Science System Assessment

Workshop Research Groups and Science Collaboration

Working Report Series 1: Research Groups

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Robert Braam & Maaike Verbree

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The Rathenau Institute focuses on the influence of science and technology on our daily lives and maps its dynamics; through independent research and debate.

Preface

Robert Braam & Maaike Verbree

This report contains the papers and presentations held at a workshop on Research Groups and Science Collaboration, the 21st of November 2007, organised by Rathenau Instituut (Science System Assessment Department), at *Poort van Kleef*, in Utrecht. The workshop was organized around an ongoing literature review on research groups by Robert Braam and Maaike Verbree from SciSA. At the workshop, the preliminary results of this study were presented, focusing on definitions, specific characteristics and collaborating mechanisms of different kinds of research groups. Besides this more general presentation, a number of colleagues presented (empirical) results on aspects of different kinds of (research) groups: organizational research groups, communities of practice, networks, policy oriented research groups and transdisciplinary groups. The workshop was primarily organized in order to exchange (preliminary) research results and to bring together researchers in the Netherlands interested in studying (research) groups in the context of science studies. An overview of remarks made in the closing discussion of the workshop is a included in the report.

The workshop has been very helpful in shaping our thinking on research groups, and we hope it also has been a stimulus for the thinking and exchange of ideas and information for other participants, from some of which we received positive feedback in this sense. One of the guiding ideas in the research program on science system assessment at SciSA, is that science should be studied as an ecosystem. An ecosystem with a complex network of relations and interacting functions, constantly developing by internal dynamics and in relation to its societal environment. We think, more insight in the variety and functioning of research groups in science is important to understand the ecosystem of science. We hope this report on the workshop, as an additional event in the ecosystem of science, will stimulate further clarification and integrating of the several perspectives on research groups that came to the fore. Also, we hope the report will stimulate future exchange of new research results. We thank you all for participating.

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1 General introduction

Peter van den Besselaar

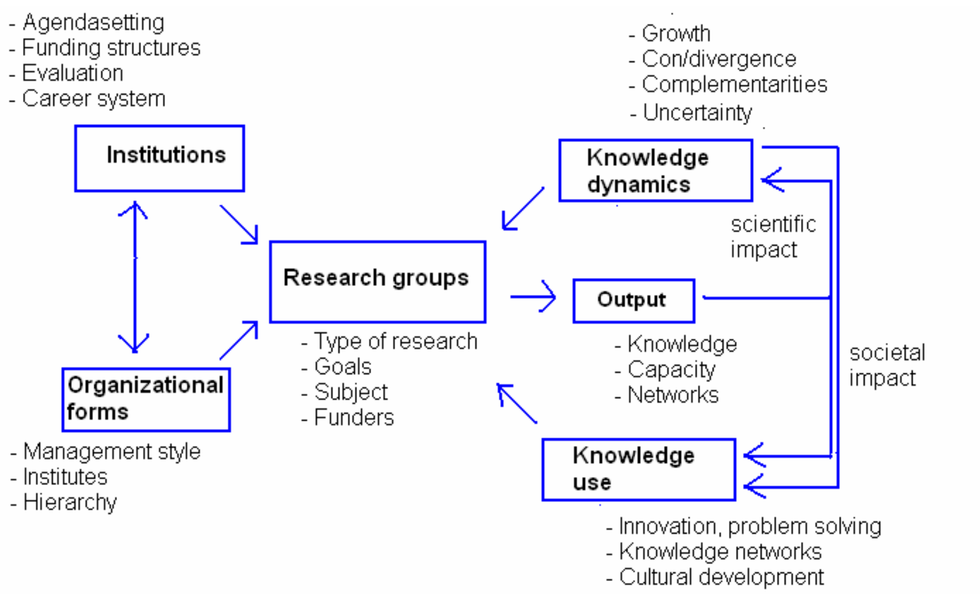
1.1 The Science System Assessment program

The first Science System Assessment program of the Rathenau Instituut was launched in 2006, after the Ministry of Education, Culture and Science had expressed the need for such a program. The main goals of the program are:
- Analysing the dynamics of promising (existing and new) research fields;
- Studying the functioning of the Netherlands science system, focussing on the way it responds to new scientific and societal challenges;
- Studying the science-society relation, and the perception and image of the sciences;
- Informing policy makers and parliament in an accessible way about the science system.

In order to realize these aims, the department reviews and integrates existing information and knowledge about the science system, and conducts original research to extend and improve our understanding of the science system. The research staff of the department currently is about 15 FTE.

The current research program consists of a few research lines. Firstly, one on the dynamics of research fields, in which we develop theories and methods to understand the different ways research fields develop over time. Secondly, we study the way management and organization of research groups influences knowledge production and the performance of researchers and groups. Thirdly, we study the effect of specific institutions (like funding, evaluation systems, or career systems) and organizational forms (like concentrating research in larger research institutes) on knowledge production. Finally, we focus on how to measure the output and outcomes of research. The next figure gives an overview.

Figure 1 A model of the science system



1.2 Differences between research fields

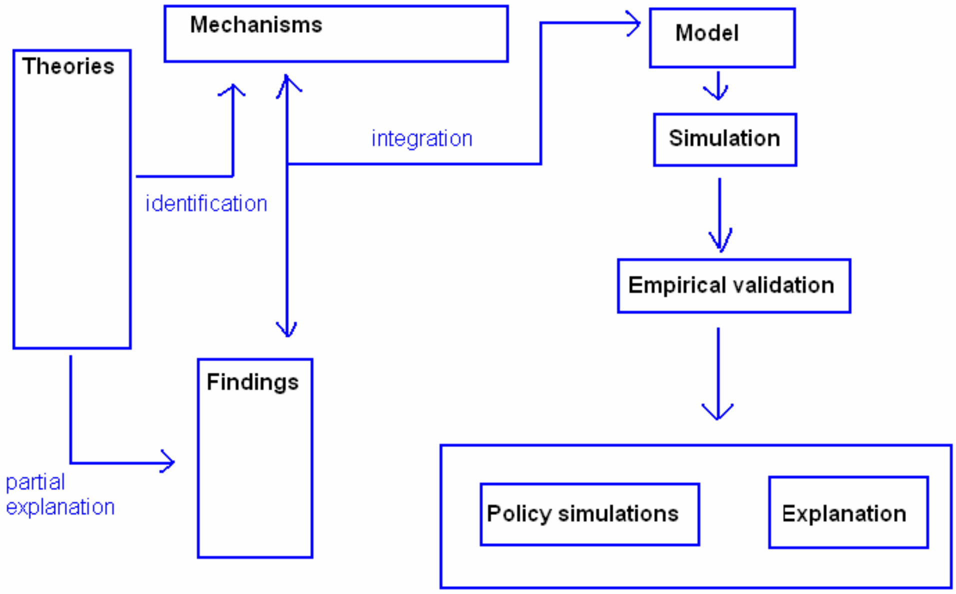
It is generally agreed that relevant differences exits between research fields, for instance based on types of research, ranging from applied research to basic research and everything in between. One should also differentiate between disciplinary, multidisciplinary, interdisciplinary and transdisciplinary research, each of which may require different organizational forms and institutional environments to blossom. Another distinction between fields is based on the nature of the field and its phase of development. Some fields grow fast, over uncertain and diverging trajectories, whereas others are more stable in terms of growth and direction. Some fields are based on individual projects, whereas others require long term planning, large investments and large scale research teams and institutes. Finally, fields differ in terms of socio-cultural and economic relevance. Some fields experience vested social interests and/or economic interests that try to co-shape the research system and the research agenda's.

1.3 Research groups and science collaborations

The science system assessment program gives a frame of reference for our core questions of today, which are about organization, management, performance and dynamics of research groups, and about research collaboration and communities.

In our conceptual model above, we placed the research group in the center. The group can be characterized by the type of research it does, but also by its funding, organization, goals, management style, etc. The group is embedded in the institutional and the organizational environment. The research group also is the unit that produces the (knowledge) output. This output can be used by and/or become part of the general body of knowledge in the field. Of course this communal body of knowledge in the field is not only produced by one group but by a collective of groups over a longer period of time. Summarizing, we see the research group as the smallest unit in this system, it is the location where knowledge production takes place and training of new generations of researchers is organized and where people are creating their (internal and external) informal networks. Of course depending on the field specifics, the research group may be large or may consist of only a single researcher.

Figure 2 Multi-theoretical modelling



1.4 Combining perspectives on research groups

Different perspectives exist to study research groups. For example, one may use a small groups dynamics perspective on research groups, or an institutional approach, or one from management theory. Alternatively, one may study research groups using theories about virtual organizations, communities of practice, network organizations or invisible colleges. All these perspectives will be discussed today. In other words, a multitude of theories exist on how research groups are formed, function and change over time. Each of these theories addresses the underlying social mechanisms only partially. One way of proceeding from that would be to use the theoretical mechanisms (according to the theories in question) to build a multi-mechanism model of the dynamics of research groups. In a next step, this model could be used to simulate research group dynamics and for more advanced testing of the theories and their relations. In this way, we may better be able to explain all kinds of phenomena we observe. And it could be used in policy simulation: what happens with research practices and research outcomes if one would change characteristics of research groups, or if one would influence the organizational or institutional environment of the group?

1.5 Workshop program

In the workshop, the preliminary results of a literature review on research groups will be presented, followed by a number of studies on different aspects of the functioning of research groups. In the various presentations, different perspectives will be used: organizational studies, communities of practice, invisible colleges, virtual teams, and transdisciplinary research groups.

The program ends with a discussion about the central concepts, trying to relate them to each other, and find ways to proceed in combining them into a multi-mechanism model of the dynamics of research groups.

2 Perspectives on research groups in science

Maaike Verbree & Robert Braam

2.1 Introduction

“But what exactly do we mean by a ‘research group’?” This nagging question repeatedly came up in discussions on our projects in the science system assessment research program. As we - surprisingly – found out, we couldn’t really formulate or reach consensus on a clear-cut definition of a ‘research group’ as a unit of analysis. Therefore we decided upon a review of the literature. In this presentation we offer our preliminary results of reviewing a small part of the available literature on research groups.

To start with, we highlight a few points that seem relevant to us in placing our review on research groups in a somewhat larger historical perspective. First, ever since the seminal works of Price (De Solla Price, 1965) and Crane (Crane, 1972) on networks, invisible colleges, or specialties in science, a large number of studies has been performed trying to capture the social and intellectual structure and development of scientific research in practice. We are, of course, not the first to review this particular literature. Already by the early eighties of the last century, Daryl Chubin (Chubin, 1985) had made an extensive bibliographic overview of the literature on specialties, reviewing over 300 entries, ranging from general theoretical and citation-based studies to studies of specific fields in the natural sciences, and laboratory site studies. In his article, Chubin, reflecting on his review, came to relate ‘research circles’ also to (new) interdisciplinary research, thus to a broader perspective then the initial ‘disciplinary’ perspectives by Crane and Price.

As a second point, we mention an essay by Helga Nowotny, focussing on the place of the individual in the research system (Nowotney, 1990). Nowotny states, that the individual scientist is always in an inherent tension with the collectivity of science. Each historical period of the development of science, shows a form of social mediation between the individual and the collective to handle this tension. In the early periods of science, mediation was performed in ‘democratic elite social circles’. In the post world war II period in the 20th century, mediation related to individual researchers working in teams in organisations.

Taken together, these two points illustrate that not only the literature on ‘research groups’ is growing, showing a certain divergence of perspectives, but also the object under study is in a process of dynamic change. The idea of looking at science as a dynamic self organizing ecosystem, may be of help to explain some of the conceptual varieties that we find in the literature, and in relating them to general notions of change in science, such as mode 2, and the triple helix, to give recent examples.

A third point to make, is that we came across some extensive literatures on social networks, small groups, research group performance, and knowledge management, that seem very relevant to the study of research groups in science, but that developed rather separately from the above literature on specialties. We think it may be interesting to draw from the literatures of all these different areas and analyse findings from alternative perspectives on groups, and to compare these results to the literature more specifically focused on research groups in science, in order to better understand group variety.

We will order our review results and findings in the following three sections:
1. Findings regarding group research and network analysis;
   1a. Theoretical perspectives on small groups / networks
   1b. Mechanisms behind network and group formation
2. Empirical findings regarding literature on research groups in science:
   2a. Perspectives on 'research groups' in science
   2b. Developments in context / settings of science
3. Approaches and practical ways of detecting groups
   3a. Approaches to detecting groups
   3b. Tools and available software solutions

Up till now, we reviewed, over 60 documents, including 34 journal articles and 23 books (see Table 1). The majority is from the last decades, and from the period before 1980. This number, we acknowledge, is only a small part of what we could read, part of which is still laying in copies on our work desks.
We decided to stop searching and reviewing the literature when we encounter no new perspectives, types of groups, or mechanisms behind groups. And, if that isn't the case, time will be a sure limit.

