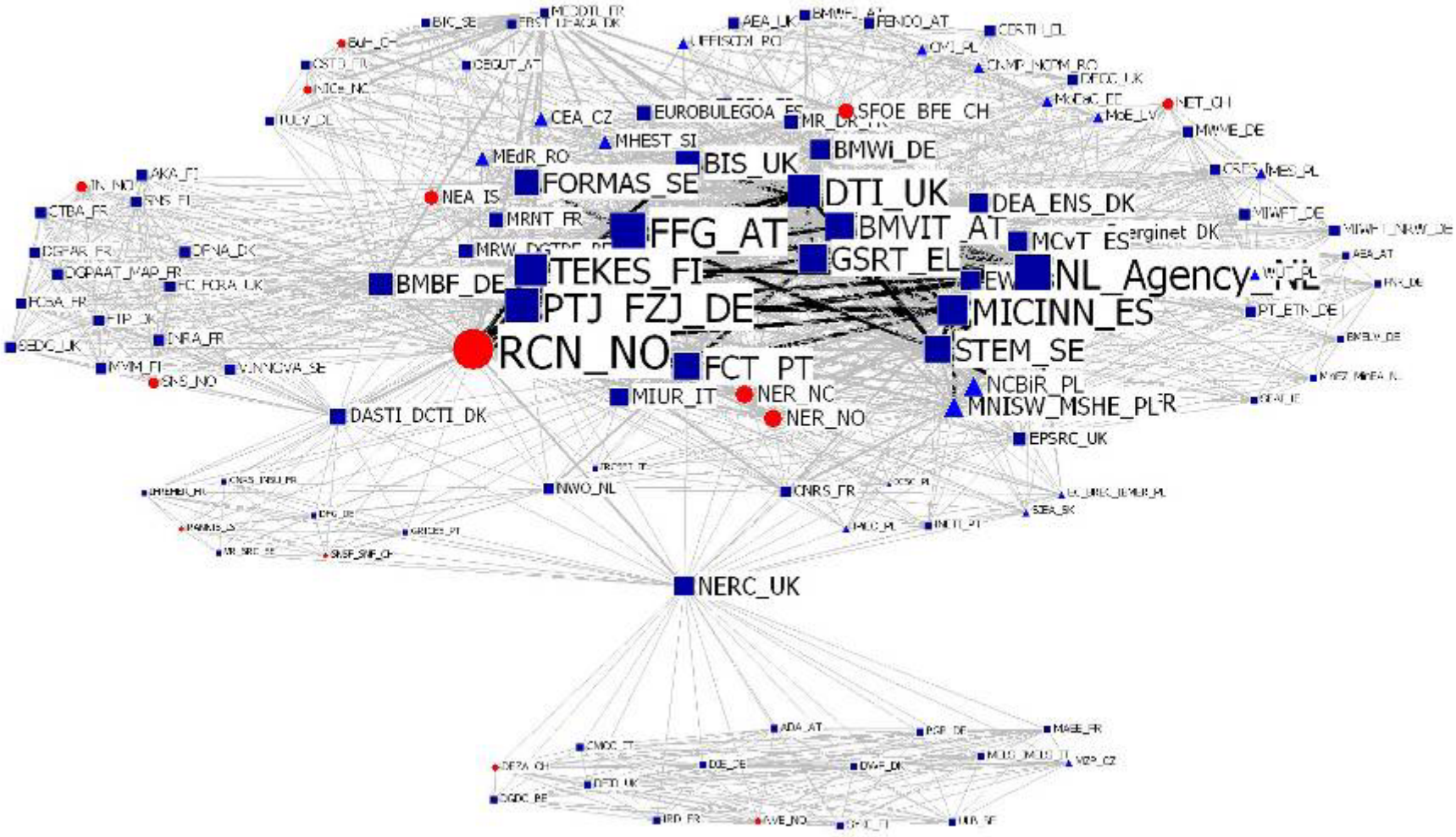
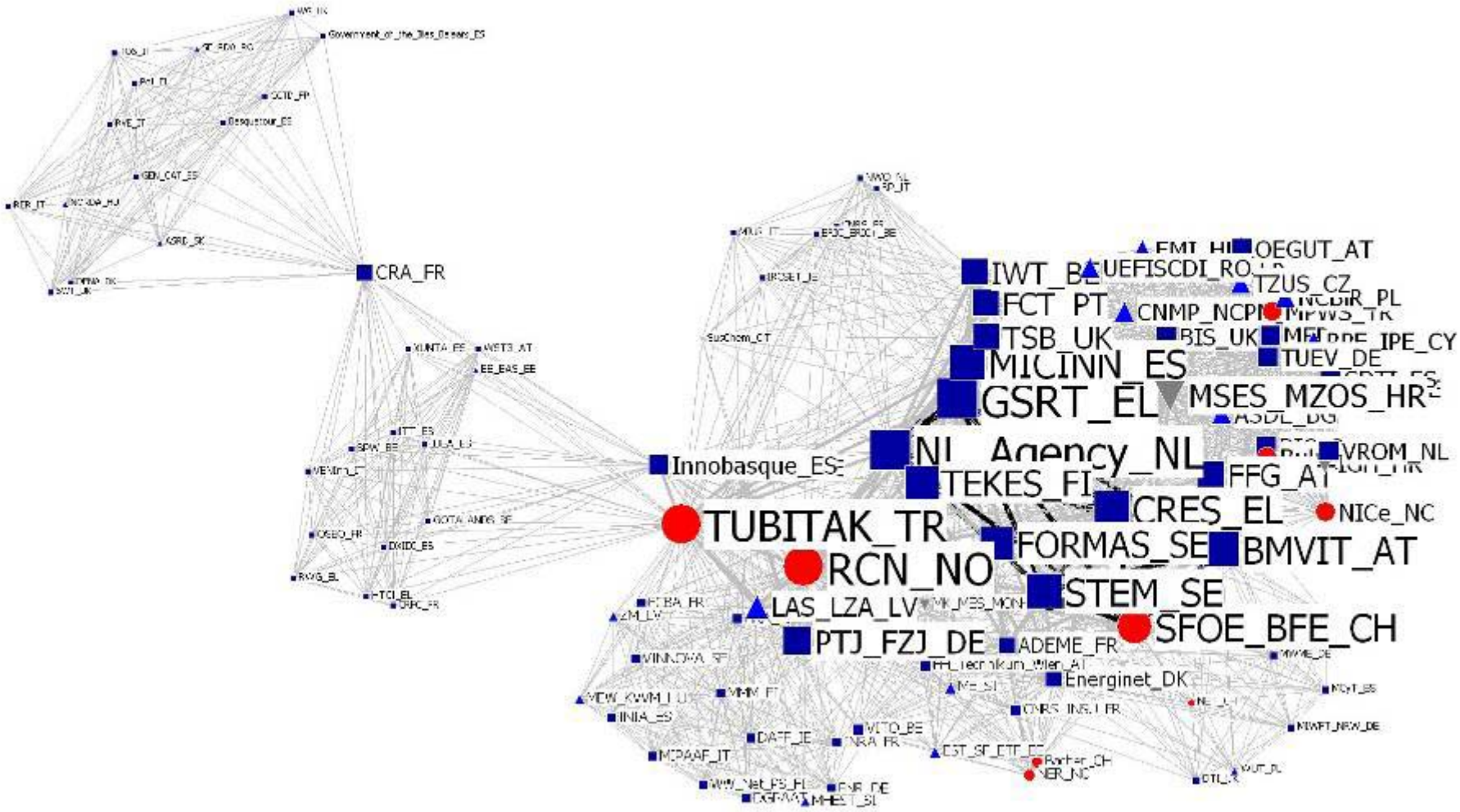


**Figure 42 Links between organisations in ERA-nets in the Energy research field in the FP7**



### 6.2.6. Nanosciences, nanotechnologies

#### l. Main network characteristics

**Table 28 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_NANO | 3 | 44 | 968 | 14,7 | 22,0 | 0,889 | 0,471 |
| FP7_NANO | 5 | 58 | 1717 | 11,6 | 29,6 | 0,883 | 0,46 |

**Figure 43 Position of ERA-nets according links between participants in the FP6**

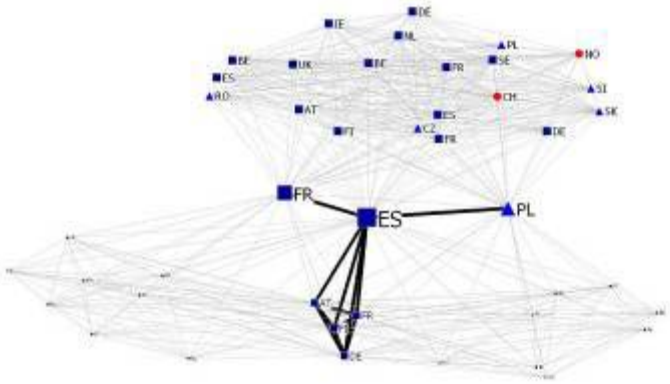
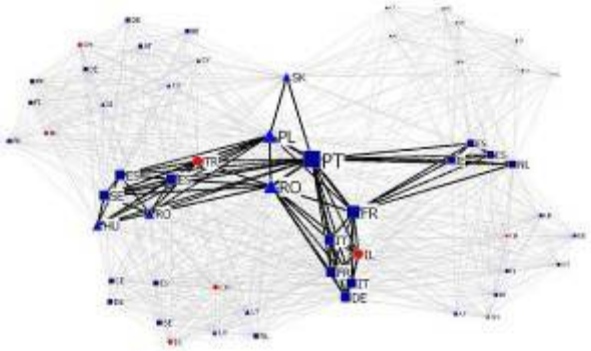



**Figure 44 Position of ERA-nets according links between participants in the FP7**




#### m. Network Key players

**Table 29 Ranking of the 10 first key players in the FP6**

| ID | label | country | Degree |
|---|---|---|---|
| MICINN_ES | Ministry of Science and Innovation | ES | 43 |
| CEA_FR | Atomic Energy Commissariat | FR | 35 |
| MNISW_MSHE_PL | Ministry of Science and Higher Education | PL | 35 |

**Table 30 Ranking of the 10 first key players in the FP7**

| ID | label | country | Degree |
|---|---|---|---|
| FCT_PT | Foundation for Science and Technology | PT | 80 |
| NCBiR_PL | National Centre for Research and Development | PL | 74 |
| UEFISCDI_RO | Executive Agency for Higher Education Research Development and Innovation Funding | RO | 72 |
| TEKES_FI | Finnish Funding Agency for Technology and Innovation | FI | 64 |
| CNMP_NCPM_RO | National Centre for Programme Management | RO | 63 |
| MICINN_ES | Ministry of Science and Innovation | ES | 59 |

