

**Title**

The role of network analysis in the impact assessment of ERA funding schemes: the case of ERA-net actions in FP6 and FP7

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**Keywords**

Network analysis, ERA, ERA-nets, coordination, collaboration, impact.

The objective of this paper is to examine the impact of the ERA-net scheme on national funding agencies based on their collaboration characteristics. Section 1 provides a brief overview of our motivation for investigating links between ERA-net participants and its relevance to the questions of impact for the ERA-net scheme. Section 2 concerns our methodological approach where the network analysis concept and evaluative questions are presented. Finally, Section 3 summarises the preliminary result and section 4 gives an overview on possible development of our research.

## Motivations

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. The analysis follows work underpinned by JRC-IPTS analysing networks in the European Framework Programmes (1984-2006) using social network analysis (Heller-Shuh et al, 2011) and the impact assessment of ERA-net schemes through the Netwatch<sup>1</sup> platform.

This paper addresses the question of the impact of the ERA-net scheme on the behaviour of intermediary institutions. We consider here, as proposed by Barré (2008), the "intermediary institutions" level (research councils, funding agencies in some cases) with a "programming function". This level is positioned between the government level being primarily in charge of the orientation function and the scientists in charge of the "research performance". By assessing the impact of the ERA-net scheme, we are considering national policies alignment and the methodology and tools to better measure the European move towards a better coordination of research activities we use network analysis to attempt to assess the reduction of ERA fragmentation between the two Framework Programmes. In our case it concerns structural measures of networks formed by the collaboration of intermediary institutions.

The aim is to demonstrate that changes in collaboration behaviour of intermediary institutions are directly linked to the policy alignment issue.

## Approach

According to the most basic definition, a network can be seen as a "set of actors and the ties among them" (Wasserman and Faust 1994). Concretely, in the case of ERA-NET analysis, a node can represent a country, an organisation, or an S&T field. Network analysis can be used to qualify links between entities, and also to quantify and to qualify the position of entities among each other. We use such analysis to answer evaluation questions assessing the change between periods, the stakeholder's behaviour or reveal key players. The analysis results from an interpretation of graphs and figures that need to be complemented with other research. Network analysis can bring added value to assess the impact of the scheme on ERA on participants 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 (Borgatti, 2006), those who are the more connected or those playing a particular role. This type of analysis can enlighten changes in a network according to different criteria named structural measures. 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 for characterizing the structural importance of a node's position in a network. The coherence of a network can also be measured allowing the characteristics of a network (density, clustering, compactness, etc).

The main evaluation questions we propose to answer are the following: What are the main collaboration links between countries according to research fields? What are the main key

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<sup>1</sup> NETWATCH is the European Commission's information platform on transnational R&D programme collaboration. The current focus is on ERA-NETS, but the scope will be increased to include a broader range of initiatives.

players in the networks by research field? What are the main patterns of collaborations between organisations? What is the evolution of networks pattern between FP6 and FP7?

The NETWATCH database is the source of information we have used to conduct network analysis. Nodes represent, in this case intermediary institutions (organisations, ministries, funding agencies) and the links between nodes represent one or several collaborations in ERA-NETs.

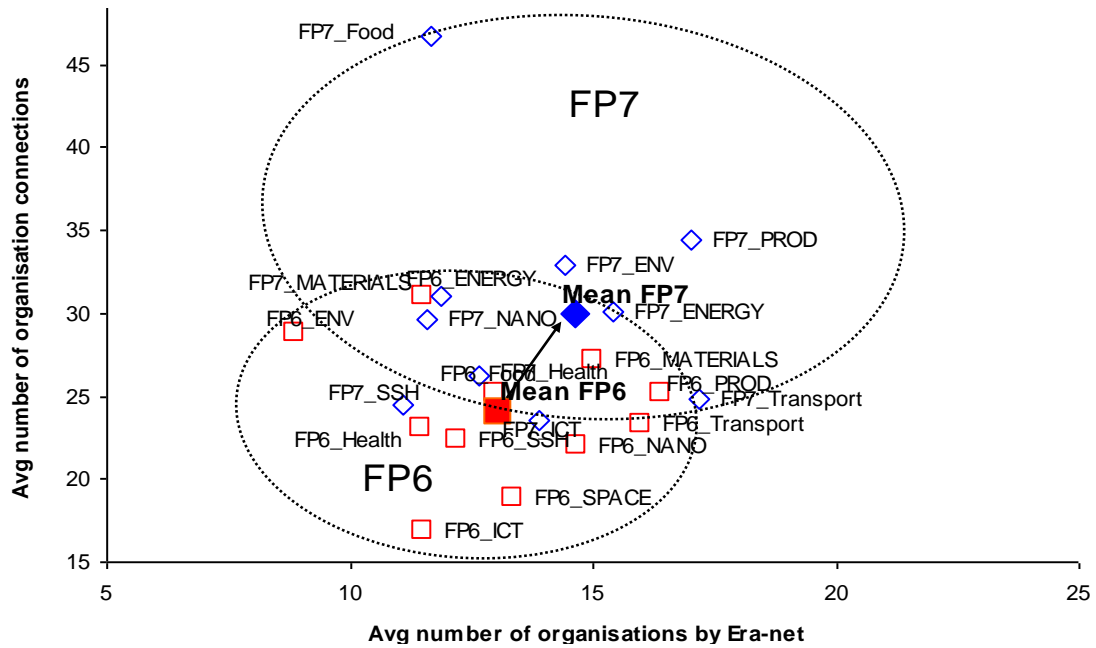
Network analysis provides structural parameters and graphs to measure changes and modifications that occurred in networks between FP6 and FP7 to observe structuring effects of ERA-NET actions on participating organisations. Indicators are calculated at network level (i.e. clustering coefficient, coherence measures) and at organisation level (centrality indicators).