Table 1 Reviewed literature, up to 19th November 2007

Type	Groups	Science Groups	Group mapping	All
Articles	5	25	4	**34**
Books/chapters	8	15	[1] also in 1.	**23**
Papers, conf., ..	3	1	2	**6**
All	**16**	**41**	**6**	**63**

By year blocks: 1960-1970: **2** / 1970-1980: **11 /** 1980-1990: **5** / 1990-2000: **17 /** 2000-2007: **28**

As of yet, we have some idea of the types of groups in science that can function as units of analysis, and of relationships between them. As a first conclusion we think it is the interrelation between different kinds of groups, enacted by individual memberships to multiple groups, that forms an interesting approach to follow in trying to understand the science system. As the science system is evolving and coalescing with more practical and societal oriented networks, a multi-membership approach may be helpful, to study the functioning of, e.g., transdisciplinary groups.

2.2 Preliminary results

We will today present our first findings regarding group research (1) and groups in science (2), and we thereby focus on clearing up the concept 'research group' as a unit of analysis. Other aspects, and a review of approaches and practical ways of detecting groups (3), will be given only in a later instance.
Before presenting our preliminary results and conclusions, we will now first explain which methods we used in finding answers to our questions.

2.3 Methods

We used different search strategies to collect our literature. We searched the ISI Web of Knowledge using keywords: ‘research group’ or ‘team’ and ‘scientific collaboration’ or ‘networks. This resulted in an enormous amount of articles. A large part of these had no relation with definitions or studies on specific ‘research groups’. A more directed search strategy was the snowball method. We searched in the reference lists of relevant articles and books. Thirdly, we asked our colleagues, who are studying research groups or scientific collaboration, for recommendations. A last strategy was searching for books at Amazon.com, as a substantial part of the relevant literature is published in books, while in the ISI Web of Knowledge it is not possible to search for books. Amazon was very useful for this part, because it gives recommendations for relating books.

2.4 Small group perspectives

We started our study with a broad scope by searching for group definitions in general in order to get an idea of what is meant by the concept ‘group’. The literature on groups is enormously. There are different kinds of perspectives on small groups that are collected by Poole and Hollingshead (2005). There are 9 perspectives described (see Table 2). Every perspective has several key assumptions about a group. For example, the Functional perspective views groups as having a goal orientation, evaluation of group behavior or performance, utility and regulation of interaction processes, influence of internal or external factors via interaction processes (Poole & Hollingshead, 2005, p. 24). Some of the key assumptions are differently described in different perspectives, but seem more or less similar. We categorized these key assumptions in 7 general variables about groups (see Table 2).

One difficulty to give one clear definition of a group, relates to the many different possible perspectives to look at small groups. We find, however, that key assumptions on groups from these perspectives can be categorized in a way that some general key variables about groups can be identified. Thus, it can be assumed that by studying (research) groups the following group variables have to be taken into account: 1) Goal: the presence and maximization of a shared group goal versus the goals of individual members that might be in tension; and the general goal of being a group member as for instance adaptation for survival and reproduction. 2) Interactions: this variable is about group activities between group members like communication relations, conflict and cooperation activities. These activities can also have an symbolic meaning. 3) Context: this is about the environment of the group and the influence of external and internal factors on the group like political factors or emotional processes. 4) Interdependence between group members in different ways, for instance for protection and procreation to guarantee species survival, dependence to achieve goals, and dependence on time construct. 5) Perception: the shared cultural group perception had many labels as group mind, social identity, but also group existence perceptions, symbolic constructions of biological sex and the social construction of time play a role in this variable. 6) Group composition: this variable tells something about the similarities and differences between members in a group in preferences, resources, choices, conflict, power, status and gender. 7) Episodic: the episodic element focuses on groups in a specific time period or development phase.

As shown in Table 2, not all perspectives include all the variables in an equal way. Our follow up goal is to give an overview of what is known and what is not known about research groups from empirical studies in relation with these found group variables.

Table 2 Small group perspectives and key assumptions based on Poole and Hollingshead (2005)

Small Group Perspectives	Key assumptions	Goal Group vs. Individual	Interactions	Context External vs. internal processes	Interdependence	Shared cultural group perception	Group composition	Episodic
Functional perspective	Goal orientation	X						
	Evaluation of behaviour/ performance	X						
	Interaction processes: utility and regulation		X					
	Influence of internal/ external factors via interaction processes			X				
Psychodynamic perspective	Biological instinct: species survival				X			
	Group mind					X		
	Emotional processes			X				
Social identity perspective	(Social) identity					X		
	Intergroup differentiation						X	
	Intergroup context				X			
Conflict-Power-Status perspective	Outcome maximization of individual/ group	X						
	Interdependence between actors drives group interactions				X			
	Difference in preferences, resources, choices → differences in conflict, power, status						X	
Symbolic-interpretive perspective	Significant symbol: perception of existence					X		
	Symbolic activities: interactions (predispositions, practices, processes, products)		X					
	Groups are embedded in			X				

	environment/ context							
Feminist perspective	Equality between man/ woman in capability and deserving						X	
	Influence of internal (proximal factors: intra- and interpersonal) /external (distal factors: societal, economic, political) factors			X				
	Influence of gender (refers to social, symbolic constructions of biological sex) in groups					X		
Social network perspective	Relationships		X					
Temporal perspective	Time: social construct, resource, problematic issue for theory/ research	X			X	X		X
	Change: systematically change of groups over time, temporal patterns of group processes, complex systems							X
Evolutionary perspective	Adaptation: selection, variation, retention	X						X
	Historical evolutionary approach: past circumstances → psychological mechanisms of group living			X				X
	Functional evolutionary approach: individual behaviours → reproductive potential groups	X	X					

Further review results might lead to an extension of group variables that are important for studying groups. Ultimately, the set of group variables are going to be used for modelling research groups in a computational model.

2.5 Groups in science

According to the different perspectives on small groups, it is not surprising that there are different perspectives on research groups in science as well. This means that it is not possible to give one clear definition on what a research group is. Instead, we distinguish different unit of analysis of research groups. Each unit of analysis has its own specific setting of group variables. When reviewing the literature we collect a considerable amount of definitions of research groups. The concept of the research group is labelled in many ways. By comparing those labels and definitions we saw that some labels and definitions could be grouped together. This grouping resulted in four units of analysis with specific key assumption for each unit of analysis (see Table 3).

The first unit of analysis is the research area network. Like the label shows, it is about a network of scientists that are grouped together around a research subject. In this network you can find smaller communities where members show more social coherence and feel a higher degree of identification. Some individuals in such research area networks are characterized by more intensive interactions by collaborating. This group type is characterized by a social and intellectual dimension and members vary in the degree of integration (eg.Chubin, 1976; Gläser & Laudel, 2001; Zuccala, 2006). The second unit of analysis is the organizational research group. Within this unit, we distinguish the research group/ team/ unit from the more intensive collaborating R&D teams or research project teams. This group type is characterized by a leader or manager, who may perform different roles; a relation to a formal environment responsible for the coordination; and a fixed membership composition in amount of members, live span and recruitment (eg. Andrews, 1979; eg. De Haan, 1994; Heimeriks, Hörlesberger, & Van den Besselaar, 2003; Stankiewicz, 1976). The third unit of analysis is the organizational research network. These are collaborations between multiple, increasingly heterogeneous, research organizations. The characteristics of these collaborations are the variety and overlap in institutional forms, the communication networks in collaboration projects, and the coordination of a common agenda and resources (eg. Contractor & Monge, 2002; Heimeriks et al., 2003; Shrum, Genuth, & Chompalov, 2007). The last group type is the community of practice, that is characterized by vague socially or visible boundaries, and where bounding of people together in practice and becoming member is a social process (Lave & E., 1991, reprint 2003). Although this type exists of practitioners instead of scientists, we think it is useful to involve this type. A community of practice exist because of knowledge production and sharing in practice around a shared object or activity of interest. The number of sites where knowledge production is taking places has increased (Gibbons et al., 1994).

Table 3 Units of analysis and group variables

UNITS OF ANALYSIS	GROUP VARIABLES
Research area networks • Research field/ scientific discipline/ scientific specialty: characterized by subject from broad to small • Scientific community/ clusters/ cohesive groups/ modules: characterized by social coherence and identification	• Social dimension: size and composition → competition and coordination to gain recognition/ controllers held conceptions of ideals • Intellectual dimension: scope and problem content → mutual dependence in making competent contributions, task

• International collaborative networks of scientists/ invisible college: characterized by intensive interactions/ collaboration	uncertainty in producing and evaluating knowledge claims, allocation of reputations and resources for intellectual products. • Variation in specialty integration/ hierarchical nature in networks/ multiple membership/ shared nodes by different communities/ overlapping communities/ sub-groups: connectedness higher between nodes than to the rest of the network and intellectual practices contentious to network.
Organizational research groups • Research group/ team/ unit • Collaboration in R&D teams/ research project teams	• Leader with variety in role: managing/ consulting/ policy/ active researching • Relation to a formal environment (entity, organization, government policy): provide support service, sanctioning or specifying goals, task assignment, institutionalization of coordination • Membership composition: minimum members, existence and live span; recruitment from multiple groups/ units/ organizations
Organizational research networks • Multiple-organizational collaboration in science/ heterogeneous research networks • Knowledge network management	• Variety/overlapping institutional arrangements/spheres • Communication networks in project collaboration • Common agenda/ coordination of resources
Communities of practice • Practitioners producing and sharing knowledge on common object / activity	• No socially, visible boundaries • Bounding of people together in practice • Membership is social process 'legitmate peripheral participation'

2.6 Preliminary results

Thus, we have distinguished four different units of analysis of research groups in science. Now, we want to conclude by explaining how these units of analysis differ and how they relate to each other.

First of all, we want to illustrate the differentiation to categorize the units along two group organizing components, namely content and formality. The content relation of research area networks and organizational research networks are academic. For organizational research networks and communities of practice the content relation is practical. The organizational research groups and organizational research networks are formally organized. Research area networks and communities of practice are informally organized.

Secondly, we want to explain the relation between the units of analysis. As a point of departure we take the individual researcher to show these relationships. An individual scientist may have multiple memberships to multiple, overlapping groups (Palla, Derényi, Farkas, & Vicsek, 2005). If we give a concrete example of the many group memberships of e.g. Peter van den Besselaar, you see that as a researcher he is part of a complex network of groups in science. Those groups are not isolated from each other as is showed in Figure 3. This is what Palla et al. (2005) call a 'web of communities'. The phenomenon of overlapping memberships, leads to (explains) knowledge flows between these groups.

Figure 3 Relations between research groups and units of analysis

Activity	Unit of analysis	Actors
I. Knowledge production	Research area networks	Scientists
II. Research output	Organizational research groups	Scientific/ technical researchers
III. Knowledge management	Organizational research networks	Organizational managers
IV. Learning and knowledge sharing	Communities of practice	Practitioners

We think this multiple membership and overlapping communities perspective, is important to study research groups in science in context of their wider environment, that is linked by the networks of its members. We also think it is fruitful to incorporate different perspectives in studying research group to see the whole picture. We have found some useful perspectives in view for studying research groups in their context, such as social networks, system dynamics, knowledge management and organization. In continuing our review we will use these perspectives to look for further information on mechanisms behind group formation and development in science. Also, we will be searching for empirical findings on each unit of analysis that we now distinguish, and the relations between them. Finally, we want to review approaches, tools and software to detect groups of each type we found. Thus, we hope to be able to better describe the units of analysis and the relations between them in the science system.

Thanks for your attention, we welcome any remarks, suggestions for our results and follow up review.

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3 Organisational Medical Research Groups

Inge van der Weijden

3.1 Context

An understanding of the determinants of research performance is a prerequisite for designing effective micro and macro research policies. It may give research leaders and administrators tools to attract motivated individuals as well as to achieve organizational and project goals. Furthermore, research leaders and administrators may be stimulated to improve and control research group performance (van der Weijden, 2007, p.168). The project *'micromanagement of medical research groups'* examines the relationship between managerial control and research performance of Dutch medical and health research groups. These groups are formally organized and related to an University Medical Centre (UMC) or a (selected) non-university research institute. The project addresses the following question: do (certain) research management activities enhance the performance of academic groups? A two-wave longitudinal quantitative study design was used to gather data from research leaders over a period of five years (T1:2002; T2:2007). In this presentation I will present some preliminary results of the survey study conducted in 2007. In the period May-September 2007 we sent a questionnaire to a total of 832 medical group leaders, mainly chaired professors. A total of 102 research leaders were non-eligible. They turned out to be attached to their research group only a short period of time (less than 6 months) or could not answer the questions because hardly any research was done in the group (focus on patient care) or had just left the research group (professors emeritus). 215 leaders returned a filled questionnaire by mail for an overall response rate of 30%.
In this presentation I will focus on four topics (see below) that are most relevant for the workshop theme.