**Figure 45 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

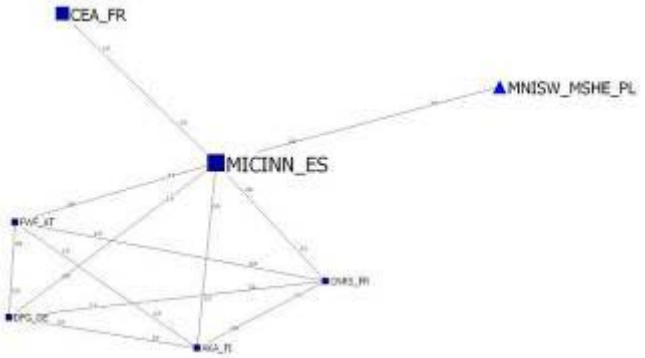



**Figure 46 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**

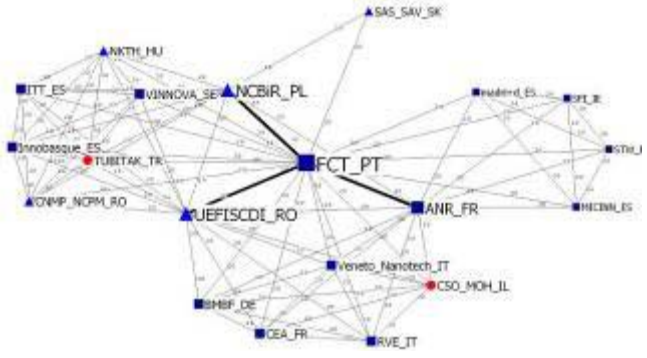


**Figure 47 Links between organisations in ERA-nets in the Nano research field in the FP6**

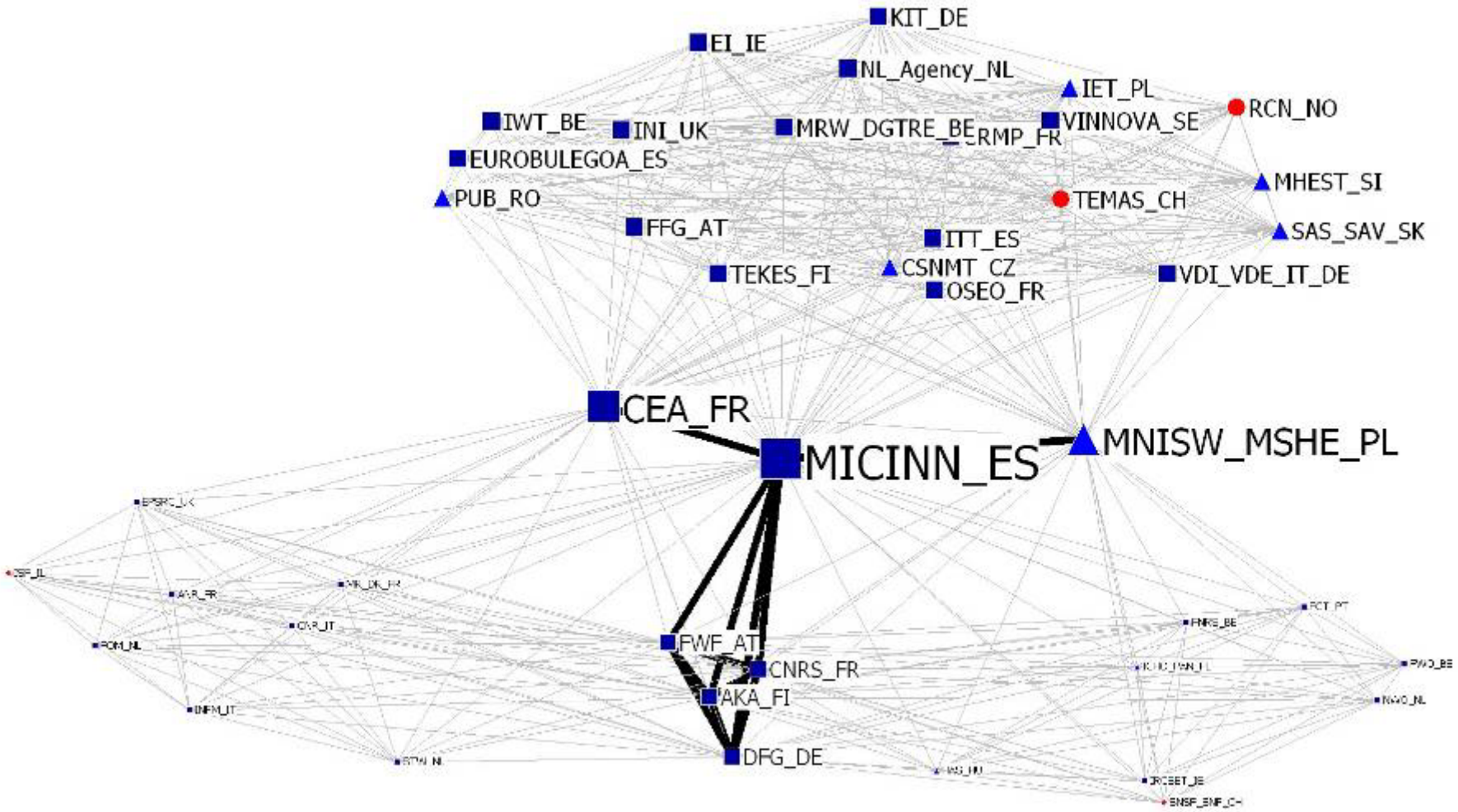
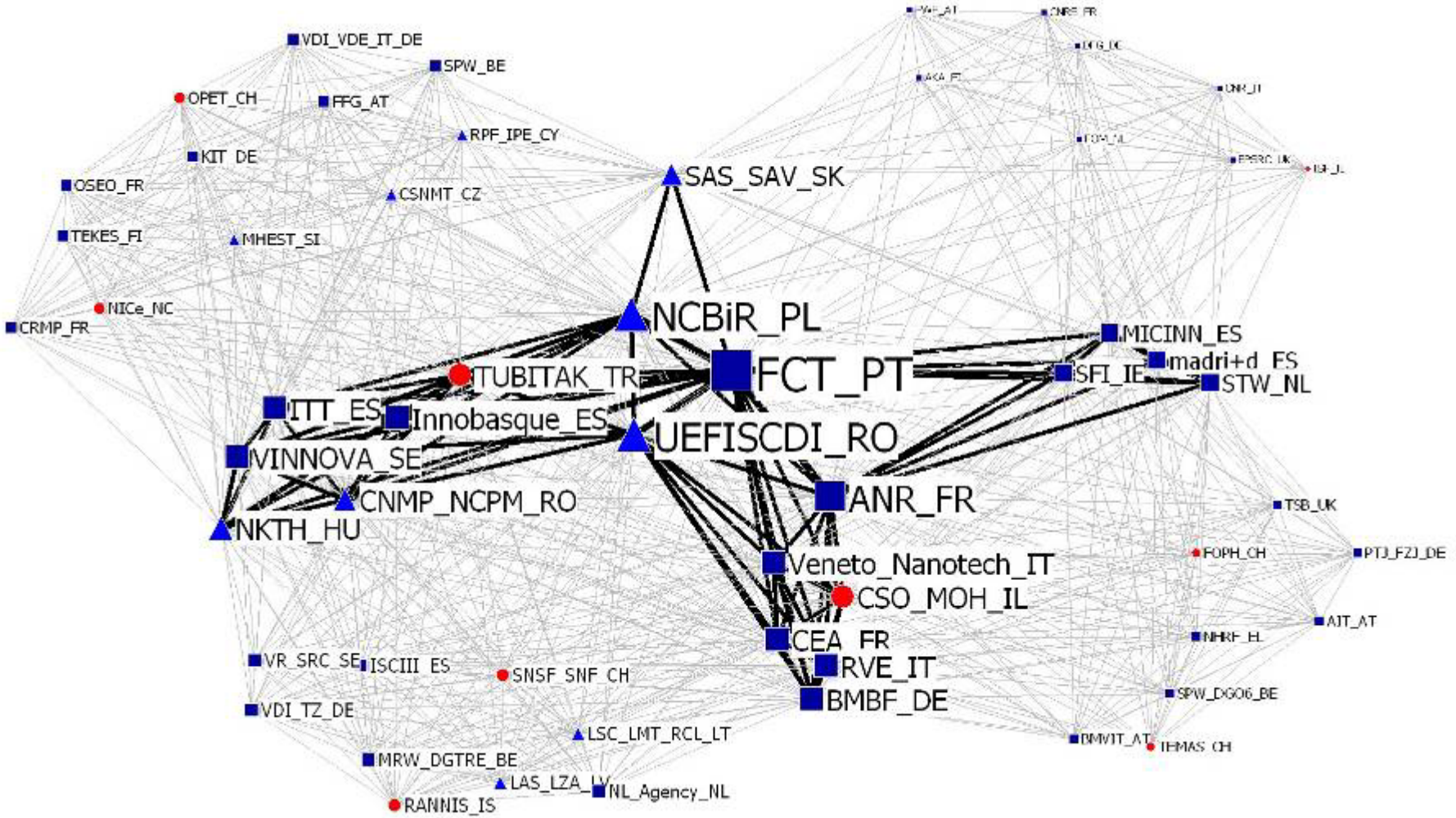


**Figure 48 Links between organisations in ERA-nets in the Nano research field in the FP7**



### 6.2.7. Materials

#### n. Main network characteristics

**Table 31 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_MATERIALS | 4 | 60 | 1629 | 15,0 | 27,2 | 0,849 | 0,419 |
| FP7_MATERIALS | 7 | 83 | 2572 | 11,9 | 31,0 | 0,792 | 0,333 |

**Figure 49 Position of ERA-nets according links between participants in the FP6**

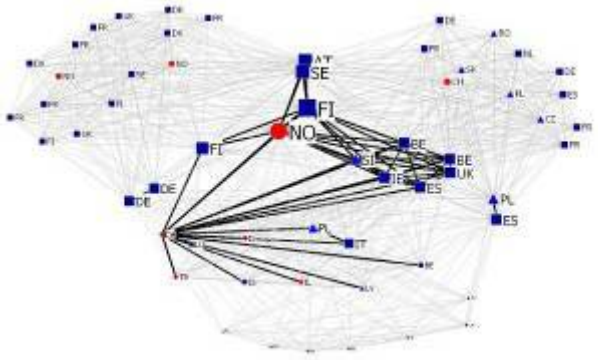
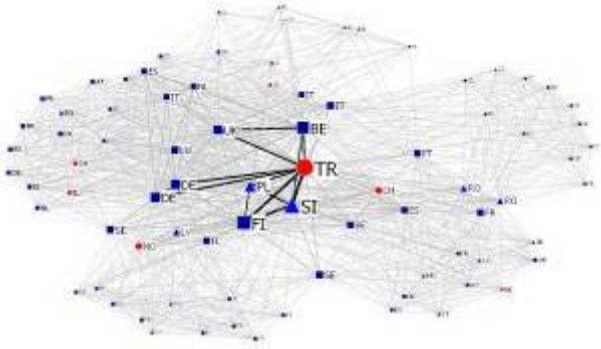