### **Preliminary results**

As has already been observed regarding research organisations (Pohoryles 2002b, Barber et al 2006, Georghiou 1999, Caloghirou et al 2001.), the integration between intermediary institutions has increased over time, due to the involvement of institutions within simultaneous multiple projects. This indicates a move towards a more integrated European Research Area, and that collaboration within European funding frameworks has lead into more durable links between collaboration partners. The same integration phenomena could be observed at network level for, of course, different reasons compared to research organisations.

As Roediger-Schluga & Barber (2006) have described regarding research organisations, there has also been a significant tendency for the same institution to participate in consecutive Framework Programmes and that there is recurring collaboration between the same organisations within the Framework Programmes. Furthermore, the clustering (grouping) of organisations in networks seems to have increased over time. The development of institution clusters (also named smallworlds) reveals collaboration habits and will be analysed in a near future (see following section).

The change between the FP6 and FP7 in terms of network structure does not reveal strong disparities between research fields but mean values have drastically increased. The number of organisations participating in ERA-net actions and the number of connections by organisation increased between FP6 and FP7 and are logically correlated nevertheless we observe a faster increase regarding the number of connections per nodes suggesting networks are denser in the FP7 than the FP6.

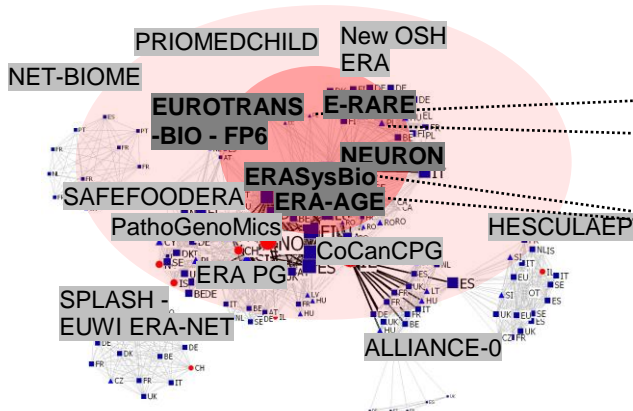
**Figure 1 Evolution of ERA net profiles according research fields**


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 next Figure 1). 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.

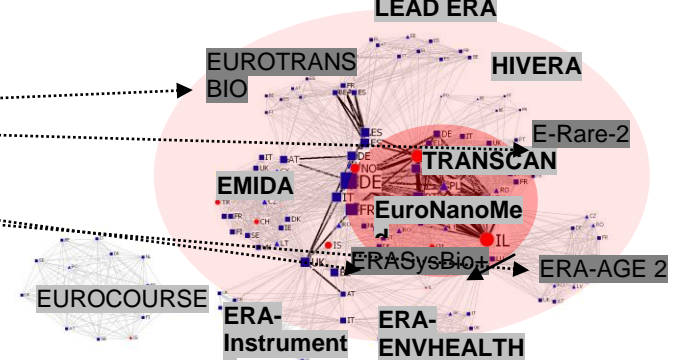


determinants of the network evolution could be investigated (changes in participation rules, content of work programme and available funding, participant behaviour, etc).<sup>3</sup>

**Figure 3 Position of ERA-NETs according to links between participants in the FP6**



**Figure 4 Position of ERA-NETs according to links between participants in the FP7**



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<sup>3</sup> The network analyses partially presented above provide an opportunity to elaborate ERA-NET scheme and its relationship with funding mechanisms. It is already seen that ERA-NET scheme has interacted with the funding mechanisms. Moreover, it is possible to evaluate its effects on the scheme in detail, which will be presented in the completed work.

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## Annex

**Table 1 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 ERA-net	Mean
numbers of ERA-net	FP6	15	9	2	17	10	3	4	5	4	11	3	1	7	<b>7,5</b>
	FP7	12	12	8	12	7	5	7	6	5	10	1		9	<b>7,7</b>
number of nodes (participants)	FP6	172	117	23	151	115	44	60	82	64	134	40	12	89	<b>91,1</b>
	FP7	152	140	111	173	108	58	83	102	86	111	24		103	<b>104,4</b>
Number of ties (links)	FP6	3965	2943	389	4350	3573	968	1629	2067	1490	3003	756	144	2262	<b>1.800,4</b>
	FP7	3982	6533	2612	5693	3247	1717	2572	3515	2134	2722	625		2861	<b>2.671,6</b>
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	<b>13,1</b>
	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	<b>14,6</b>
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		<b>24,0</b>
	FP7	26,2	46,7	23,5	32,9	30,1	29,6	31,0	34,5	24,8	24,5	26,0			<b>30,0</b>
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			<b>0,774</b>
	FP7	0,787	0,687	0,866	0,79	0,845	0,883	0,792	0,861	0,792	0,778				<b>0,826</b>
Density	FP6	0,118	0,19	0,091	0,16	0,229	0,471	0,419	0,28	0,368	0,151	0,44			<b>0,264</b>
	FP7	0,152	0,173	0,201	0,17	0,256	0,46	0,333	0,316	0,278	0,187				<b>0,321</b>
Compactness	FP6	0,353	0,479	0,305	0,49	0,583	0,736	0,71	0,589	0,674	0,451	0,47			<b>0,531</b>
	FP7	0,461	0,45	0,519	0,45	0,578	0,73	0,666	0,486	0,492	0,438				<b>0,570</b>