3.2 Definition of research groups

In this project we used the definition of Andrews (Andrews, 1979b, p. 19) to define research groups. *'For a group of individuals to be regarded as a research unit, it had to meet three criteria: (1) The group had to have at least one recognised leader who was significantly involved in its work. (2) The group had to include a total of at least three people (including the leader) who were significantly involved in its work, and each of these people had to have been a member of the group for at least half a year. (3) The group had to have an expected life span of at least one year'.*

3.3 Characteristics of medical research groups and leaders research groups

It shows that, on average, 22 research staff members were working in a research group. On average, the composition of medical research groups is stable over time. 78% of the respondents have the opinion that the permanent positions of staff members in the group is more or less stable (no job movement) for a couple of years.

Writing and publishing scientific articles (91%), development of new knowledge (54%) and training of young researchers (40%) were the most important goals of the research groups supervised by the respondents.
The term ‘health research’ covers many activities, and it has been shown that it is not easy to make a straightforward classification of all these activities (Omta, 1995; Rigter, 1986). In this study, the degree to which research is related to potential patients is used to distinguish between three categories of health research: para-clinical, pre-clinical and clinical research (see also van der Weijden, 2007a p. 20). Para-clinical research emphasises both health-care research and diagnostic testing. The relationship with patients is of an advisory nature. In pre-clinical research no direct contact with patients exists. Research has a fundamental orientation and is often carried out by medical biologists and biochemists. In clinical research a direct relation exists with clinical practice. Of the 215 respondents, 84 are research leaders of pre-clinical groups, 92 are research leaders of clinical research groups and 39 are research leaders of para-clinical research groups.

3.4 Research leaders

The average age of the respondents is 53 years and the majority is male (87%). 88% of the respondents works in a university setting (UMC); 12% works in a non-university research institute. On average, the respondents are functioning as head of their medical research groups for over 12 years now. In general, medical research leaders spend most of their time (25%) on supervision of PhD students. As could be expected, more time was allocated to patient care ($F = 9.784$; $P<0.01$) in clinical research groups than in pre- and para-clinical research groups. Research leaders spend 20% of their time on internal management activities and 10% of external management activities. Examples of internally organized research management activities are: (i) organization of research meeting, e.g progress meetings of current research projects, discussion about research proposals and papers; (ii) use of rewards in order to motivate staff members; (iii) organization of research policy meetings; (iv) organization of research evaluations. In spite of these managerial tasks, research group leaders are, in general, still highly involved in medical and health research in general and in particular in research conducted in their own research group. Leaders think they are acting as a oracle in solving research problems within their groups. They also have the opinion that their staff members think of them as highly skilled scientists. The respondents are not the only research leader of their group. 75% of the respondents indicate that a second research leader is (formally or informally) acting in the group.

3.5 Group characteristics and research performance

Group size and age are two examples of characteristics of research groups which are studied in this project. Scholars reported positive relationships -including curvilinear ones- between research performance and these contingency variables (for an overview see van der Weijden et al., 2007b). In both para-clinical and clinical research groups, group size (fte’s) correlates positively with research performance. The size of para-clinical research groups correlates positively with the number of SCI publications (period 2004-2006). In clinical research groups size correlates positively with the number of SCI publications and the Dutch medical research council activity (period 2004-2006). These findings suggest that, as one would expect, there are more opportunities for e.g. contact, reward structure and obtaining research resources in larger research groups. Interestingly, in pre-clinical groups there are no correlations between group size and research performance.

The age of clinical and para-clinical research group leaders correlates positively with their Dutch medical research council activity. This suggests that the leader's professional expertise as a scientist significantly affect the unit's productivity. For instance Dill (1985) contended that the professional experience of leaders enables them to influence members' knowledge and values, to facilitate contacts and networks, to attract other competent researchers, to help colleagues, and so on. Interestingly, in pre-clinical groups there are no correlations between age and research performance.

3.6 Research management activities and research performance; the example of a reward structure

The use of rewards is an example of a internally organised management activity that studied in this project. In the literature, material (e.g. bonus, salary increase, promotion) and immaterial rewards (e.g. public recognition, training facilities, sabbatical leave, career possibilities and planning) are distinguished. Rewards are often used as an incentive mechanism to encourage participation, increase individual effort, and increase cooperation within group problem solving tasks (Gavish, Gerdes and Kalvenes, 2000). Furthermore, it can motivate scientists to perform at higher levels. The proper use of rewards culminates academic research performance (see for instance studies of Latham and Wexeley, 1981; Omta and de Leeuw, 1997, van der Weijden, 2007a & b). In our project we measure four different kinds of rewards (see van der Weijden, 2007a p.68):
-financial bonus system;
-special commendations;
-development of research skills (= possibility to take national and international courses, to attend national and international conferences, to gain experience in foreign research groups, to supervise MSc and PhD students);
-flexibility (= possibility to have flexible working hours and to work at home).
We find a positive correlation between the extent to which *financial rewards* are offered in clinical groups and the number of SCI publications. The extent to which *honourable mentions* (special commendations) are given to research staff in order to motivate research staff show, in clinical groups, a positive correlation with the number of SCI publications and. In pre-clinical groups a positive association is to be found with the amount of external research funding obtained. The extent to which opportunities are offered in para-clinical and pre-clinical groups to develop *research skills* correlates positively with the number of SCI publications. In pre-clinical research groups there is also a positive correlation between skills development and the amount of external research funding obtained. In none of the groups the extent to which opportunities are offered to *work flexible hours* is significantly (positively or negatively) associated with research performance. Finally, there is no correlation between use of rewards (of any kind) in medical research groups and the Dutch medical research council activity.

3.7 Preliminary conclusions

Group characteristics, group size and age of research leader, have significant positive correlations with performance of para-clinical and clinical research groups. In pre-clinical groups, there is no significant (positive or negative) correlation between group characteristics and performance. Rewards have significant positive correlations with performance of mainly pre-clinical and clinical research groups. In sum, the preliminary results of this study are in line with van der Weijden (2007a) who indicate that (bio)medical and health groups are different. Perhaps, this differentiation can, to some extent, be explained by the differences between pre-clinical and clinical research

groups with regard to dependency on external financial resources (see van der Weijden, 2007; Table 4, p. 23).
Finally, the first results of this study reveal that managerial choices of Dutch (bio)medical and health research leaders, concerning the use of different types of rewards, are resulting in differences among performances measures. We advise to use different rewards in order to perform well on the various research goals that are set within (bio)medical and health research groups.

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4 Communities of practice

André Somers & Floortje Daemen

The concept community of practice offers some valuable insights on the dynamics of knowledge production and knowledge sharing. The community of practice describes the social setting in which knowledge is produced, according to Lave and Wenger: “a community of practice is an intrinsic condition for the existence of knowledge” (Lave & Wenger, 1991, p. 98).

4.1 Situating the community of practice

Lave and Wenger’s learning-theory requires an important rethinking on the general, ‘traditional’, view on learning. Traditional learning-theories were based on the notion that learning is an individual, isolated activity. Learning was seen as a simple process of transfer or assimilation, in which factual knowledge is unproblematic internalized. Wenger (1998) illustrates that the traditional view on learning is still prevailing in the majority of educational systems nowadays:

“We arrange classrooms where students – free from distractions of their participation in the outside world- can pay attention to a teacher or focus on exercises. We design computer-based training programs that walk students trough individualized sessions covering reams of information and drill practice. To assess learning we use tests with which students struggle in one-on-one combat, where knowledge must be demonstrated out of context, and where collaborating is considered cheating” (Wenger, 1998, p. 3).

However, Lave and Wenger have formulated a ‘situated’ view on learning, based on social practice theory as formulated by Bourdieu (1977), Ortner (1984), Bauman (1973) and Giddens (1979). These theories of social practice go beyond the reduction of the person to the mind and emphasize agent, world and activity as integrated in practice. Lave and Wenger have adopted this view and translated it into a situated view on learning.

The principle of Lave and Wenger’s theory is that learning and work practices are inseparable; learning is perceived in terms of participation. In order to understand the process of knowledge sharing the whole system of values and believes that is part of the surrounding world of an agent is taken into account (Lave & Wenger, 1991; Wenger, 1998). According to Lave and Wenger, we should see a community of practice as “a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice” (Lave & Wenger, 1991, p. 98). The relations between the members of a community of practice are dynamic. New members learn, get familiar with the practice and become ‘oldtimers’ themselves.

Furthermore, the members of a community of practice are not necessarily co-located. Another important characteristic, according to John Seely Brown and Paul Duguid, is that communities of practice are “often noncanonical and not recognized by the organization” (Brown & Duguid, 1991, p. 49). This means that organizational communities often do not correspond with informal emerging communities of practice

(Andriessen, 2005; Brown & Duguid, 1991), in which knowledge is produced and relatively easy transferred among members. These characteristics make a community of practice a difficult to identify entity, as it does not have socially, visible boundaries (Lave & Wenger, 1991).

Altogether, this leaves us with a concept which is difficult to grasp. However, Wittgenstein (1992) showed that is not always needed to have a strict demarcation of concepts, just like it is not always needed to define the exact place on the colour spectrum where blue turns into green when talking about colours. It may be practical to define that blue turns into green at a wavelength of 500nm, but that does not mean that this demarcation is needed when speaking about green and blue. Thus, instead of defining the exact borders and composition of a community of practice, the concept of community of practice can be used as a description of how groups of people bound together in a practice, exchange and share knowledge, and why sharing that same knowledge with another community of practice might prove hard or even impossible.

4.2 Sharing knowledge within a community of practice

How is knowledge shared within a community of practice? Lave and Wenger describe learning as increasing participation of the apprentice in the socio-cultural practice of that community. They named this process ‘legitimate peripheral participation’. This means that learning “essentially involves becoming an ‘insider’” (Lave & Wenger, 1991, p. 48), becoming part of and understanding the communal context (Brown & Duguid, 1991). When learners participate in communities of practitioners, they gain mastery of knowledge and skills. Lave and Wenger see the requirement of expertise as a process of movement towards full participation. In this process the relations between learners and experienced members changes, which causes the production and reproduction of the social order (Lave & Wenger, 1991, p. 47). This shows that learning is quintessentially a social process, in which the relation between the learners and experienced members plays and important role.

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5 Network of scientists: Invisible college

Alesia Zuccala

5.1 What is an invisible college?

Lievrouw's (1999) assessment of the nature of Invisible Colleges raised an important question: Are invisible colleges *structures of scholarship* (discernable and measurable from outside elements – i.e., published documents) or are they *social processes* rooted in informal human behaviours, perceivable only to those who carry them out? To reconcile the structure versus process problem she proposed the following definition:

> *An invisible college is a set of informal communication relations among scholars ore researchers who share a specific common interest or goal.*

According to Zuccala (2006) this definition is too narrow. It promotes the idea that communication systems are NOT rooted in formal structures, but they are.

The subject specialty, rooted in documented evidence (i.e., published papers) may be viewed as the *structural component* of the Invisible College, whereas the Invisible College itself is the underlying *social component*.

There is usually a lack of real information about Invisible Colleges because it is easier for researchers to study the specialty or structural component, rather than the interpersonal or social component.

5.2 The Invisible College Model

The space intersecting the Information Use Environment (IUE), the Subject Specialty and the Social Actors produces an organisational structure termed the (I)nvisible College. An (I)nvisible College may or may not be visible, depending on its association with a particular type of IUE. Some IUEs are grounded by a physical space, while others are not; thus the IUE is basically "the set of elements that affect the flow and use of information messages into, within, and out of any definable entity"(Taylor, 1986, p. 3.) If the IUE is established as a physical space, it has the potential to fortify an (I)nvisible College with the provision of human, physical and/or technological resources.

The subject specialty informs the (I)nvisible College of its disciplinary rules and research problems. The rules or problems may be transferred from background discipline(s) or newly developed and agreed upon by the scientists who believe that they are more suitable to the specialty area's research focus.

The scientific researchers who understand and agree upon the rules and interact with one another to solve research problems are the social actors. Social actors make use of the (I)nvisible College to support their information seeking and information sharing, but they may reinforce or instantiate in action the (I)nvisible College through the contribution of bibliographic artifacts, or evidence of scientific achievement for preservation.

5.3 The Invisible College versus other groups

Price (1968) considers the Invisible College to be part of a broader communication system that include's the scientists *work team, professional membership group, reference group* and *formal organisation*.

The *formal organisation* (ie. the university; college; institute) emphasizes "roles and lines of responsibility and products rather than people themselves" (p. 6).

Within a *formal organisation*, the scientist sometimes belongs to a specified *work team* (e.g., a laboratory team).