**Figure 50 Position of ERA-nets according links between participants in the FP7**




#### o. Network Key players

**Table 32 Ranking of the 10 first key players in the FP6**

| ID | label | country | Degree |
|---|---|---|---|
| RCN_NO | Research Council of Norway | NO | 5 |
| TEKES_FI | Finnish Funding Agency for Technology and Innovation | FI | 5 |
| FFG_AT | Austrian Research Promotion Agency | AT | 4 |
| VINNOVA_S | Swedish Governmental Agency for Innovation Systems | SE | 4 |
| AKA_FI | Academy of Finland | FI | 3 |

**Table 33 Ranking of the 10 first key players in the FP7**

| ID | label | country | Degree |
|---|---|---|---|
| TEKES_FI | Finnish Funding Agency for Technology and Innovation | FI | 7 |
| TUBITAK_TR | The Scientific and Technological Research Council of Turkey | TR | 7 |
| IWT_BE | Agency for Innovation by Science and Technology | BE | 7 |
| FFG_AT | Austrian Research Promotion Agency | AT | 6 |
| MHEST_SI | Ministry of Higher Education Science and Technology | SI | 6 |
| FORMAS_SE | Swedish Research Council for Environment Agricultural Sciences and Spatial Planning | SE | 6 |

**Figure 51 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

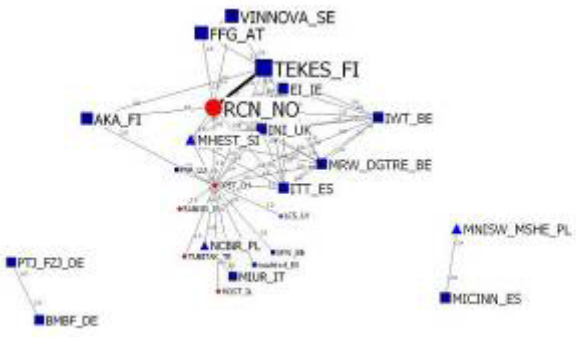



**Figure 52 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**

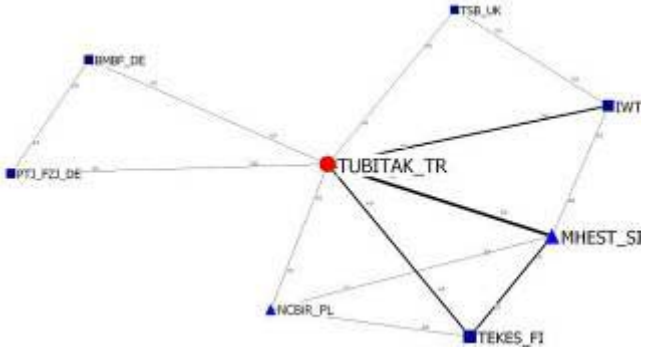


**Figure 53 Links between organisations in ERA-nets in the Materials research field in the FP6**

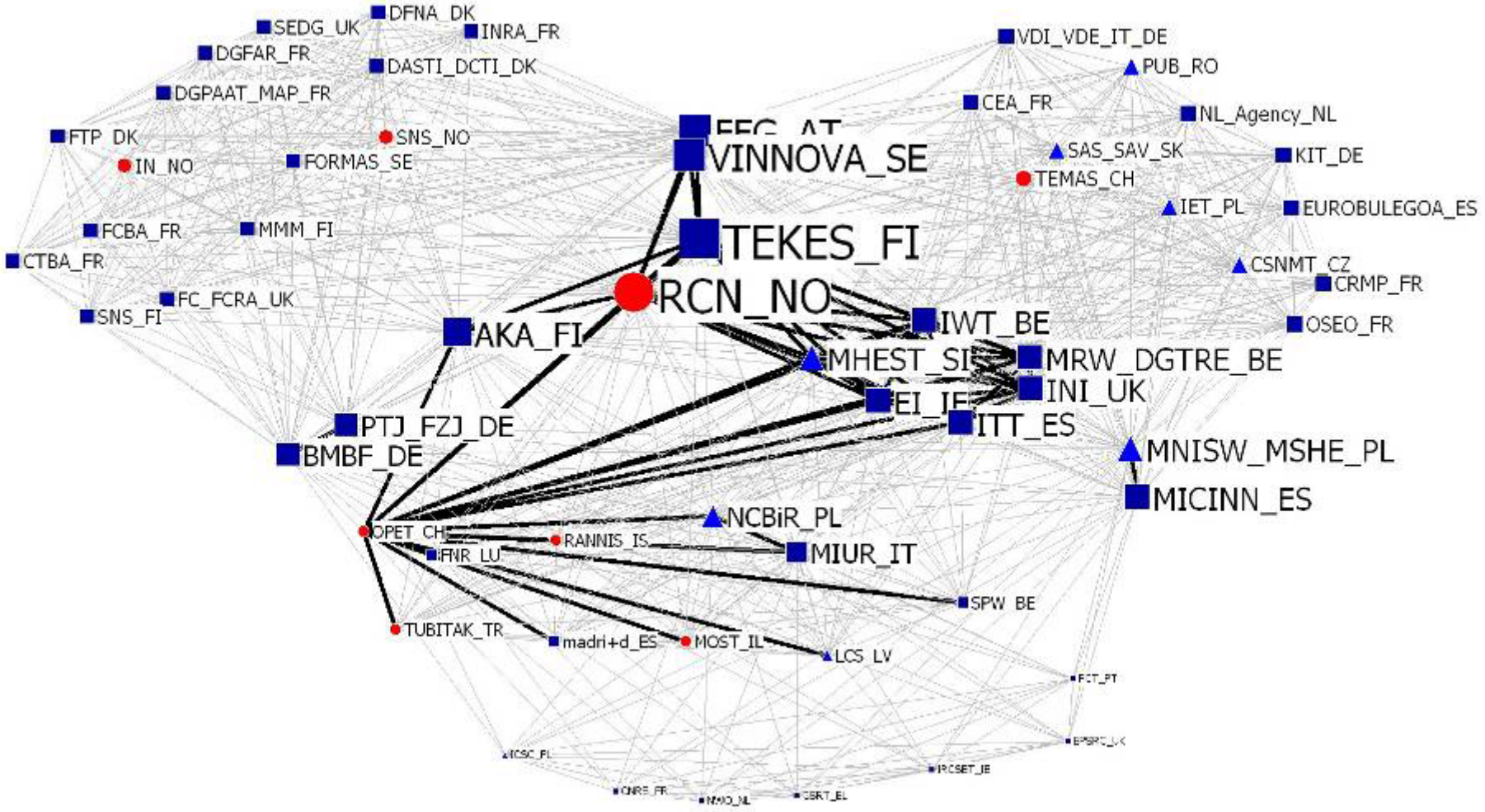
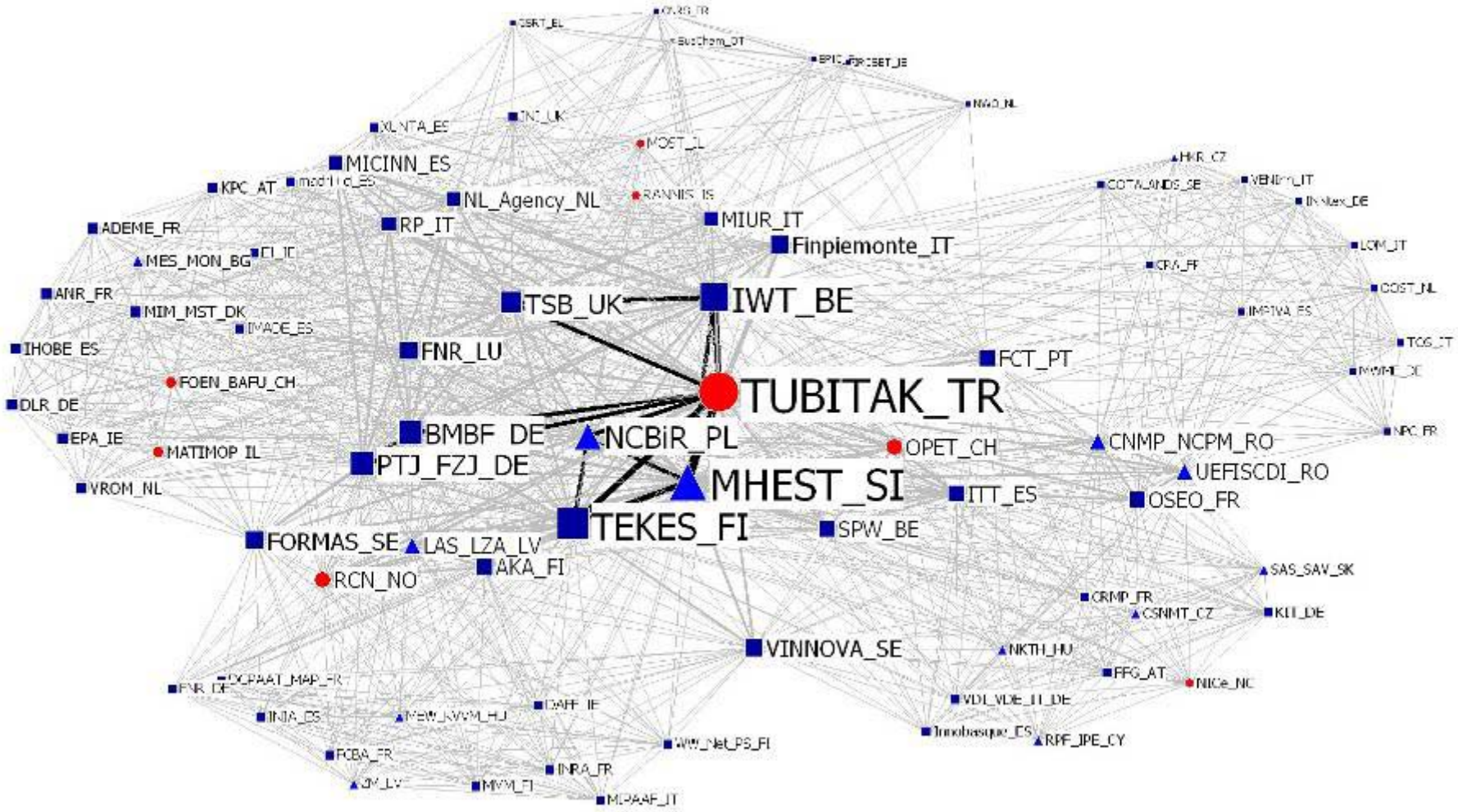


**Figure 54 Links between organisations in ERA-nets in the Materials research field in the FP7**



### 6.2.8. Industrial productions processes

#### p. Main network characteristics

**Table 34 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_PROD | 5 | 82 | 2067 | 16,4 | 25,2 | 0,834 | 0,28 |
| FP7_PROD | 6 | 102 | 3515 | 17,0 | 34,5 | 0,861 | 0,316 |

**Figure 55 Position of ERA-nets according links between participants in the FP6**

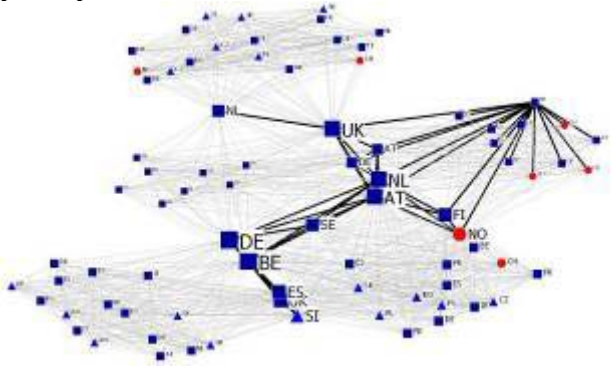
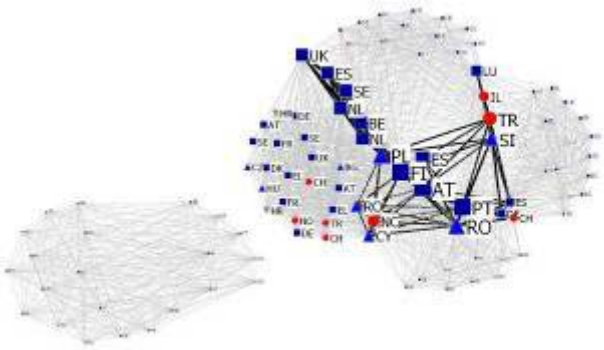



**Figure 56 Position of ERA-nets according links between participants in the FP7**




#### q. Network Key players

**Table 35 Ranking of the 10 first key players in the FP6**

| ID | label | country | Degree |
|---|---|---|---|
| FFG_AT | Austrian Research Promotion Agency | AT | 61 |
| RCN_NO | Research Council of Norway | NO | 53 |
| TEKES_FI | Finnish Funding Agency for Technology and Innovation | FI | 53 |
| IWT_BE | Agency for Innovation by Science and Technology | BE | 51 |
| KIT_DE | Karlsruher Institut für Technologie | DE | 51 |
| VINNOVA_S | Swedish Governmental Agency for Innovation Systems | SE | 51 |

**Table 36 Ranking of the 10 first key players in the FP7**

| ID | label | country | Degree |
|---|---|---|---|
| MHEST_SI | Ministry of Higher Education Science and Technology | SI | 78 |
| TUBITAK_TR | The Scientific and Technological Research Council of Turkey | TR | 78 |
| TEKES_FI | Finnish Funding Agency for Technology and Innovation | FI | 70 |
| NCBiR_PL | National Centre for Research and Development | PL | 65 |
| FNR_LU | National Fund for Research | LU | 57 |

**Figure 57 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

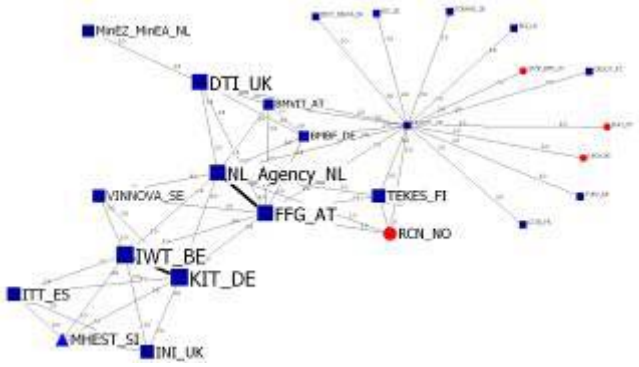



**Figure 58 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**

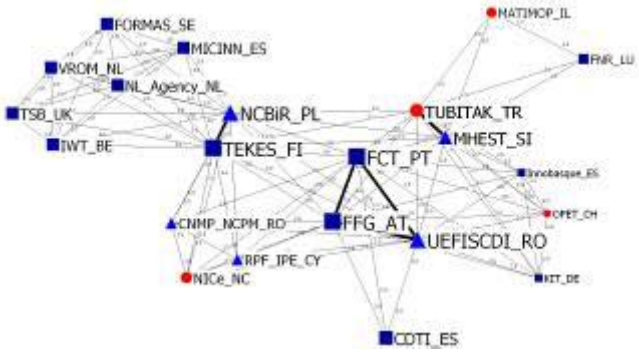


**Figure 59 Links between organisations in ERA-nets in the industrial production processes research field in the FP6**

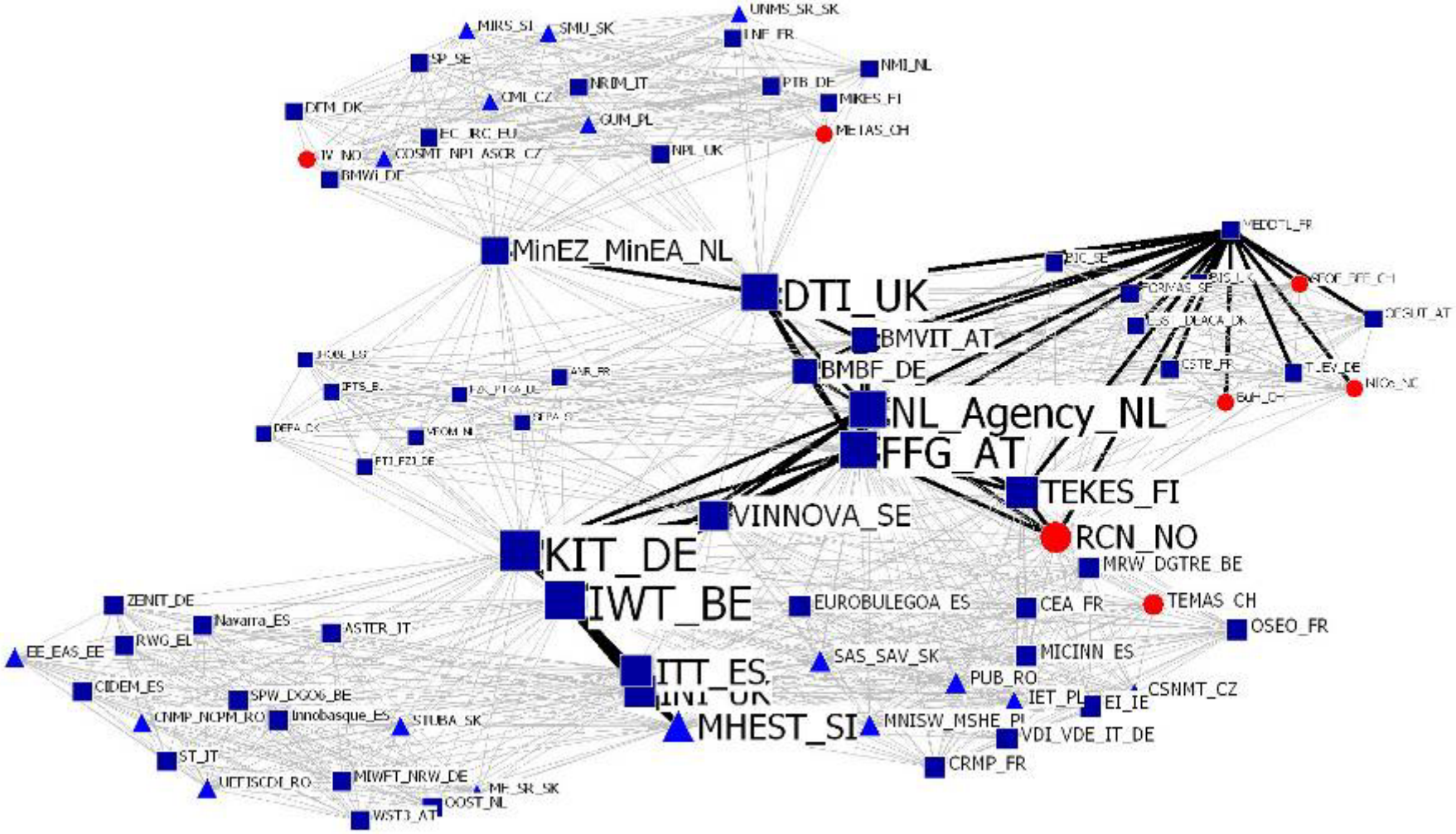
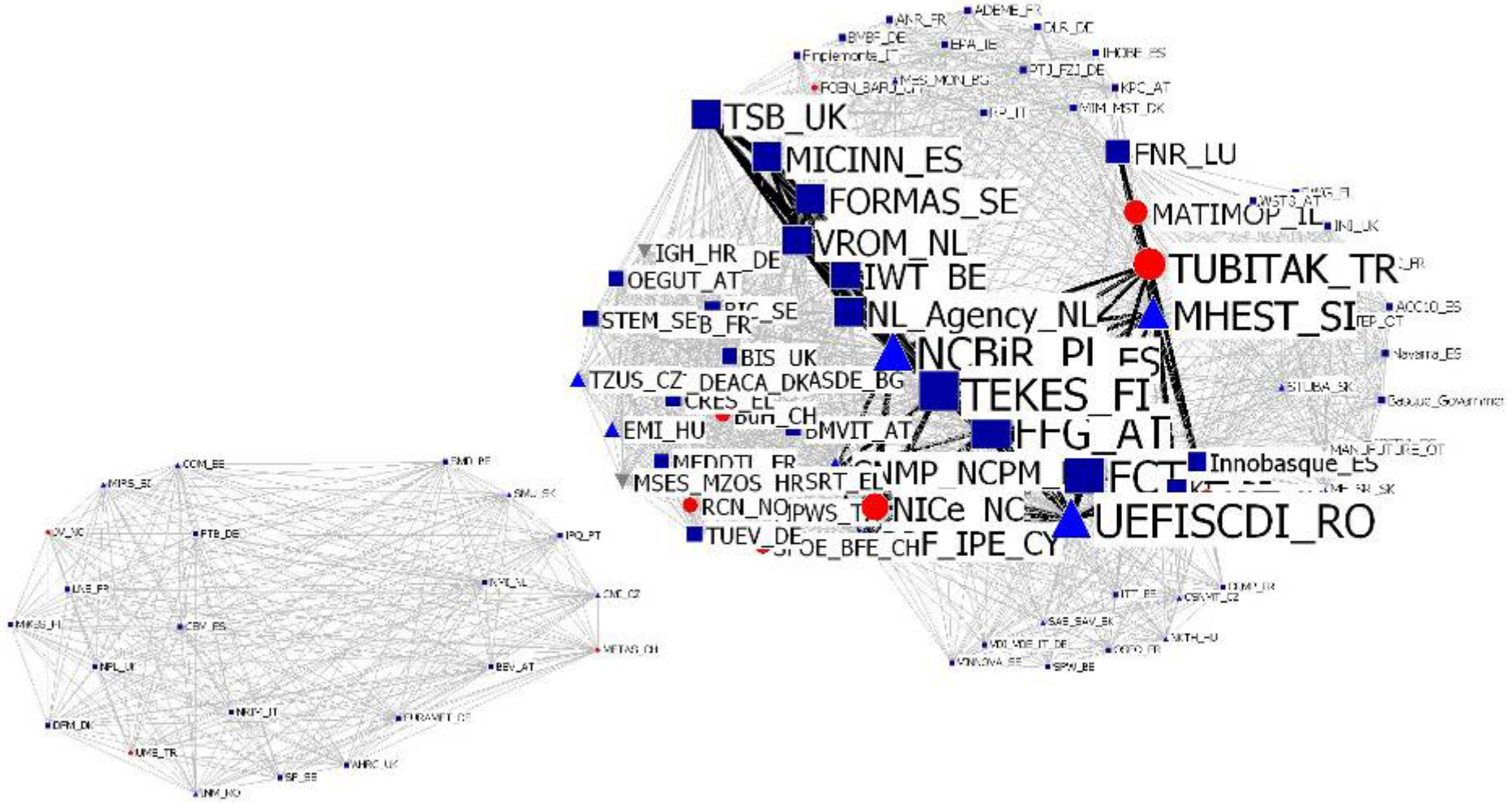