The scientists' *professional membership group* (e.g., "I am a mathematician") controls "the official information channels of the scientists' field" (i.e., primary journals and monograph series) whereas the Invisible College does not.

The scientists' *reference group* "includes other scientists with similar specialisation, similar training, excellence of work or other characteristics" (p. 5)

The *Invisible College* is like the *reference group*, but it is better described in terms of a subsystem, with a smaller number of international researchers and it is designed for "direct access." Within the Invisible College the scientist is "more likely to arrange meetings, plan joint projects and coauthor works with participants of the same [social] network"(p. 5).

5.4 Assessing the Invisible College

A cocitation map of the specialty component of the Invisible College provides a historical snapshot of how the research has evolved up to a specific point in time. Also, within a specified time frame, for instance (30 to 50 years) the piling up of cocitations may be significant enough to determine author relationships. Traditionally the coauthorship clusters represent intellectual associations, but White (1990) suggests that the ACA map may reflect "many other relationships other than intellectual influence" – e.g., friendships (p. 94).

The social activities of various members of an Invisible College can occur in a variety of situations, but the most pertinent are the authors' collaborative habits – measured by coauthorship counts, and their collegial interactions as conference participants.

With a bibliometric map in hand, the researcher can focus on investigating underlying facts concerning past and present relationships among scholars within the subject. The map can act as a travelling aid in that scholarly territory where interviews with specific authors may be used to gain more interpretive power.
Role-based measures can include an investigation into reviewing activities, refereeing activities (more difficult) or committee-based activities of the scientists. The MathSciNet database includes reviewer information as part of its bibliographic record. The names of reviewers can be harvested from this databases in relation to specific papers. Some roles within the Invisible College – like reviewing - provide support to the Invisible College system in order to keep it 'healthy'.

Continued research by Zuccala and van den Besselaar (2007) is focusing on scientists' perception of the roles undertaken by Invisible College members. Can the members of the Singularity Theory community identify one another and are they aware of their own roles? How do these social perceptions match with the other 'measured' roles as seen through maps produced by bibliometric data.

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6 Research governance and collaboration: The bumpy road to ERA[1]

Eleftheria Vasileiadou & Gaston Heimeriks

6.1 Introduction

There have been two developments in the knowledge production landscape that the current paper addresses. First, the last decades have witnessed an increasing tendency towards collaborative research, on all formats: research teams (irrespective of size or geographical distribution, bottom-up or top-down) have become the relevant unit of analysis in studies of the research and scientific landscapes (Sonnenwald, 2007; Beaver, 2001). The collaborative knowledge production and organisation in research teams seems to have become a value in itself (Duque et al., 2005). But it is not traditional scientific collaboration that has been increased. In his introduction to a Special Issue on Scientific Collaboration in the Social Studies of Science, Hackett (2005) notes four important aspects, in which scientific collaboration has been recently transformed (pp. 668-9). First, the *social organization* of collaboration has changed, with traditional research groups being complemented by *episodic working groups, contractual agreements between organizations, international collaborations, and interactions between scientists, and non-scientists* (engineers, companies etc). Second, the intellectual content of collaboration has changed, with an emphasis on *interdisciplinary research*. Third, these types of collaborations use intensively what he calls new "“technologies for collaboration”, that is internet-based means of communication (Heimeriks and Vasileiadou, 2008). Finally, our understanding of collaboration has changed with a recent *distinction between co-authorship and collaboration*. What is the dynamic in such new types of collaborative endeavours?

The second development, which reinforces and is reinforced by the new landscape of collaborations, is related to *research governance*. In this paper research governance is understood as the “activity of coordinating communications in order to achieve collective” research goals through research collaboration (Wilke, 2007: 40). On one hand, there are policy initiatives at the European level, which instigate collaboration in specific formats by linking them with funding instruments. Good examples of these are the Framework Programme R&D collaborations, which have set a number of thematic priorities, such as ICTs, and Energy, and created instruments for research funding within precise frameworks and regulations. As Frenken et al. (2007) note, there is increasing European funding poured into the successive Framework Programmes, with collaborative research absorbing the biggest share in the Framework Programme 7. We can understand Framework Programmes (FP) as an attempt to operationalise the concept of European Research Area (ERA), on which the European Commission has

[1] Draft version December 2007. Please do not quote.

focused the last 7 years. Such developments can be understood in this paper as *external research governance*.

On the other hand, the research management of these new types of collaboration has become increasingly complex and professionalized, with professional associations of research managers lobbying for templates and frameworks of research assessment. A good example of this development is the role of the European Association of Research Managers and Administrators (EARMA), which was founded in 1995 after a conference on managing European collaborative projects. EARMA has now become an intermediary actor in the landscape of the ERA, influencing its dynamics. The increasing emphasis on project management and administration has also created new types of professional careers within academia, the project managers as boundary workers in knowledge production (reference), who coordinate *internal research governance* of the new types of collaboration.

These relatively recent phenomena have co-evolved, and have transformed the knowledge production landscape in Europe, at the researching, scientizing and politicking level. The aim of this paper is to examine the relationship between research governance and research collaboration using as empirical examples three research projects funded by the European Commission, and exemplifying the new types of research collaboration, described above. The research questions that the current paper addresses is:

How do governance structures influence the dynamics of collaboration and knowledge production?

A subsequent question relates to the consequences of this for research management and science policy:
What type of research governance facilitates research collaboration?

Instead of presenting a systematic analysis, this paper rather draws from our analysis of these case studies in previous papers (Vasileiadou, forthcoming; Heimeriks, 2005), as well as from our observation and participation in these three collaborative endeavours (as in Luukkonen et al., 2006). We focus first, on the external governance structures and, second, on the internal governance structures, to show how they influence the dynamics of knowledge production in , drawing empirical material from our case studies, and from previous literature. Finally, in the discussion we present the implications that this analysis suggests fro research management and European science policy and the development of European Research Area.

In this paper we draw from previous analysis and our empirical observations from three Framework Programme collaborations: DELTA, ERICOM, and EVE[2]. DELTA was a research team working on an FP5 project under the Information Society theme, consisting of eight local groups from European countries, and the USA, and studying the impact of the use of email in companies and organisations. The project was a STREP, Small collaborative project, lasting 30 months. ERICOM was also working under the Information Society call, with a team of eight local teams from European countries, studying the use of Web and non-Web indicators for the science-technology-economy system. It was also a small collaborative project, lasting 40 months. Finally EVE was a much larger research team working on an FP6 project under the theme “Global Change and Ecosystems”, studying climate change and climate change

[2] Fictitious names.

policies. In contrast to the other two cases, it was an Integrated Project (IP), with researchers from 26 partner institutes from European countries and China, lasting 36 months.

The initial task allocation in the three teams was quite different: DELTA was an integrated collaboration, demanding a high degree of interdependence, as all partners would contribute to all tasks involved: the gathering of the data, the development of analysis tools, the analysis of the data. This was possible since most members were from the broad social sciences (social psychology, communication studies, ethnography). The research design was linear in time; with the formulation of theoretical background first, then the selection of case studies, the development of analytical tools, and gathering of data in progression.

ERICOM was a more complementary type of collaboration (Hara et al., 2003), with lower degree of interdependence between the partners: one group was responsible for the data gathering, another for the development of the analytical and visualisation tools, another for writing the reports. There were few tasks that were more integrated, where most partners would contribute and participate. Moreover, the tasks run in parallel: the phases of data collection, visualisation and analysis were synchronous.

Finally, EVE was also a more complementary type of collaboration, with lower degree of interdependence between the partners. There were few tasks that were more integrated, were most partners would contribute, but there was no task that all partners were supposed to contribute. The different teams involved did not use the same data, or analysis tools. The diversity of expertise in the team was very broad: from social scientists and practitioners in policy assessment, to chemists and climatologists. Here, as well, all tasks run in parallel: the phases of data collection, visualisation and analysis were synchronous

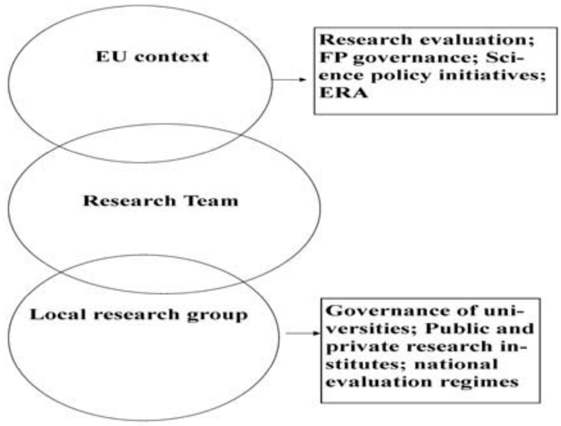
But how can we understand the dynamics of collaborations in such projects, consisting of many local groups, geographically dispersed, and at the same time working towards a collective research goal. The next graph explains the dynamic of such teams at three different levels: the local level, the global level and the contextual level.

This first graph shows the relevant contexts in which these dynamics take place, and the multi-level governance structures in which these teams operate.
The context of the research team is where the operations under study take place, with coordination and communication, decision-making and knowledge production, data sharing and socialization activities.

At the same time these teams consist of researchers belonging to their local research groups, organized in departments, institutes, knowledge centers, innovation labs etc. The governance of this level influences the dynamics at the research team level in different ways, from local human resources regulations to national evaluation regimes and the emphasis of each local context.

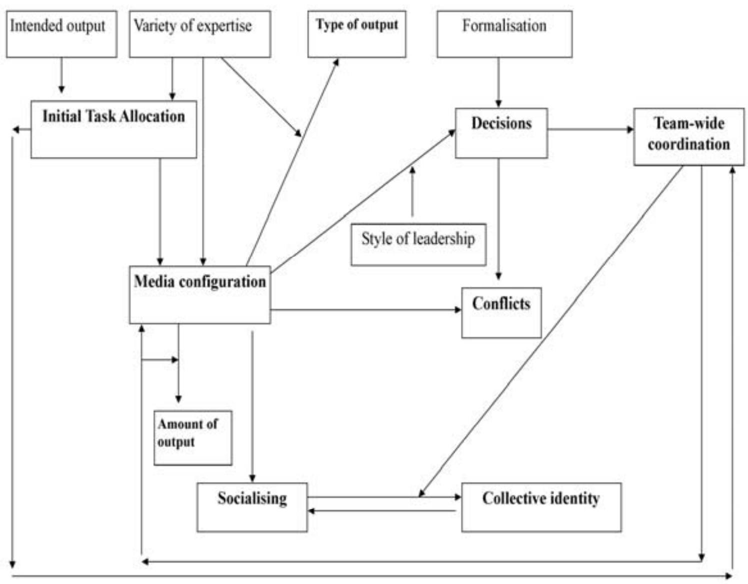
In addition, the team operates within a European level, operationalised through the interactions with the project officers and the Commission reviewers, in mechanisms such as the contract negotiation mechanisms, the specifications of partners involved, the evaluation mechanisms, the regulations about deadlines. Interesting features at this level that influence the dynamics of the teams are research evaluation criteria, science policy initiatives, ERA dynamics etc.

Figure 4 Collaboration dynamics



If we think about these teams as complex systems we can conceptualise these levels as: the local dynamics, with the activities of the constituent elements, the global dynamics, with the system-level variables, and the contextual dynamics as the embedding context that shape and constrain the operation of these teams. Moreover, we should think of individual researchers and constituents (managers, coordinators, administrators etc) as operating at all the three levels at the same time.

Figure 5 Global dynamics of the research team



This graph represents the global dynamics of the research team. It shows the relationships between different global-level variables in the team, such as media configuration, decision-making, conflicts, identity formation, knowledge production, coordination.

What is of interest here is the top-left corner: namely the initial task allocation between the local research groups, which is influenced by the intended output, and the variety of expertise in the team, and is fundamental in that the way is articulated in each team, influences in turn all other global-dynamic variables.

The analysis of the case studies suggests two fundamentally distinct types of collaboration: the integrated collaboration and the complementary collaboration, following the distinction made by Hara et al. (2003). We can understand an integrative collaboration as a collaboration of *working together apart*: all the members are involved in the formulation of the theoretical background, all groups gather data, all groups are involved in the analysis and reporting. The complementary collaboration, as working apart together, reflects a team in which the different groups have different research tasks, e.g. one group gathering the data, another developing the analysis tools, another group doing the analysis and writing the reports.

This distinction proved of fundamental importance in influencing the subsequent dynamics at the research teams: complementary teams communicate in different frequency, and through different media, take decisions through different mechanisms, have different sources of conflict risks, produce different types of output, have different identity formation mechanisms and needs, and coordinate their tasks in a different way than integrative teams.
We can understand a continuum of teams ranging from purely integrative to purely complementary. Moreover, and this point needs further discussion, there can be clusters of more complementary or integrative sub-teams, within the same research team, which we have seen in the third case study under investigation: an integrated project with 26 collaborating institutes and more than 100 researchers employed.