**Figure 60 Links between organisations in ERA-nets in the industrial production processes research field in the FP7**



### 6.2.9. Socio-economics sciences and humanities

#### r. Main network characteristics

**Table 37 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_SSH | 11 | 134 | 3003 | 12,2 | 22,4 | 0,702 | 0,151 |
| FP7_SSH | 10 | 111 | 2722 | 11,1 | 24,5 | 0,778 | 0,187 |

**Figure 61 Position of ERA-nets according links between participants in the FP6**

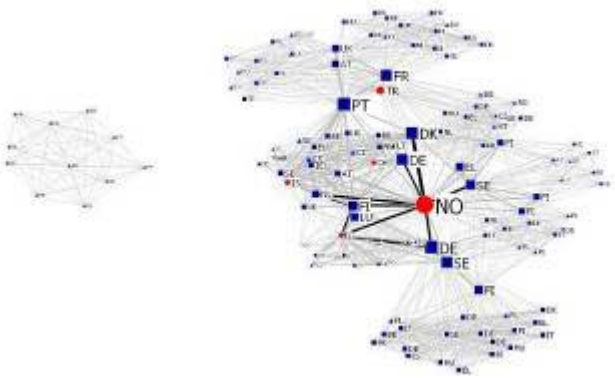
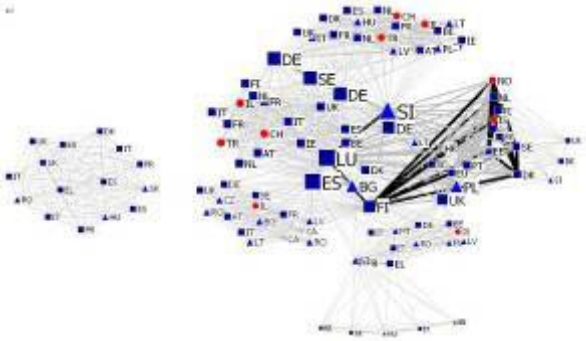



**Figure 62 Position of ERA-nets according links between participants in the FP7**




#### s. Network Key players

**Table 38 Ranking of the 10 first key players in the FP6**

| ID | label | country | Degree |
|---|---|---|---|
| RCN_NO | Research Council of Norway | NO | 74 |
| BMBF_DE | Federal Ministry of Education and Research | DE | 44 |
| AKA_FI | Academy of Finland | FI | 39 |
| VINNOVA_S | Swedish Governmental Agency for Innovation Systems | SE | 39 |
| FCT_PT | Foundation for Science and Technology | PT | 53 |
| FNR_LU | National Fund for Research | LU | 32 |
| GSRT_EL | General Secretariat for Research and Technology | EL | 32 |

**Table 39 Ranking of the 10 first key players in the FP7**

| ID | label | country | Degree |
|---|---|---|---|
| MHEST_SI | Ministry of Higher Education Science and Technology | SI | 59 |
| MICINN_ES | Ministry of Science and Innovation | ES | 53 |
| FNR_LU | National Fund for Research | LU | 55 |
| NCBiR_PL | National Centre for Research and Development | PL | 52 |
| BMBF_DE | Federal Ministry of Education and Research | DE | 43 |
| FORMAS_SE | Swedish Research Council for Environment Agricultural Sciences and Spatial Planning | SE | 43 |
| PTJ_FZJ_DE | Project Management Juelich Research Centre Juelich | DE | 43 |