The governance and management needs of these two distinct types are fundamentally different.

A. External governance:
In which ways does the EU context impinge upon the dynamic of such teams? The FP governance structures result in very specific types of collaborations: collaborations with a rather high degree of formalisation, an existence of a scientific and managerial leader, multiple levels of authority, with a scientific leader, as well as work-package leaders, internationalisation and interdisciplinarity, existence of external evaluation (usually two-fold, assigned by the project officers, and by the consortium itself), as well as non-scientific output. What does this imply for the working processes within the collaborations?
What does this mean for the dynamics?
decision-making processes to be formalised, and also complex, given the two levels of authority established (work-package leader and scientific leader).
communication problems/tensions because of interdisciplinarity and geographical distribution
collaborations prone to conflicts between research and management, given the existence of scientific leaders, and external evaluation processes.
existence of external evaluation and the variety of disciplines in a consortium are expected to lead to high productivity.
Collaboration prone to conflicts because of multiple levels of authority

B. Internal governance:
At the same time governance structures at the local level influence the dynamics of these research teams. One such example are the human resources policies through which members of the research teams are employed. In one case under investigation, the employment of a researcher at one local institute, and the expertise criteria used, created tensions in another collaborating institute, and the stopping of one research task. The assumption was that a researcher hired to work for that specific task should have different expertise.

The balance between teaching and research is also an issue of potential tension in the dynamics of such research teams, related to governance of universities and departments. Another one relates to the evaluation and assessment regime of each local institute: for innovation spin-offs these criteria are naturally quite different than to a university department that operates under the “publish or perish” motto. The differences in evaluation regimes create different motivations for the involved researchers, and institutes, which in turn influence the dynamics of knowledge production in the team: should a deliverable be articulated as a working paper? A book chapter? Or a policy brief?

A last example of local governance structures impinging on the research team dynamics are the intellectual property rights. Especially in collaborative teams involving private research institutes this influences knowledge production in the team: to what extent patented tools benefit from the collaboration with other members? To what extent are the tools and models made available throughout the whole team?

6.2 Conclusion/ Discussion

We have shown how for these new types of collaborations at the European landscape, the research governance structures at the local and the EU level influence their dynamics, and knowledge production. More often than not, the mismatch between governance structures at the EU level, the team level and the local level create tensions which result in conflicts in the teams. In the two case studies in FP5 all the conflicts that took place related to mismatch of governance structures between these three levels.

Harmonization between governance structures is offered as a solution by some actors, especially at the EU level. However, this would not be desirable, for two main reasons. First, there are substantial disciplinary differences, with regards to already established governance and identity formation mechanisms, as studied extensively by the Prime network of excellence. Second, harmonization carries with it the risk of rigidity, which is diametrically opposed with the creative knowledge work that research consists of.

In addition, the fact that there are two fundamentally different types of collaboration, the complementary, and the integrative, creates the need for flexibility in the governance structures at all levels. At the contextual level, the contract negotiation mechanisms, the specifications of partners involved, the evaluation mechanisms, cannot be the same for complementary and integrative types of projects. Applying the same regulations with a high degree of formalization to fundamentally different types of projects does not create the best conditions for the development of these projects. This flexibility applies also for the research governance at the team level: the, by now, standardized online management tools, the professional research managers and the administrators of projects don’t take into account the different management needs of complementary and integrative projects. Finally, at the local level flexibility of time management schemes, human resources policies, departmental organization, and evaluation and assessment schemes would create the favorable conditions for creative knowledge production within these research teams.

This diversity, and the flexibility of rules it requires, is also related to what type of projects the Commission supports, and what types of outcomes it enables. The managerial success of a research project does not always lead to innovative results, or a high level of output. These two are not contradictory, but they are not necessarily complementary either, as the research here showed. Regulations about coordination mechanisms, recommendations for professional project managers, specification of means of communication, formalization of rules and strict adherence to deadlines do not necessarily support creativity, innovativeness and publications in top-journals. Given the importance of FP project collaborations for the socialisation and training of European researchers, as well as the increasing funds poured in the Framework Programmes, it is useful to re-examine the dynamics between the regulations imposed, their degree of formalization and the different possible outcomes of research projects.

Finally this flexibility at the research governance structures would enable differentiated types of European Research Areas to emerge, instead of constructing and imposing a top-down vision of ERA. With respect to this we need to take into account that these new types of collaboration are the socialisation and training environment for an increasing amount of European researchers. In short, what type of knowledge production and ERA do we expect with the governance structures currently in place?

7 Transdisciplinary Research Groups

Femke Merkx

7.1 What is transdisciplinary research?

There are two main approaches or conceptualizations of transdisciplinary research, the one is found in the USA, the other is found in Europe. In the USA transdisciplinary research is also called team science. The concept refers to a strong form of collaboration between different disciplines in problem oriented research. Transdisciplinary research or team science has been strongly developed in a group of research centers affiliated with the US National Cancer Institute in the National Institutes of Health: the Transdisciplinary Tobacco Use Research Centers. The European approach to transdisciplinary research is also problem oriented and cross-disciplinary, but differs from the team science approach as it emphasises the importance of including non-scientific, tacit knowledge of stakeholders and practitioners. Also the issues studied in European transdisciplinary research differ from those studied by team science. European transdisciplinary research is most strongly developed around issues of sustainability and spatial planning.

7.2 Why transdisciplinary research?

Hoppe and Huijs argue that transdisciplinary research is needed to solve badly structured societal problems (Hoppe & Huijs, 2003). Problems are defined as badly structured if involved actors have very different problem perceptions, if relevant knowledge is controversial and if uncertainties are big. Pohl and Hirsch Hadorn (2007, p.16) phrase it like this: “The conditions for transdisciplinary research are given when knowledge about a socially relevant problem field is unclear, when the concrete nature of problems is in dispute, and when there is a great deal involved for those concerned by these problems. TR copes with such problem fields in a process that integrates a variety of disciplines and actors from public agencies, civil society and the private sector, in order to identify and analyse problems with the aim of developing knowledge and practices that promote what is perceived to be the common good.”

7.3 Why focus on transdisciplinary research groups?

Transdisciplinary research groups have specific characteristics – and encounter specific challenges. Therefore we need to know consider transdisciplinarity as a specific category when theorizing about research groups. Transdisciplinarity implies the need to accept local contexts and uncertainties and the need to be action oriented. There is a need to establish linkages between theoretical development and professional practice and the gap between scientific knowledge development and societal decision making processes needs to be bridged (Lawrence & Després, 2004, p.399) This means that other objectives apply then those that normally structure scientific research. Besides transdisciplinary research groups are often on projectbase.

That implies that team members have double or even multiple memberships which pose conflicting requirements on their work and which might make it difficult for them to take responsibility for the team result.

7.4 Transdisciplinary research for integrated coastal zone management research – a discussion of barriers

In a field study about coastal defense research Merkx et al. (2007) found that transdisciplinary research forms an important challenge for this research field. Both qualitative and quantitative indicators were developed to assess the transdisciplinary constitution of this research field. For an extensive discussion on these indicators we refer to the reports that were published on this project and which can be found on the Rathenau website (www.rathenau.nl). A scientific publication is forthcoming in Research Evaluation (Merkx and Van den Besselaar, forthcoming). Apart from the development of indicators, barriers against the development of transdisciplinary research groups were identified. Three relate to processes of group functioning and formation and will be discussed below:

1. A lack of Communication Skills, Respect and Reflexivity
2. The Scientific Reputation System
3. Societal Steering of the Research Agenda

7.4.1 First Barrier: Communication Skills, Respect and Reflexivity

Transdisciplinary working is difficult. On the level of individual researchers it requires a strong disciplinary background in combination with the ability to communicate and collaborate with researchers who have a different disciplinary background, who talk a different language, who use different concepts and methods, and who are educated in different paradigms on how to do research. Many scientists lack the communication skills, reflexivity and mutual respect to engage effectively in transdisciplinary research collaboration.

7.4.2 Second Barrier: The Scientific Reputation System

The scientific reputation system was identified as another important barrier for scientists to participate in transdisciplinary research as it is difficult to establish a career on transdisciplinary research. Scientific excellence and output in disciplinary oriented journals form the dominant evaluation criteria of scientific research. That is even the case for funding programmes that are directed at socially relevant research and which aim to contribute to the resolution of important societal problems.[3]

[3] Bill Kamphuis observes that scientific evaluation criteria and mechanisms promote analytical research at the cost of coastal engineers' orientation towards improving the design of coastal engineering structures and measures (synthesis). "The question that is not asked is: What do these "improvements", which are essentially study results (analysis), do for the design (synthesis)? We need to be clear as engineers that the ultimate goal of our research is improved design (synthesis).If it is not, we have become scientists (analysts). (Kamphuis, 2005, p. 12)"

7.4.3 Third Barrier: Societal Steering of the Research Agenda

A third barrier for transdisciplinary research is formed by the dominant model for science-society interactions and the way in which societal steering of research is organized. In the dominant model science and society are two more or less distinct worlds and the model for science-society interaction is one of demand & supply, where science produces knowledge and this is applied to societal problems. In this model societal steering of research is organized by means of agenda setting. Societal stakeholders, such as representatives from industry and policy are involved in setting the research agenda. This will only work when there are clear problem definitions on the part of society, which remain stable over the period of a research programme.
In integrated coastal zone management however the problem definitions are not clear, rather problems are 'badly structured' and require transdisciplinary research. Transdisciplinary knowledge is developed through the interaction of research, policy making and project implementation aimed at solving a particular problem. Accordingly, all parties involved contribute to the development of transdisciplinary knowledge: not only scientists but also policymakers, consultants, stakeholders, etc.
To conclude, in many current approaches towards societal steering of research, top down agenda setting dominates. Whereas such an approach may *shorten* the linkages between scientific research and society, it does not strengthen the *local* linkages between research and practice. Something which is much needed in transdisciplinary research. Indeed, more than that, top down societal steering of research may impede productive local interactions and bottom up societal steering of research.[4]

7.5 Lessons for current research policy discussions: The establishment of large inter- and multidisciplinary research organizations

The discussion above on barriers for transdisciplinary knowledge development is highly relevant in the context of the current reorganizations within the public knowledge infrastructure for delta, coastal and sea research. In particular this concerns the reorganization of public and semi public research institutes to form the Deltares and to form Imares.[5] Both these reorganizations can be regarded as an improvement compared to the earlier situation in which there were many research institutes with partly overlapping research agenda's ('versnippering').

From our analysis on the main barriers for transdisciplinary knowledge development it follows however that the establishment of large cross-disciplinary research organizations is not a panacea for overcoming barriers towards the development of transdisciplinary knowledge. In the expert meeting that we organized institutional

4 Similar side effects have been reported in relation to the Technological Top Institutes.
5 Institute for Marine Resources & Ecosystem Studies, a merger of the Netherlands Institute for Fishery Research (RIVO, 120 people), the research group Ford and Sea ('Wad en Zee') from Alterra Texel (20 people) and the department Ecological Risks from TNO Build Environment and Geosciences in Den Helder (20 people).
Research in the Delta Institute will address the many knowledge questions that relate to living, building and working in a Delta region. Within the Delta Institute the two Grand Technological Institutes (GTIs), WL|Delft Hydraulics and GeoDelft will merge with some parts of TNO-NITG, and with the knowledge sections of the Specialist Services of the Directorate General of Public Works and Water Management. That includes parts of the National Institute for Coastal and Marine Management (RIKZ) and the Road and Hydraulic Engineering Institute (DWW)

disciplinary segregation was not regarded as an important barrier towards the development of transdisciplinary knowledge. The barriers that were discussed above were considered more important. Therefore we expect that on itself institutional integration will not help much for stimulating transdisciplinary knowledge development.

7.6 Literature on transdisciplinary research groups

7.6.1 The management of transdisciplinary research

On the basis of empirical studies Hollaender et al. (2003) conclude that the success of TD research largely depends on the way in which managerial support is organized. The management of transdisciplinary research groups is difficult because, scientists working in transdisciplinary research projects have double or multiple memberships (of a project team, a university department, a broader scientific community) and "TD management therefore, only partly can control resources relevant to the members of the research team" (Hollaender et al. 2003, p.7).
Three areas of management are of particular importance in the management of TD research teams:

1. Management of interests, conflicts and relations
TD research is typically interinstitutional research and membership is transient. Solutions are needed for dealing with research findings and for creating incentives for scientists to participate and to bear responsibility for the group results. "Quality management has to take into account the entire diversity of project goals and evaluation criteria relevant to all af the team members regarding their disciplinary and institutional background" (p.10)

2. Management of communication and information
The use of language, concepts, methods, norm perceptions and problem framings will differ between the different members of transdisciplinary teams. Therefore communication processes have to be actively supported.