**Figure 63 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

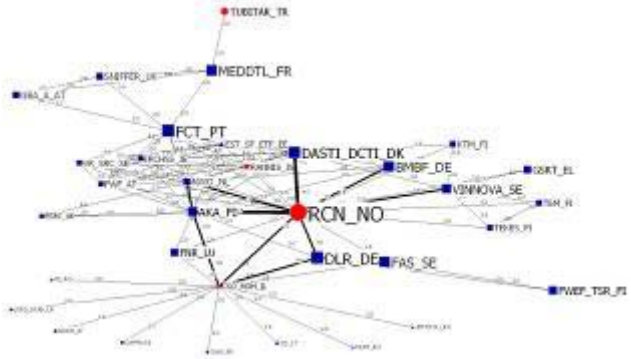



**Figure 64 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**

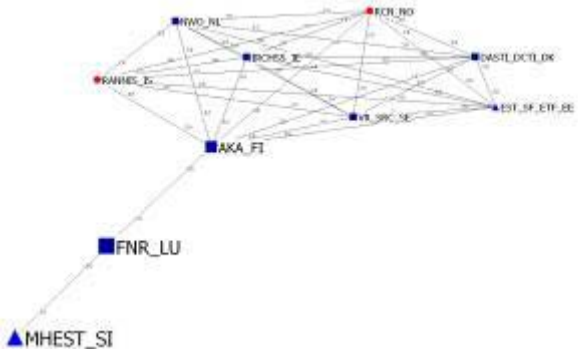


**Figure 65 Links between organisations in ERA-nets in SSH research field in the FP6**

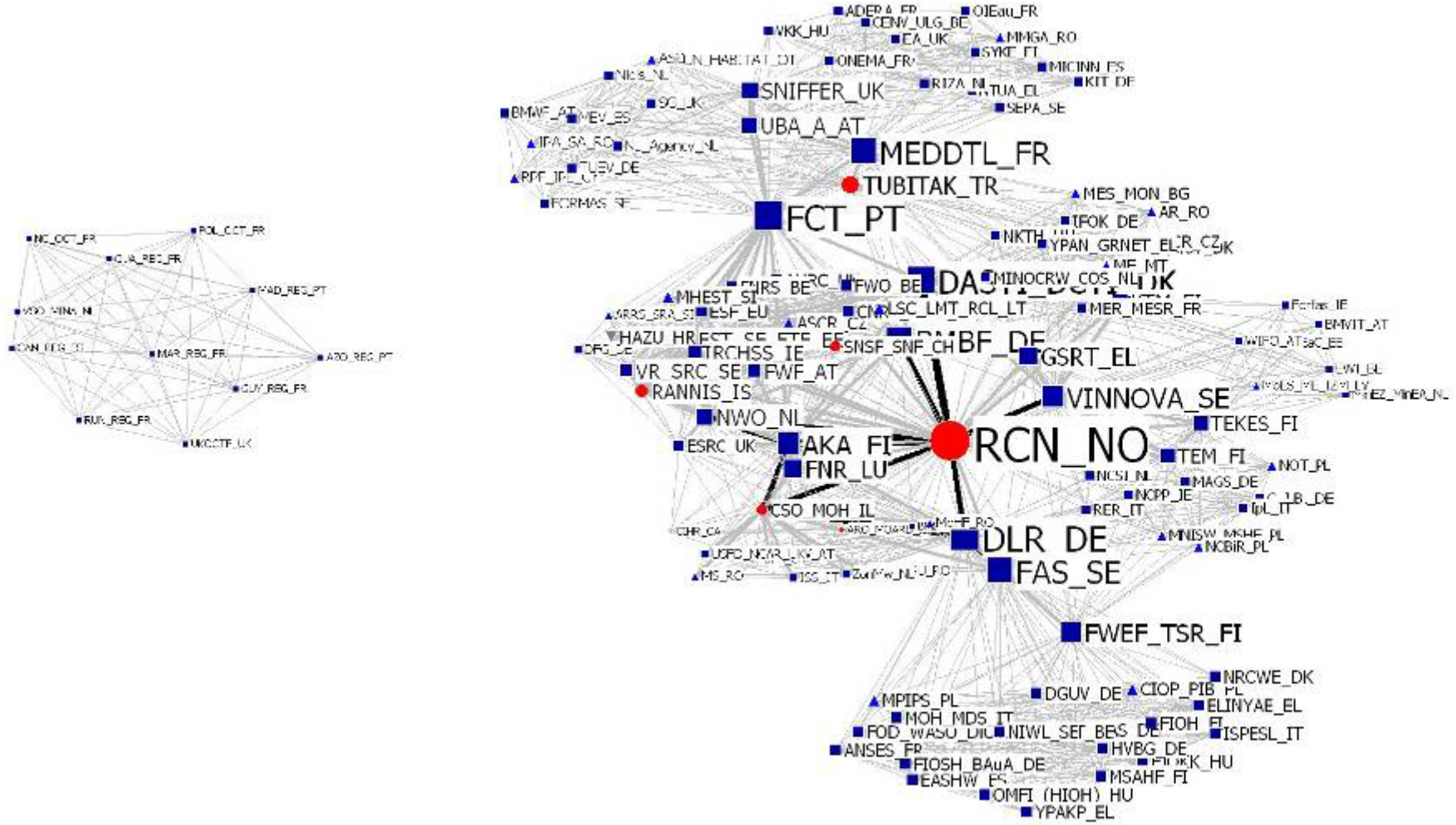
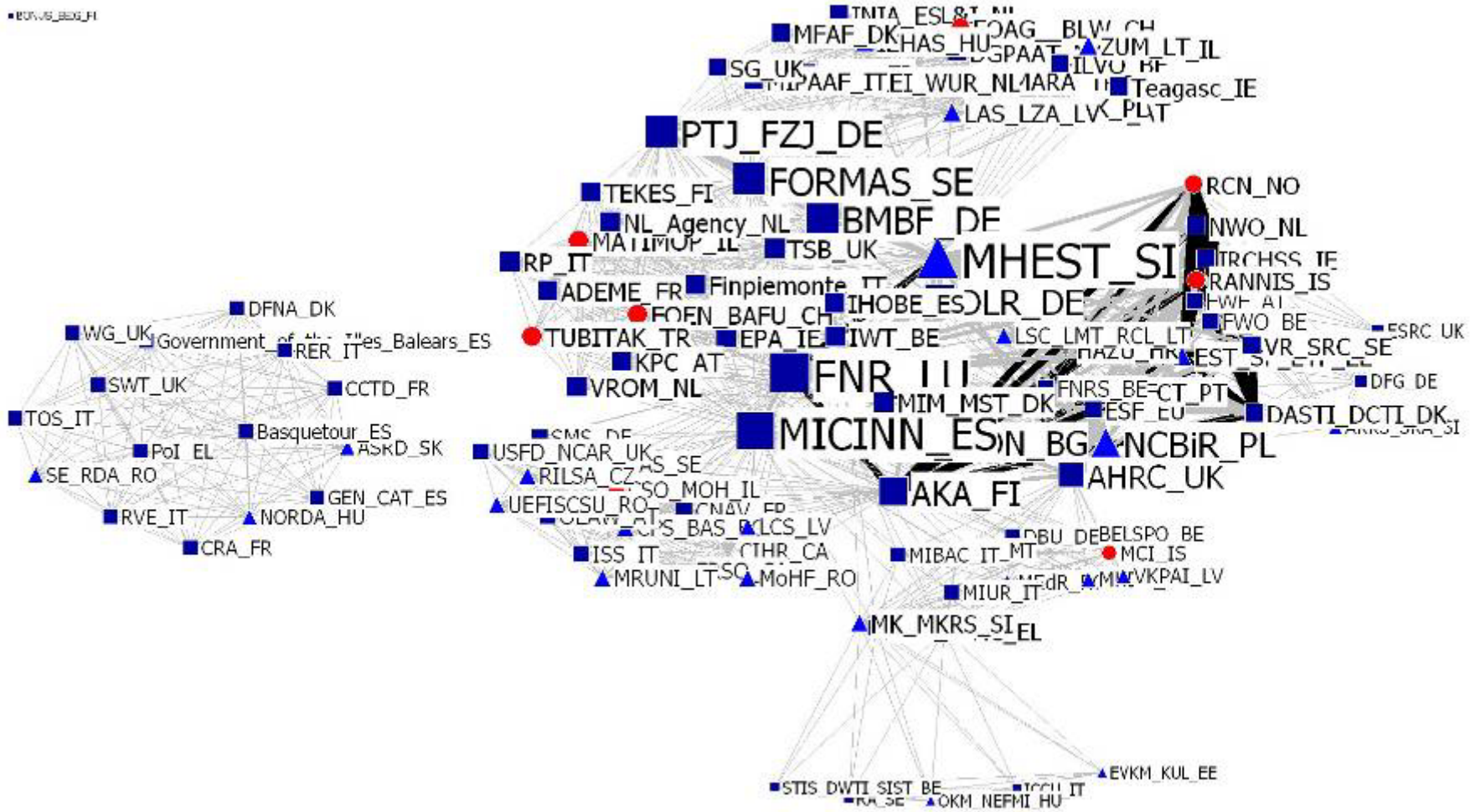


**Figure 66 Links between organisations in ERA-nets in SSH research field in the FP7**



### 6.2.10. Transport (surface transport and aeronautics)

#### t. Main network characteristics

**Table 40 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_Transport | 4 | 64 | 1490 | 16,0 | 23,3 | 0,82 | 0,368 |
| FP7_Transport | 5 | 86 | 2134 | 17,2 | 24,8 | 0,792 | 0,278 |

**Figure 67 Position of ERA-nets according links between participants in the FP6**

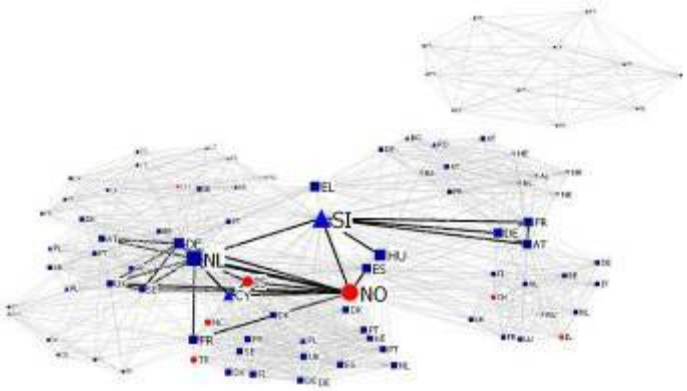
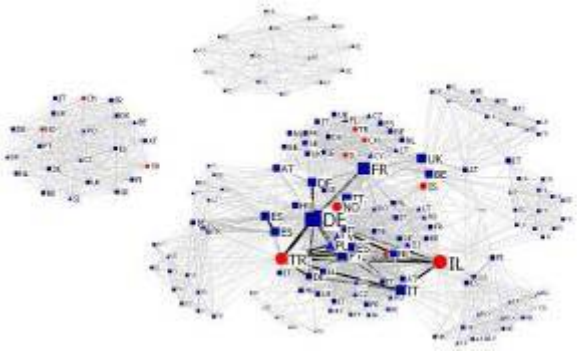



**Figure 68 Position of ERA-nets according links between participants in the FP7**




#### u. Network Key players

**Table 41 Ranking of the 10 first key players in the FP6**

| ID | label | Country | Degree |
|---|---|---|---|
| BMVIT_AT | Austrian Federal Ministry of Transport, Innovation and Technology | AT | 47 |
| BIS_UK | Department of Business, Innovation & Skills | UK | 42 |
| MinEZ_MinEA_NL | Ministry of Economic Affairs | NL | 42 |
| NCBiR_PL | National Centre for Research and Developmentl | PL | 42 |
| BELSPO_BE | Belgian Federal Science Policy Office | BE | 39 |
| VINNOVA_SE | Swedish Governmental Agency for Innovation Systems | SE | 39 |

**Table 42 Ranking of the 10 first key players in the FP7**

| ID | label | country | Degree |
|---|---|---|---|
| NCBiR_PL | National Centre for Research and Developmentl | PL | 79 |
| BMVIT_AT | Austrian Federal Ministry of Transport, Innovation and Technology | AT | 69 |
| FFG_AT | Austrian Research Promotion Agency | AT | 67 |
| RCN_NO | Research Council of Norway | NO | 62 |
| TUBITAK_TR | The Scientific and Technological Research Council of Turkey | TR | 62 |
| VINNOVA_SE | Swedish Governmental Agency for Innovation Systems | SE | 59 |

**Figure 69 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

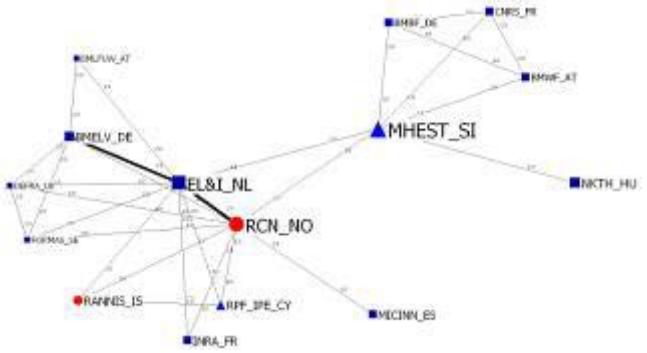



**Figure 70 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**

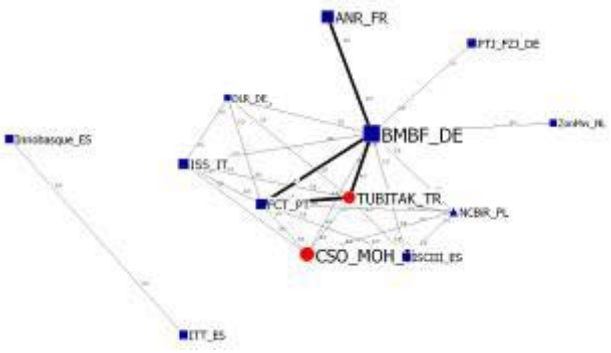


**Figure 71 Links between organisations in ERA-nets in transport resarch field in the FP6**

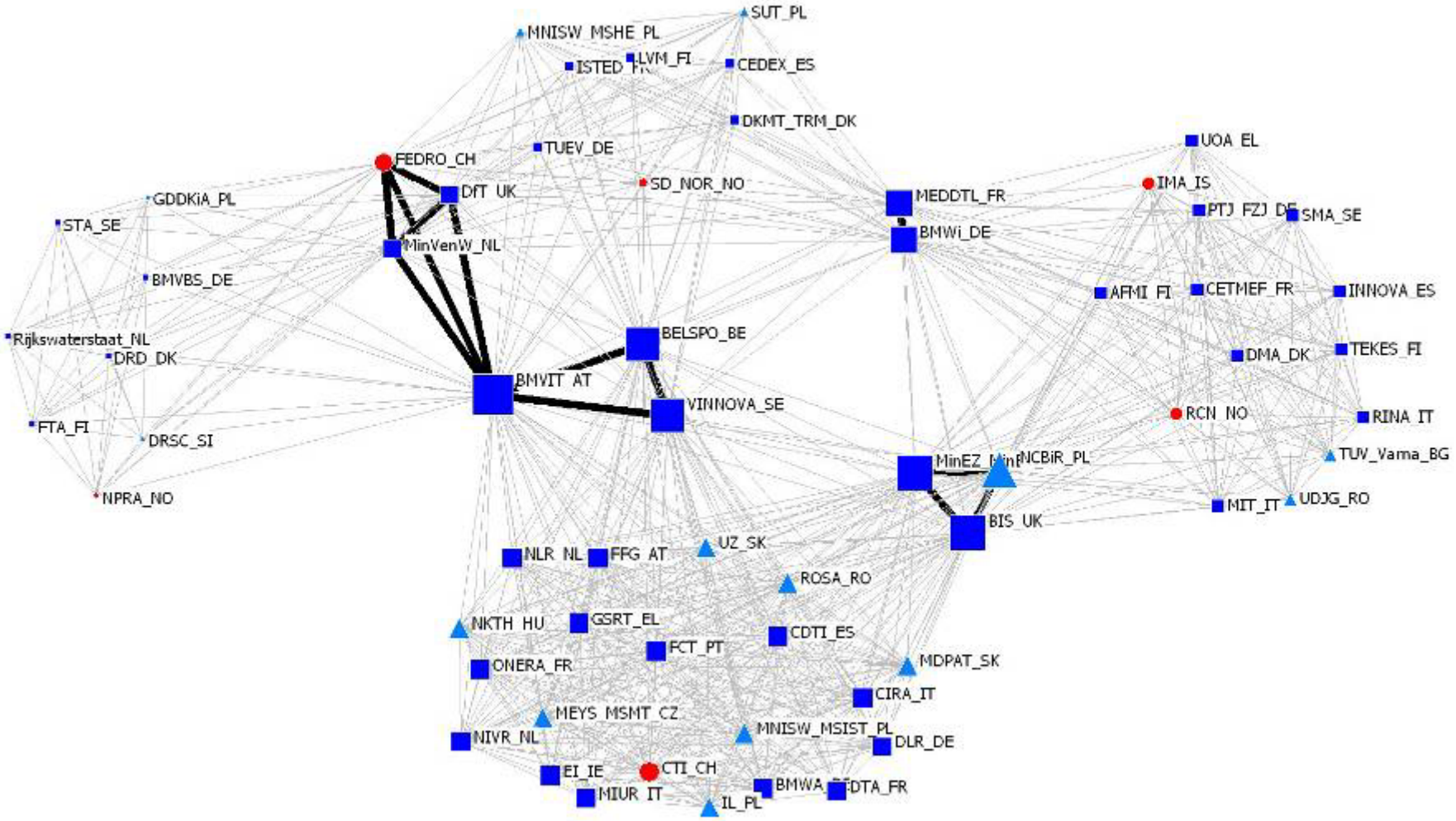
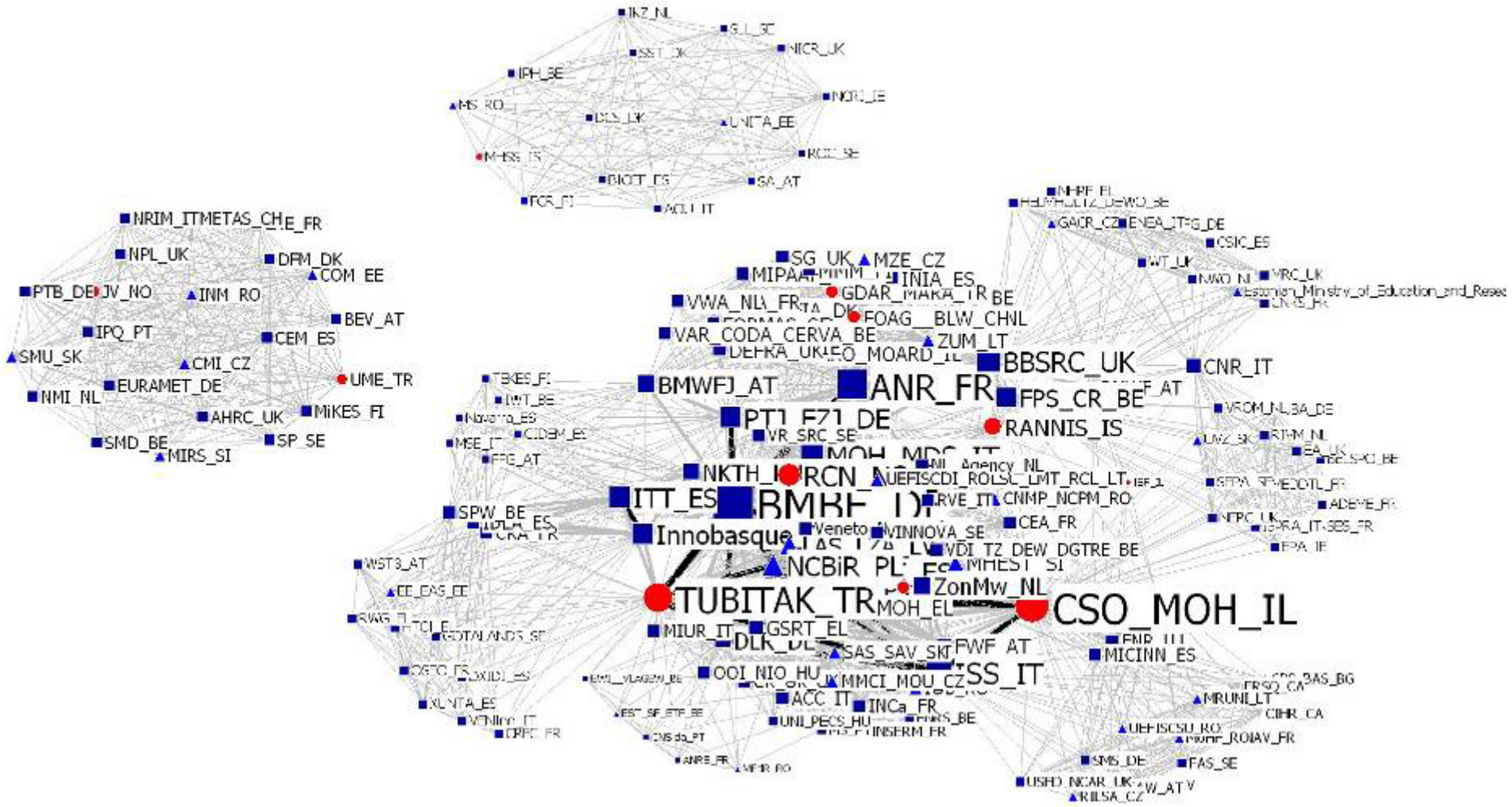


**Figure 72 Links between organisations in ERA-nets in transport research field in the FP7**



### 6.2.11. Space

#### v. Main network characteristics

**Table 43 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_SPACE | 3 | 40 | 756 | 13,3 | 18,9 | 0,941 | 0,436 |
| FP7_SPACE | 1 | 24 | 625 | 24,0 | 26,0 | 1 | 1 |

**Figure 73 Position of ERA-nets according links between participants in the FP6**

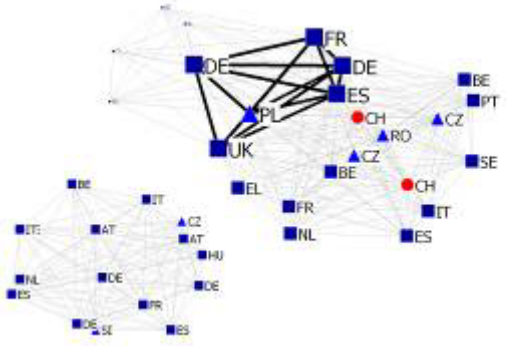
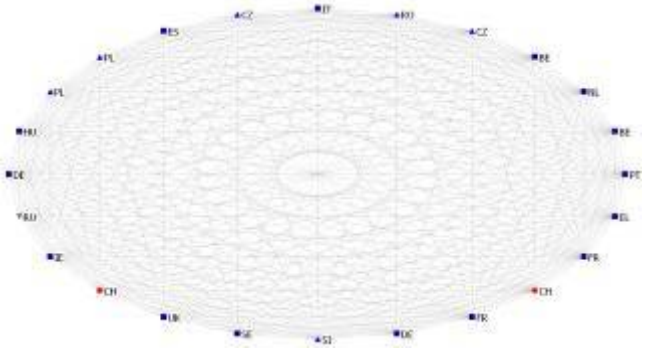



**Figure 74 Position of ERA-nets according links between participants in the FP7**



#### w. Network Key players

**Table 44 Ranking of the 10 first key players in the FP6**

| ID | label | country | Degree |
|---|---|---|---|
| BMBF_DE | Federal_Ministry_of_Education_and_Research | DE | 23 |
| CNRS_FR | National_Center_for_Scientific_Research | FR | 23 |
| MICINN_ES | Ministry_of_Science_and_Innovation | ES | 23 |
| NCBiR_PL | National_Centre_for_Research_and_Development | PL | 23 |
| PT_DESY_DE | Project_Management_DESY | DE | 23 |
| STFC_UK | Science_and_Technology_Facilities_Council | UK | 23 |