3. Management of knowledge and integration
Methods or concepts of integration have to be discussed in an early phase of the project. Integration can be done by a leading team or project leader, but it is more desirable that integration is a collective team effort. In practice this is very time consuming.

Further comparative empirical research in the management of transdisciplinary research projects is needed. (Hollaender, Cline Loibl and Wilts, 2003)

7.6.2 Forms of transdisciplinary collaboration

Pohl and Hirsch Hadorn (2007) wrote a book on the Principles for Designing Transdisciplinary Research. Most of the book deals with the processes and different methods of achieving integration throughout the different phases of a research project. For our discussion about transdisciplinary research groups their distinction between different ideal types of transdisciplinary collaboration are relevant. The distinction is based on earlier empirical work by Rossini and Porter (1979) on the organization of group work in technology assessment.

1. Common group learning. Intensive group interaction results in common group knowledge.

2. Negotiation among experts – “Pairwise interaction at boundaries between component experts” results in “better informed and interrelated analysis”.

3. Integration by leader – “Pairwise interaction only between the leader and other individuals.” “Leader acquires composite knowledge and synthesizes findings” (Rossini and Porter, 1979, p. 74)

Modelling is considered an important integrative tool that can be used with all three forms of collaboration.

7.6.3 Experience from Transdisciplinary Tobacco Use Research Centers (TTURC)

In the USA transdisciplinary research is also called team science. The concept refers to a strong form of collaboration between different disciplines in problem oriented research. Transdisciplinary research or team science has been strongly developed in a group of research centers affiliated with the US National Cancer Institute in the National Institutes of Health: the Transdisciplinary Tobacco Use Research Centers. Stokols et al. (2005) discuss a cross-center comparative study of three of these centers. The centers were institutionalized place-based transdisciplinary research centers rather than geographically dispersed teams. Institutional and organizational differences between the three centers allowed for comparative research. It appeared that readiness for collaboration was influenced by:

- Breadth of disciplines represented.
A larger diversity and cognitive distance between disciplines decreased the readiness for collaboration.
- Prior working relations
Prior working relations increased readiness for collaboration
- Spatial proximity between offices
Spatial proximity between offices increased readiness for collaboration
- Freq. of face-to-face interaction
A higher frequency of face-to-face interaction increased readiness for collaboration

“One challenge inherent in evaluating transdisciplinary scientific ventures is that their outcomes emerge gradually and may not become evident for several years or even decades” (Stokols et al, 2005, p. 210). Instead of using formal outcome assessment criteria, the authors suggest to assess the emergence of integrative and novel ideas. Despite differences in the factors influencing readiness for collaboration all three centers developed integrative and novel ideas in the first five years after the centers were established. The overall message of this article concerning the optimal circumstances for transdisciplinary collaboration is mixed. On the one hand centrifugal tendencies at large highly diverse research centers may undermine transdisciplinary success (Rhoten, 2003). On the other hand “too much closeness among team members and similarity among their scientific perspectives can foster “groupthink”and suppress innovation. (…) A major challenge (…) is to achieve an appropriate balance between diversity and debate on the one hand and intellectual integration and social support on the other.” (Stokols et al, 2005, p. 211, 212)

7.7 References

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8 Some reflections and comments

Maaike Verbree & Robert Braam

8.1 Workshop on Research Groups in Science

This workshop was organized around a review of the literature on research groups that we perform at the Science System Department of the Rathenau Instituut. The mission of the Science System Assessment research program is to increase, integrate and make accessible the knowledge about the science system. In this program, research groups (and individual researchers within them) are at the core, as the smallest part, of the science system. Research and knowledge production is taking place in this component of the system and it is the place where new generations of scientists are educated. But what exactly do we mean by a 'research group'? That question repeatedly came up in discussions about projects in the science system research program. Our literature review is meant to give an overview of different types of research group in order to better understand the dynamics of research groups in the science system.

8.2 Some findings and remaining issues?

In the workshop we presented our preliminary results, based on a qualitative research on the literature. We analyzed what definitions and key assumptions on research groups were given in the literature and what kinds of labels were used. We categorized these definitions and labels around two dimensions. First of all, group types can be distinguished by the nature of the topic they are focused on: academic versus practical. Secondly, the groups can be distinguished by their level of formality: formal organization versus informal organization (see figure below).

Figure 6 Types of Research Groups

Dimensions	***Topic nature***	
Formality level	*Academic*	*Practical*
Formal	**Organisational research groups**	**Organisational research networks**
Informal	**Research area networks**	**Communities of practice**

We found that the literature on research groups is broadly divided by the lines of these four categories. For example, in studies on research performance there is often little mentioning of the international research environment of different fields that influence the research performance of the research group settled in an organisation. On the other hand, if one looks at the specialty literature, little or nothing is said about the local organisational background of the specialty members. It seems, these literature are rather isolated from each other, while in reality individual researchers are member of multiple groups and have multiple relations. These multiple group memberships and multiple relations between researchers are important for the functioning of the science system. Thus, interrelations between research group types should be studied.

During the workshop some more general issues came up asking for clarification or further study:

1. The overall goal and the specific research question
2. Group versus network
3. Unit of analysis
4. Time dimension

We will discuss each of these issues in more detail below.

8.2.1 The overall goal and the specific research question

As mentioned earlier, the overall goal of the Science System Department is to understand the science system as a whole. The smallest part of the system is constituted by the researcher within a research group. Our general research question is: what are the mechanisms behind research group dynamics? Group dynamics is a broad concept, including group formation, group structure, and group collaboration. In our review we want to give an overview about what is known and what is not known about (various types of) groups, and about the mechanisms of research group dynamics. Mechanisms, such as, e.g., preferential attachment[6], where scientists work together because of mutual advantage.

8.2.2 Group versus network

There was some discussion about the 'group' concept used. It was clear that scientist are embedded in a local organisational research group. But is it right to call the wider scientific networks, where scientists are likewise a part of, a group as well? This issue is at the core of our research project. We find in the literature that scientists are active in different groups and networks: the local organisational research group or department, other organisational research groups or departments in a collaborating manner, the scientific communities of his/her topics of interest, and the more practical networks for sharing knowledge about methodologies or exchanging knowledge about patient care, that scientist might be active in. We call these different areas where scientists participate in, 'group types'. As different 'groups' are interrelated by the activities of scientists participating in them, the interrelations between groups should be analyzed as well.

8.2.3 Unit of analysis

In our presentation we used the term 'unit of analysis' in distinguishing the above mentioned types of research groups. This turned out to be somewhat confusing, and raised the question if research groups are the right unit of analysis, instead of individuals, given the overall goal/research question? We must admit, our basic unit of analysis is indeed the individual scientist. But, this individual scientist has relations with other scientist and practitioners in the shared fields of interest. The relationships of a scientist with others constitute a 'group'. Some of these relations between individuals are overlapping, so scientists are member of the same group or network. Some of

[6] Wagner, C.S. &Leydesdorff, L., Measuring the globalization of knowledge networks, paper presented at "Blue Sky II 2006: What Indicators for Science, Technology and Innovation Policies in the 21st Century?, September 25-27, 2006, Ottawa,Canada.

these relations are multiple; scientists are member of more then one group or network in the science system. It is because of these overlapping and multiple relationships, that we cannot analyse one 'group type' in isolation, but have to look at the whole network of relations between scientists in different groups in the science system, both formal and informal, and academic or practical.

8.2.4 Time dimension

Another question regarded the importance of the 'time dimension'. Indeed, the group types we introduced are not in a stable state. If you want to look at group dynamics, you must consider the dimension of time. Though not mentioned in the presentation, we certainly include literature on the time dimension in group dynamics and group development, both within and between groups[7].

8.3 Some further remarks and suggestions received for studying groups in science

- Given the variety of group concepts, it is important to look at the advances and disadvantages of a specific concept, by comparing other concepts, to clarify the used concepts, and to pick the right concept that fits the specific research question.
- Theoretically there is some work to do on two main issues regarding groups in the science system: 1) How to handle issues of change? 2) Regarding the important information on how the science system functions; should we compare many groups, or do we have to focus on specific groups?
- Watch out for 'dancing around definitions', but look at what is the real interest of research. Which group to look at (or all 4 research groups) depends on the research problem you want to answer.
- Watch out for a 'battle of concepts' in describing research groups, but look instead at the historical perspective of the different concepts (where they come from): when was the concept used, when did it came up, how did it evaluate, and when/where new concepts came up (research networks)?
- Watch out for a Eurocentric approach, take a broader scope, including more countries.
- It may be challenging to link concepts of evolutionary economics in change and dynamics to deepen the analysis of (research groups in) the science system.
- It is striking that scientists can be members of various groups of different size. Also, individuals may have different identifications with groups. Even members of the same groups (home research group, international network of excellence) can have different identifications with these groups.
- It is good to look at all these types of groups and define characteristics of these group types. We should know more about what is needed for the optimal functioning of groups? For example: do we need to know more about stratification of roles, financing in certain areas; does a group functions better when having a focus on specific problems, mobility, permeability, status, etc.?
- The different concepts of groups may relate to the same groups but with different emphasis. It may be hard to integrate these to run simulations in one model. Modelling is very/too optimistic a target.
- Scope is broad, watch out for too broad a scope, as this may lead to making the model useless.

7 Crane, D., Invisible Colleges: diffusion of knowledge in scientific communities, University of Chicago Press, 1972; De Haan, J., Research Groups in Dutch Sociology, Amsterdam Thesis Publishers, 1994.

- A way out of analytical confusion may be to look at research groups in context: of policy, dynamics of science, or the context of functioning.
- Groups may have vague boundaries, relating to/influencing how individuals interact in a group.
- How does knowledge production (individual or at group level) on the group?
- Do search for empirical results of group functioning on different units of analysis/ types of groups.

We want to thank all participants for their helpful remarks and interesting contributions, and hope all will benefit from this workshop in their own research as well. We are very pleased to have met and exchanged knowledge and ideas with an inspiring network of nearby colleagues in Science System Assessment.

Program

10.30 – 11.00	Welcome (coffee/ tea)
11.00 – 11.15	*Introduction* Peter van den Besselaar (workshop moderator)
11.15 – 11.45	*Perspectives on research groups (literature review)* Robert Braam & Maaike Verbree
11.45 – 12.15	*Organisational research group* Inge van der Weijden
12.15 – 12.45	*Communities of practice* Andre Somers (presentation) & Floortje Daemen
12.45 – 13.45	Lunch
13.45 – 14.15	*Network of scientists: invisible college* Alesia Zuccala
14.15 – 14.45	*Research governance and collaboration: The bumpy road to ERA* Eleftheria Vasileiadou (presentation) & Gaston Heimeriks
14.45 – 15.15	*Transdisciplinary research networks* Femke Merkx
15.15 – 16.00	*Discussion* Peter van den Besselaar (workshop moderator)
16.00	Drinks

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Power point presentations

Research groups research & science system assessment

Peter van den Besselaar

System versus research assessment:

– Does the science system brings what is expected?

– Which components of the system contribute or hinder the performance of the system?

– And is this field specific?

System assessment?

– Research assessment

– Research about the societal value of science

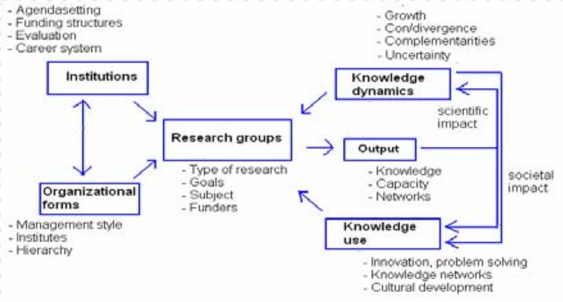
Relevant system components & attributes

- Institutions
  - Agenda setting
  - Funding
  - Careers
  - Evaluation systems
- Organizational arrangements
  - Size
  - Management style
  - Individual or group
  - Hierarchy

Field differences

- Field dynamics
  - growth
  - uncertainty (convergence / divergence)
  - cognitive dependencies
- Nature of research
  - from basic to applied
  - disciplinary, multi-, inter-, trans-disciplinary
- Social and economic environment: demand and pressures

A model of the science system



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Science System Assessment

Research group research

- -Research group as smallest unit of the science system
- -Place of knowledge production, training, networking
- -In contexts
  - -Disciplinary
  - -Applicational
  - -Funding
  - -Organizational (resources)

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Contexts and perspectives

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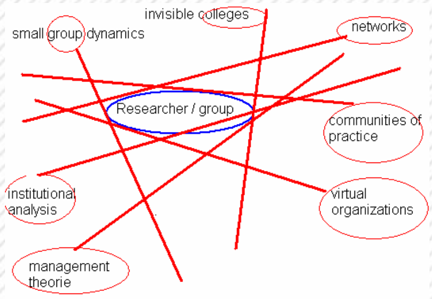

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Multi-theoretical modeling

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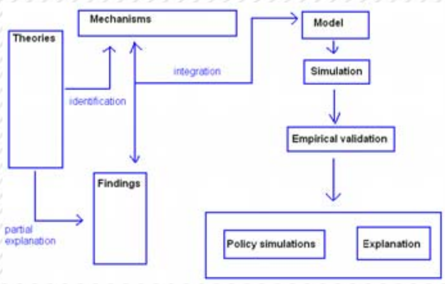

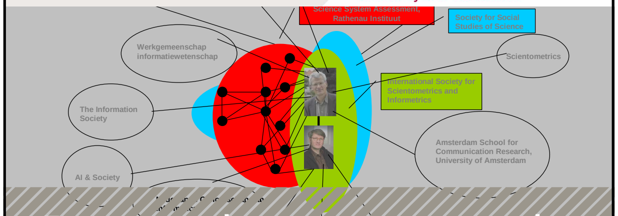

Perspectives on research groups in science

Overview

- Introduction: Robert Braam
- Preliminary results: Maaike Verbree

Introduction

- Reason and scope of research group study
- Literature overview

Reason and scope of research group study

- What exactly do we mean by a ‘research group’?
  - Nagging question ➔ review literature
- Historical perspective (changes)
  - Literature on specialties (disciplines => interdisciplinarity)
  - Individuals in science (elite networks => org. res. units)
  - Developing structure of science /society (Mode2; Triple helix).

Reason and scope of research group study

Scope of ‘research groups’:

•Separate literatures on:
- Specialties in science
- Small groups, social network analysis
- Research group performance
- knowledge management, CoP’s

• ➔ Use and compare results from different literatures

Reason and scope of research group study

Reviewed literature, 21th November 2007

	Groups	Groups in Science	Mapping	*All*
Articles	5	25	4	*34*
Books	8*	15	[1]*	*23*
Papers	3	1	2	*6*
All	*16*	*41*	*6*	*63*

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21 november 2007

Science System Assessment

Literature overview

1. Group research and network analysis
   a. Theoretical perspectives on small groups/ networks
   b. Mechanisms behind group/network formation
2. Empirical findings
   a. Perspectives on ‘research groups’ in science
   b. Developments in context/settings of science
3. Detecting groups
   a. Approaches to detecting groups
   b. Tools and available software solutions

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Science System Assessment

Preliminary results

- Methods
- Small group perspectives
- Groups in science
- Preliminary conclusions

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Methods

- ISI Web of Knowledge and directly in journals (eg. *Research Policy, Small group research* :
  - *Research groups/ teams; scientific collaboration/ networks*
  - *Key books, journals, dissertations, and articles*
    - *Theories of Small groups* (Poole & Hollingshead, 2005);
    - *In search of performance (van der Weijden, 2007), Research Groups in Dutch Sociology (de Haan, 1994)*
- Reference lists: *snowball method*
- Colleagues: *recommendations*
- Amazon.com: *search + recommendations*

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Small group perspectives: key assumptions

Small Group Perspectives	Goal Group vs. Individual	Interactions	Context External vs. internal processes	Interdepen dence	Shared cultrural group perecpetion	Group compo-sition	Episodic
Functional perspective	X	X	X				
Psychodynamic perspective			X	X	X		
Social identity perspective				X	X	X	
Conflict-Power-Status perspective	X			X		X	
Symbolic-interpretive perspective		X	X		X		
Feminist perspective			X		X	X	
Social network perspective		X					
Temporal perspective	X			X	X		X
Evolutionary perspective	X	X	X				X

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Small group perspectives: key assumptions

- Goal: group versus individual
- Interactions
- Context: internal versus external
- Interdependence
- Shared cultural group perception
- Group composition
- Episodic

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Groups in science

UNITS OF ANALYSIS	KEY ASSUMPTIONS
Research area networks • Research field/ scientific discipline/ scientific specialty • Scientific community/ clusters/ cohesive groups/ modules • International collaborative networks of scientists/ invisible college:	• Social dimension • Intellectual dimension • Variation in integration
Organisational research groups • Research group/ team/ unit • Collaboration in R&D teams/ research project teams	• Leader • Formal environment • Membership composition
Organisational research networks • Multiple-organisational collaboration in science/ heterogeneous research networks • Knowledge network management	• Variety/overlapping institutional arrangements/spheres • Communication networks • Coordination
Communities of practice Practitioners producing and sharing knowledge on common object/activity.	• No socially, visible boundaries • Bounding of people together in practice • Membership is social process

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Preliminary conclusions

Activity	Unit of analysis	Actors
I. Knowledge production	Research area networks	Scientists
II. Research output production	Organizational research groups	Scientific/ technical researchers
III. Knowledge management	Organizational research networks	Organizational managers
IV. Learning and knowledge sharing	Communities of practice	Practitioners

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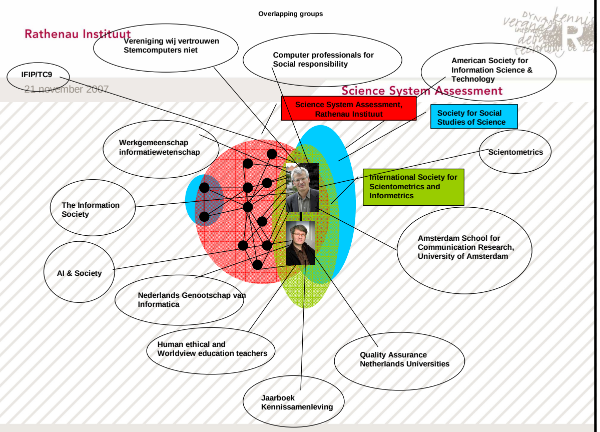

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Research groups in science

Studying research groups in science:

- Different kinds of groups
- Interrelations of different kinds of groups, and
- Individual memberships to multiple groups.

Approach:

- Multi group
- Multi memberships
- Intergroup networks

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Review research groups

Thank you for your attention

&

remarks, suggestions, discussion?

Organizational Medical Research Groups

Project: Micromanagement of medical research groups

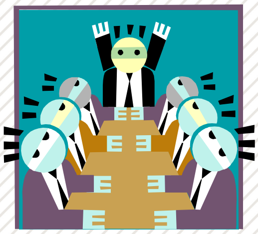
•Questionnaire: may-september 2007
•Sample: research group leaders
•215 respondents

Today: Presentation of Preliminary Empirical Results

Topics

1. Definition of research groups
2. Characteristics of medical research groups and leaders
3. Group characteristics and research performance
4. Research management activities and research performance

Definition Research Group



Criteria:

1. At least 1 recognized leader
2. Total of at least 3 people
3. Involved in research
4. Members for at least 6 months
5. Expected life span of at least 1 year

Andrews, 1979 (p.19)
Scientific productivity: the effectiveness of research groups in six countries

Group characteristics

- Mean group size: 22 fte
- Composition of research groups is stable concerning staff members with permanent positions
- Most important goals: 1. Scientific publications
  2. Development new knowledge
  3. Training young researchers

- Para-clinical groups n=39 (18%)
- Pre-clinical groups n=84 (39%)
- Clinical groups n=92 (43%)

Leader characteristics

•Leadership experience: 12 years

•Time spent to research, supervision, management, education and patient-care

•High skilled scientist
•Acting as a oracle

•75% has a second groupleader

Group characteristics and performance

Para-clinical groups:
- Group size **.464*****
- Age research leader **.447****

Pre-clinical groups:
- No significant correlations

Clinical groups:
- Group size **.404*****
- Age research leader **.311****

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Research management and performance
An example: reward structure

Correlations	Sci publications	% External research funding	ZonMw activity
Rewards:			
Financial bonus	.299**	ns	ns
Special honours	.234*	.306**	ns
Development of skills	.382* 238*	.231*	ns
Flexibility	ns	ns	ns
blue: para-clinical groups *green: pre-clinical groups* *purple: clinical groups*			

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Preliminary Conclusions

•Group characteristics (size and age) have significant positive correlations with performance of **para-clinical and clinical** research groups

•Rewards have significant positive correlations with performance of **mainly pre-clinical and clinical** research groups

•Para-clinical, pre-clinical and clinical groups are **different**

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To be continued…

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Dr. Inge van der Weijden, Rathenau Institute
Drs. Maaike Verbree, Rathenau Institute
Dr. Dick de Gilder, Vrije Universiteit

More information: www.rathenau.nl

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On communities of practice in a research setting

Community of Practice

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The community of practice describes the social setting in which knowledge is produced

Concept is based in learning theory: not specific to research environments. (Wenger, Lave & Wenger see text for references)

Learning or acquiring knowledge is not simply a process of transferring but a process of participation: learning and work practices are inseparable, knowledge is not just factual, but tacit knowledge is part of the context of practice

community of practice = "a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice" (Lave & Wenger, 1991, p. 98)

CoP: Intuitive understanding

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Examples of a community of practice:

- A master at a craft with his journeyman and apprentices
- A research group with a professor, senior researchers and PhD students

CoP: A definition

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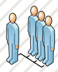
Community of practice is:

- Informal
- Shared concern
- *Do* something (practice)
- Develop way of doing it and give meaning to it
- Interact regularly
- Share a set of goals
- Work and learn together
- Communication through common background



Understanding Communities

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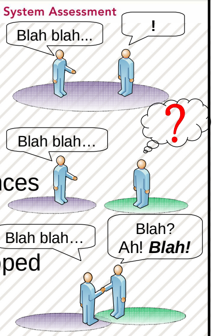
Within a community of practice, communication is relatively easy

Communication *across* communities of practice is complicated by differences like jargon

Mutual understanding can be developed through direct communication

- Takes time and effort



Why useful?

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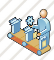
Knowledge production has grown, but we need to *Use* and *Share*



Sharing knowledge across communities leads to innovation

IT-based infrastructures seen as key

However: Most research focused on single or close-knit communities

Our Project: SCoKN

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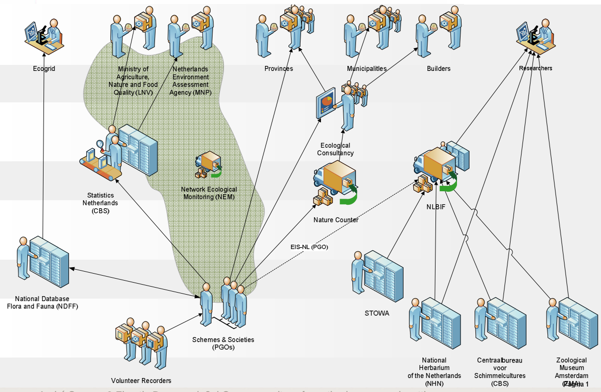
- **The Social Construction of Knowledge Networks**
- Effects of the introduction of large scale knowledge sharing infrastructures on communities of practice
- Field of Biodiversity; hugely heterogeneous communities
- Together with Floortje Daemen

Dutch Case



Within this system:

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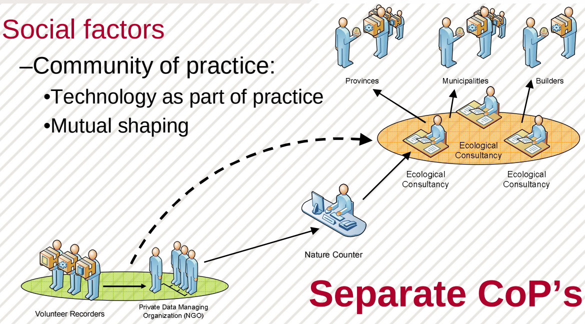
Social factors

–Community of practice:

•Technology as part of practice

•Mutual shaping



Separate CoP's

Why use CoP?

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In our setting: mutual construction of actors and technology

CoP is valuable concept to understand:

- barriers between social groups for sharing knowledge
- Influence of IT-technology on practice and therefore on knowledge sharing

However: not feasible to use directly as a unit of analysis in a study setting of interactions between large sets of heterogeneous communities.

Why use CoP?

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We interpret relevant social groups as communities of practice

Results:

- Concept of Communities of Practice is very useful to understand the dynamics of groups of actors
- CoP is enriched with the influence of technology.

Casestudies

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- 55 semi-structured interviews
  - Netherlands, United Kingdom and Denmark
- Systematic coding (Atlas.ti)
- Determine factors influencing successful knowledge sharing trough IT infrastructures
- Determine effects of the introduction of large scale knowledge sharing infrastructures on communities of practice
- Clear from case-analysis:

  Heterogeneous communities of practice increase complexity of knowledge sharing systems

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Thank you

- This research is funded by NWO -
- Netherlands Organization for Scientific Research

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Rathenau Instituut

- The Rathenau Institute focuses on the influence of science and technology on our daily lives and maps its dynamics; through independent research and debate.
- **Science Systems Assessment Mission**
- To increase and integrate knowledge on the research system
- To present this information to policy makers, administrators, politicians and scientists
- This will enable those involved in the Dutch science system to base their policies on reliable knowledge and information

Network of Scientists: The Invisible College

Alesia Zuccala
SciSA, Rathenau Institute, Borneo, Room 110
November 21st Workshop *Research Groups*
Poort van Kleef, Mariaplaats 7, Utrecht

What is an Invisible College?