**Table 45 Ranking of the 10 first key players in the FP7**
- no figure as only one action

**Figure 75 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

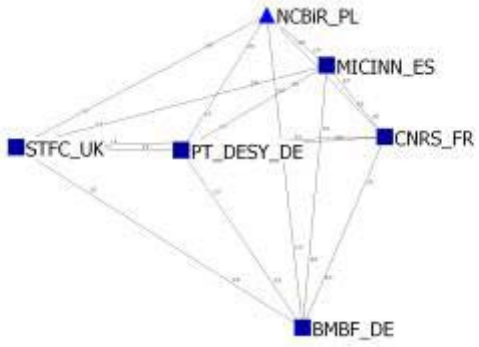



**Figure 76 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)**
- no figure as only one action

**Figure 77 Links between organisations in ERA-nets in the Space research field in the FP6**

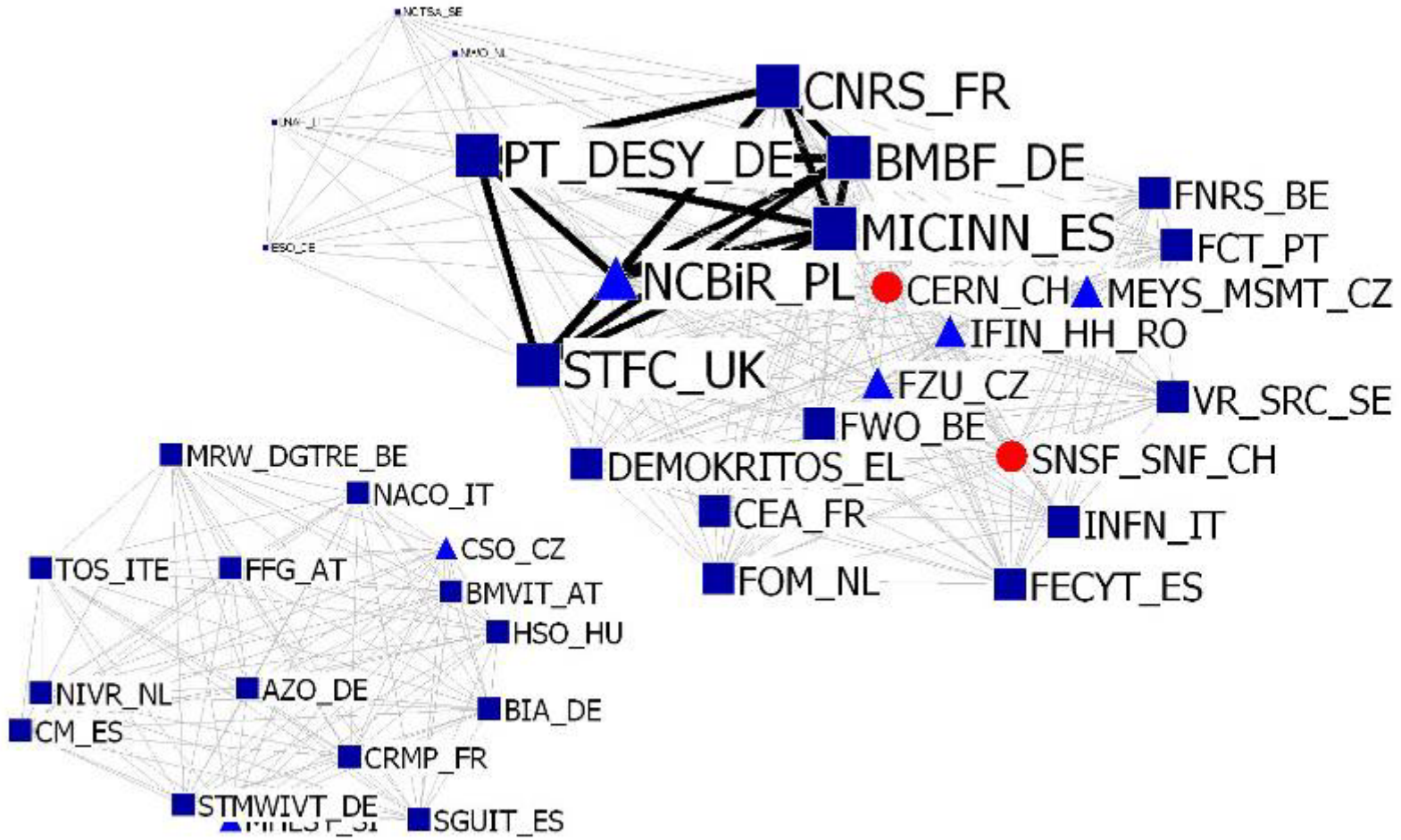
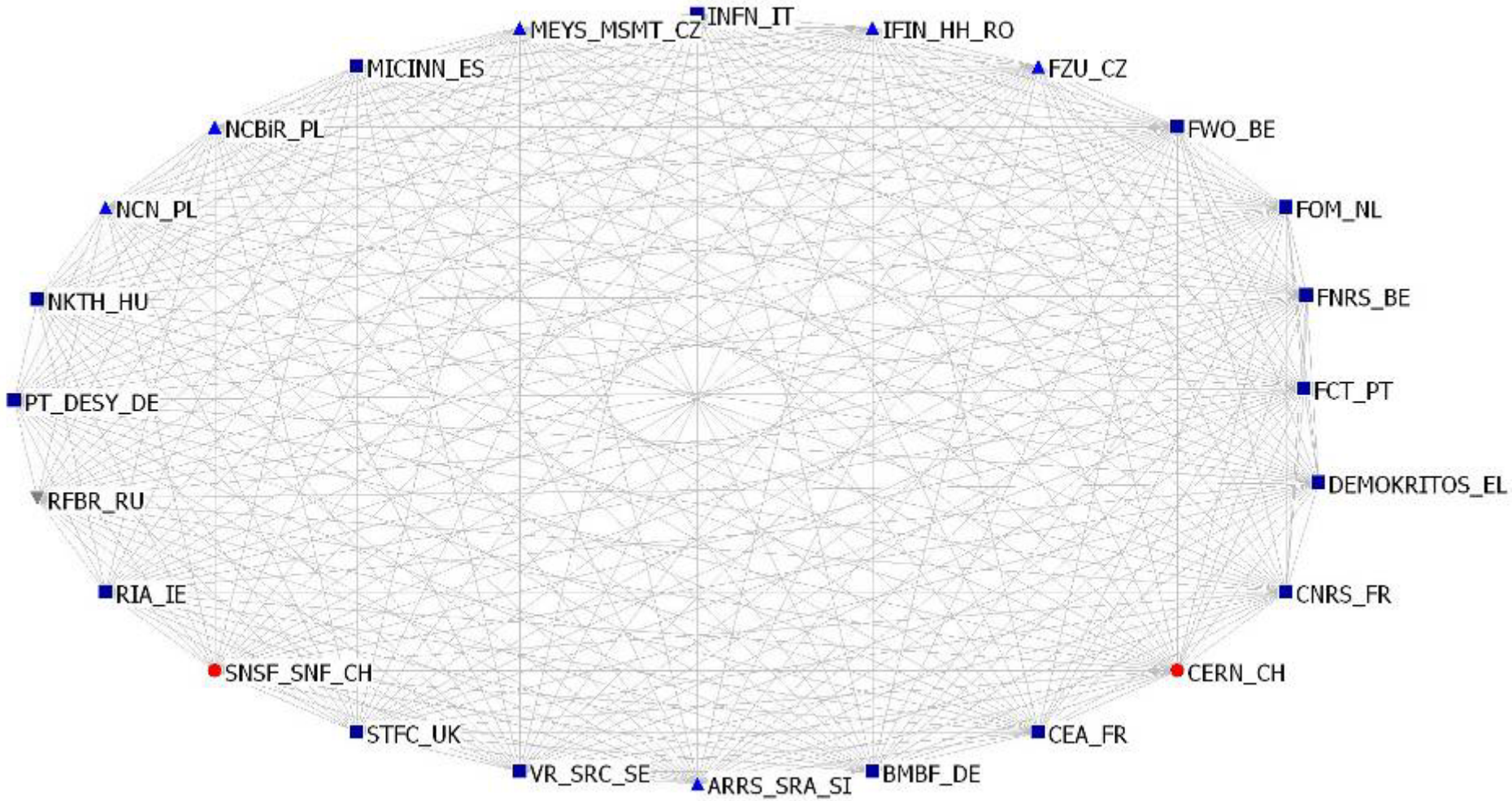


**Figure 78 Links between organisations in ERA-nets in the Space research field in the FP7**



### 6.2.12. Security and defence

#### x. Main network characteristics

**Table 46 Comparison between FP6 and FP7 network indicators**

| | numbers of actions | number of nodes | Number of ties | Avg Number of organisations by ERA net | Avg number of connection by organisations | Clustering coefficient | Density |
|---|---|---|---|---|---|---|---|
| FP6_SECURITY | 1 | 12 | 144 | 12,0 | 12,0 | 1 | 1 |
| FP7_SECURITY | | | | | | | |

**Figure 79 Position of ERA-nets according links between participants in the FP6**

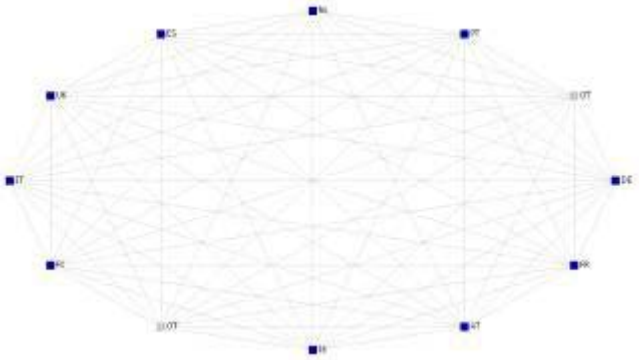


**Figure 80 Position of ERA-nets according links between participants in the FP7 –** no figure as no action

### Network Key players

**Table 47 Ranking of the 10 first key players in the FP6**

| ID | label | country | Degree |
|---|---|---|---|
| An_Garda_IE | An_Garda_Siochana_-_Irelands_National_Police_Service | IE | 11 |
| BMI_AT | Federal_Ministry_of_Home_Affairs | AT | 11 |
| DGPN_FR | Directorate_General_of_National_Police | FR | 11 |
| DHPol_DE | German_Police_University | DE | 11 |
| EUROPOL_OT | European_Police_Office | OT | 11 |
| GCS_MAI_PT | Cabinet_of_the_Ministry_of_the_Interior | PT | 11 |
| Justitie_NL | Ministry_of_Justice | NL | 11 |
| MetPo_UK | Metropolitan_Police_Service | UK | 11 |
| MinInterno_IT | Ministry_of_Interior_-_Department_of_Public_Safety_-_Office_of_Public_Order | IT | 11 |
| MIR_ES | Ministry_of_Interior | ES | 11 |
| SM_PO_FI | Ministry_of_the_Interior_-_Police_Deparment | FI | 11 |
| UNICRI_OT | United_Nation_Interregional_Crime_and_Justice_Research_Institute | OT | 11 |

**Table 48 Ranking of the 10 first key players in the FP7** - no figure as no action

**Figure 81 Strongest collaborations between organisations in the FP6 (more than ONE collaboration)**

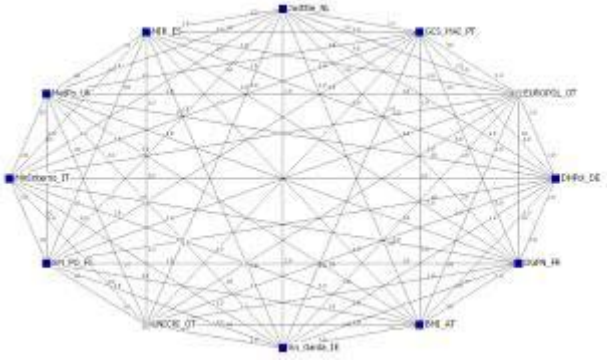


**Figure 82 Strongest collaborations between organisations in the FP7 (more than ONE collaboration)** - no figure as no action

**Figure 83 Links between organisations in ERA-nets in the Security and defence research field in the FP6**