"A set of interacting scholars or scientists who share similar research interests concerning a subject specialty, who often produce publications relevant to this subject and communicate both formally and informally with one another to produce important goals within the subject, even though they may belong to geographically distant research affiliates" (Zuccala, 2006, p. 155).

Zuccala, A. (2006). Modeling the invisible college. *Journal of the American Society for Information Science and Technology*, 57(2), 152-168.

Modeling the Invisible College

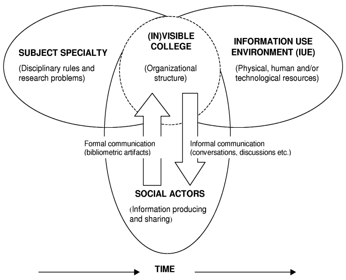

Figure 1. Structurationally informed value-added model for the study of scientific organizations

The Invisible college versus other groups

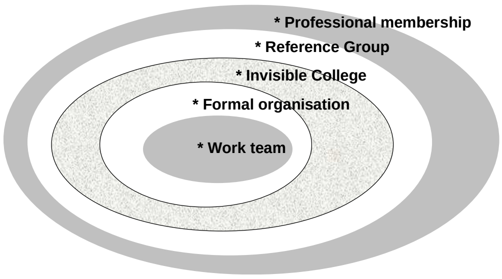

Figure 2. Paisley's (1968) view of different scientific groups.

Assessing the Invisible College

What methods can we use to confirm the existence of invisible college, (i.e., make it more 'visible') and assess how it is functioning?

- Citations; Cocitation mapping
- Coauthorship network
- Conference participation
- Interviews with the scientists (mathematicians)
- Role-based measures – e.g., recorded accounts of reviewing/refereeing (support) work

Cocitation map of Singularity Theory

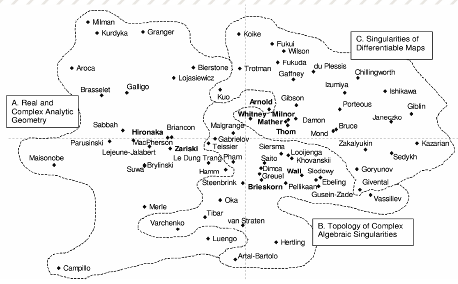

Figure 3. Author Cocitation map of Singularity Theory (1974-2000).

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Coauthorship map of Singularity Theory

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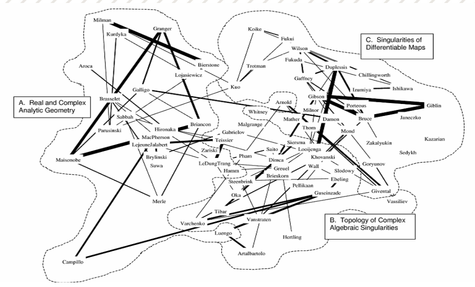

Figure 4. Author Cocitation-Coauthor map of Singularity Theory (1974-2000).

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Geographic distribution of authors

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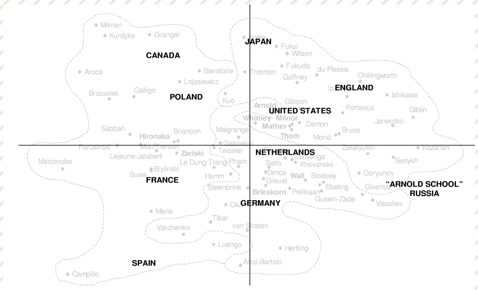

Figure 5. Co-citation and geographical distribution of Singularity Theory (1974-2000).

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Network of conference participants

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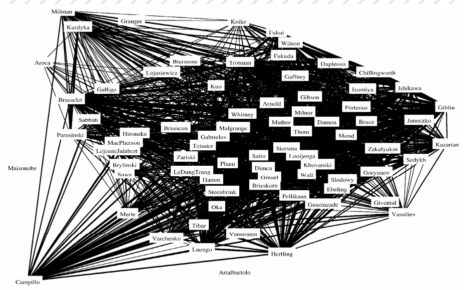

Figure 6. Network of conference participants. Singularity Theory (1970-2000).

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Invisible college roles

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Junior:

- relatively new to the invisible college;
- benefits from senior mentoring;
- has not yet published a lot of research and is developing his/her research profile

Member:

- involved with the specialty, and attends most meetings/conferences/workshops;
- collaborates often with other specialty members

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Invisible college roles

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Organiser/Supporter:

- makes time to organise workshops/conferences;
- sits on committees associated with the specialty;
- writes many editorial reviews of new papers;
- referees many papers for publication

Broker:

- involved with specialty, but spends time developing ties with other specialties;
- brings results from specialty to outside fields and specialties, and vice-versa

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Invisible college roles

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Influential:

- has produced important results influential to historical development of the specialty

Star:

- significant reputation in mathematics as a whole;
- capacity to receive awards or has won an award

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Invisible college roles

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Figure 6. Cocitation map of Singularity Theory, including roles (1974-2006).

A. Zuccala | 13 | Network of Scientists

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Implications of a role-based system

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Invisible colleges are socio-cognitive (stratified) systems. A systems-based evaluation encourages us to look at scientist's socio-cognitive role in a broader setting of knowledge development …

- Not every scientist can be an influential or a star (e.g., top scorer on the football team)
- Juniors are needed to sustain growth and add 'energy' to the system
- Supporters (reviewers; referees) endorse the work of others and help to ensure its quality
- Organisers ensure that the 'social networking' part of the system is functioning

A. Zuccala | 14 | Network of Scientists

Research governance and knowledge production in the ERA

Eleftheria Vasileiadou
Vrije Universiteit Amsterdam
&
Gaston Heimeriks
Adviesraad voor het Wetenschaps- en Technologiebeleid

Context

- Increasing trend towards collaboration; New types of collaboration
- Increasing use of ICTs in knowledge production, influencing the researching, scientizing and politicking level (Heimeriks and Vasileiadou, 2008)
- Research governance an issue at the European level with:

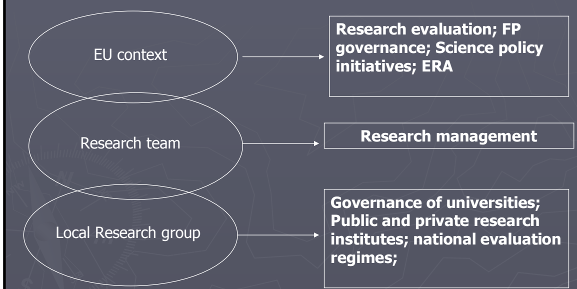
1. instruments trying to create ERA
2. research management becoming professionalised and institutionalised

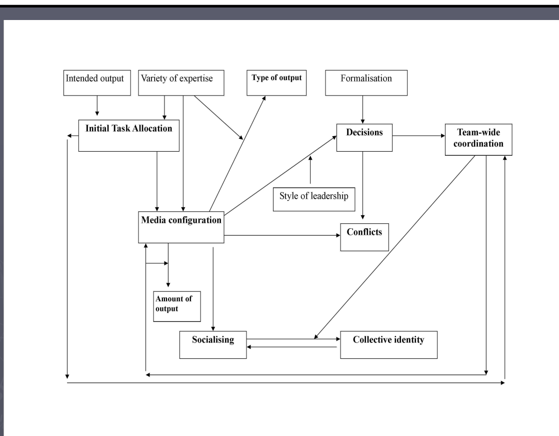
Aim of the presentation

1. How do governance structures influence dynamics of collaboration?
2. What type of research governance facilitates research collaboration?

- Empirical material: 2 case studies: distributed research teams collaborating under FP5; one case study in FP6
- Data: formal and informal communications of teams (3 years)

Operation of research teams





1. Main distinction of teams

- Initial task allocation: Degree of integrative-ness or complementarity;

Working together apart or working apart together?

- This influenced communication patterns, decision-making, coordination, output production
- Continuum of teams on the basis of this criterion
- Within the same team you can have clusters of more integrative or complementary sub-teams
- Governance fundamentally different

2. EU context → Research team

- Constitution of the teams : geographical, sectorial, and interdisciplinary diversity
- Emphasis on dissemination and exploitation activities
- Established multiple levels of authority

3. Local group → Research team

- Human resources policy
- Teaching vs. research
- Research assessment and evaluation
- Departmental organisation
- Intellectual property rights: How much do we collaborate?

Conclusions

- Research governance structures at the local and the EU level influence the dynamics of research teams and knowledge production
- Mismatch between types of governance a source of conflicts
- Managerial success of a project does not always coincide with publications in prestigious journals
- Flexibility in governance structures →Bottom-up emergence of ERA

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Transdisciplinary groups

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Overview

- What is transdisciplinarity?
- The socio-cognitive map of coastal defense research: some results.
- What is known about transdisciplinary research groups and transdisciplinary collaboration?

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Definitions of transdisciplinarity

1. Integration of all scientific disciplines into one encompassing transdisciplinary science – transgressing disciplinary boundaries in search for unity of knowledge
2. Transdisciplinary knowledge is aimed at the solution of real world problems – but not merely applied

2 subcategories:

a) Horizontal integration - Boundaries between different disciplines are transcended –e.g. ecological economics, tobacco use research

b) Vertical integration - Boundaries between science and practice are transgressed e.g. issues that have a spatial component – such as integrated water management, environmental issues

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Why transdisciplinarity?

- The development of (vertical) transdisciplinary knowledge is needed when dealing with badly structured societal problems
- Transdisciplinary research groups have specific characteristics – and encounter specific challenges. Therefore we need to know consider transdisciplinarity as a specific category when theorizing about research groups.

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Coastal defense: science, policy and societal needs

•A study to map the correspondence between the disciplinary constitution of a research field and the knowledge needs posed by societal problems and policy.

- Results:
  - Transdisciplinary research is needed for ICZM
  - Indicators to assess transdisciplinary constitution were developed
  - Barriers for Transdisciplinary Collaboration were identified

Published in: "Indicators for Cross-Disciplinary Challenges: the Case of Coastal Defense Research" (Merkx&Van den Besselaar, forthcoming in Research Evaluation)

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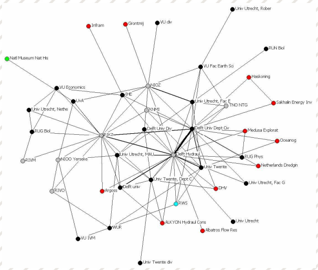
Field indicators for transdisciplinarity

General requirement:
indicators need to be related to the specific problem field (e.g. eco-engineering, beta-gamma integration)

<u>Multi methods:</u>
- identification of transdisciplinary networks / projects / programmes
- co-authorship analysis
- characterization of journals

Co-authorship analysis – coastal research



Barriers for transdisciplinary collaboration

Barriers for transdisciplinary research were identified, some relate to group formation

1. A lack of Communication Skills, Respect and Reflexivity
2. The Scientific Reputation System
3. Societal Steering of the Research Agenda

Management of transdisciplinary research

Success of TD research largely depends on the way in which managerial support is organized

Three areas of management:

1. of interests, conflicts and relations
2. of communication and information
3. of knowledge and integration

(Hollaender, Cline Loibl and Wilts, 2003)

Forms of transdisciplinary collaboration

Pohl and Hirsch Hadorn (2007) distinguish between 3 forms of collaboration:

•Common group learning – searching for something new in common
•Negotiation among experts – give and take
•Integration by leader – give or take

•Modelling as important integrative tool

Experience from Transdisciplinary Tobacco Use Research Centers

Readiness for collaboration is influenced by:

- breadth of disciplines represented
- prior working relations
- spatial proximity between offices
- freq. of face-to-face interaction

(Stokols et al. 2005)

Thank you for your attention!

Who was Rathenau?

The Rathenau Institute is named after Professor G.W. Rathenau (1911-1989), who was successively professor of experimental physics at the University of Amsterdam, director of the Philips Physics Laboratory in Eindhoven, and a member of the Scientific Advisory Council on Government Policy. He achieved national fame as chairman of the commission formed in 1978 to investigate the societal implications of micro-electronics. One of the commission's recommendations was that there should be ongoing and systematic monitoring of the societal significance of all technological advances. Rathenau's activities led to the foundation of the Netherlands Organization for Technology Assessment (NOTA) in 1986. On 2 June 1994, this organization was renamed 'the Rathenau Institute'.