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Complete Network Analysis in Research of Organized Interests and Policy Analysis: Indicators, Methodical Aspects and Challenges[1]

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This article aims at presenting advantages and weaknesses of complete network analysis in policy analysis and research of organized interests. Indicators (actor- and network-related factors) that have proven to be significant for power dimensions (trust, incentive giving and irreplaceability) will be presented. These have been derived from a policy research project in 2002. Advantages of a complete analysis of policy networks are the disclosure of latent structures, the operationalisation of power in policy arena, the measurement of policy impact of subjective factors (attitudes like radicalism, trustworthiness etc), and the "objective" bounding of the network. Challenges for future improvement are the relative "small size" of a network as a sample, the weakness of telephone queries, and the self-selection which characterizes the snowball sampling. Further questions could concern research on information, financial incentives, oligarchy and corruption.

1. INTRODUCTION

This article aims at presenting advantages of applying network analysis to policy research as well as weaknesses of this method which can be questions for future research and improvement. Indicators (actor- and network-related factors) that specify previous qualitative concepts and have proven to be significant for power dimensions (trust, incentive giving and irreplaceability) will be presented as basis for future applications. The actor-related factors interest researchers of organized interests, while the network-related factors can be useful for policy analysis. The operationalization of power is relevant to both areas.

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Our conclusions are based on experience derived from a survey that was carried out in 2002[2]. General aim of this research was to find out actor- and network-related factors that influence the power status of an interest group in a network[3]. We will briefly present the network-related factors as well as certain actor-related factors which are not internal structures (e.g. multidisciplinary team) but rather depend on the network in which an actor participates (e.g. communication properties of an actor, behavioral aspects, partners). We are going to argue that the advantages of the complete analysis of policy networks are the potential of disclosing latent structures (e.g. oligarchy), the operationalisation of power in political arena, the measurement of policy impact of subjective factors (attitudes like radicalism, trustworthiness, information "importance"), and the "objective" bounding of the network. Challenges for future improvement are the relative "small size" of a network as a sample, the weakness of telephone queries (which usually is the only cost-effective technique), and the self-selection which characterizes the snowball sampling (complete network). Further questions and applications could concern research on information, financial incentives and corruption.

2. APPLYING COMPLETE NETWORK ANALYSIS TO POLICY ARENA

All contacts have taken place by phone using standardized query (see operationalized variables in appendix II). In each network, the first actor to be interviewed was selected randomly by internet or catalogues of environment-related conferences. The initial question was "please, mention an environmental issue of the last 2 years, where you were successful". And the next question was "please name all actors that you have contacted in the framework of this issue". Afterwards, we contacted and interviewed the actors named. This snowball technique permitted us to contact the whole network for each issue (appendix III). We conducted a snowball sample until the network was completely enumerated (no new actors named), and not simply until we reached a certain number of actors that we would consider to be sufficient. Thus, a complete network analysis has taken place.

3. OPERATIONALISATION AND INDICATORS

The main task of the empirical social research is the precise operationalisation of variables specified in Bryman (2001). Valid and reliable measures of these constructs were made which can be difficult when measuring latent constructs like trust. In that case researchers have the responsibility not only for the operationalisation (in our case formulation of the standardized queries) but also for the clear definition of the variables. The clearer the definitions and the more integrated in the social theory, the more objective and transferable knowledge they produce. Simultaneously, empirical researchers are also confronted with possible measurement error due to insincerity or ignorance stemming from subjectivity and misunderstanding (Krott & Suda 2001, p.7, 8). A solution to the insincerity problem can be approached by means of indirect indicators derived from qualitative interviews (e.g. our economic indicators). Error from ignorance or misunderstanding can be prevented by selecting interview partners with access to the relevant information and by previous testing of the query.

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[2] This survey has covered 12 issue networks consisting in total of 234 actors (public services, interest groups, enterprises, universities) in 8 European countries. This article aims to describe only the methodological aspect of this research and part of the results as example, but not the policy content of these issue networks. We only make clear that these are of environmental interest. Briefly, we mention these as follows: 1. Denmark: Certification of sustainable management of natural resources, 2. Finland: Certification of sustainable management of natural resources, 3. Spain: Certification of sustainable management of natural resources, 4. Germany- Bavaria: Eco-account, 5. Germany- Bavaria: Mapping of biotopes, 6. Sweden: Key biotopes, 7. Greece: Revision of constitution regarding environmental policy, 8. Sweden: Governmental forestry strategy, 9. UK- Scotland: Scottish forestry strategy, 10. UK- Scotland: Loch Lomond and Trossachs National Park, 11. Ireland: Provisional marketing services in natural resources, 12. Spain: Research project castanea.

[3] The initial hypothesis was that the power status of an organisation depends both on its own characteristics and on the characteristics of the policy network in which it is involved (Blom-Hansen 1997)

A basic mathematical entity for the following formulas is the link from an actor *i* to actor *j*. If there is a link (e.g., information exchange[4]) from actor *i* (e.g., forest service) to actor *j* (e.g., a certain environmental group), then this link is defined as:

$$Z_{ij} = 1$$

If there is no link in this direction ($i \rightarrow j$) then:

$$Z_{ij} = 0$$

A link (e.g. trust exchange) can also be valued: $Z_{ij} = 1,2,3...$

The total number of actors participating is defined as N.

The minimum, maximum and averages of all variables over all 234 actors and 12 networks are presented in appendix IV. The significance of each independent variable for each of the three power dimensions is presented in appendix V.

3.1 Dependent variable: power

The power (P) of each actor has been measured as a sum of trust that an actor gains, the (financial) incentives it offers and the irreplaceability that it is supposed by the other participants to have. Power was first measured in a 5-level scale (P=1 to 5) where 1 means no trust at all[5] and 5 means total trust (3), incentives (1), and irreplaceability (1)[6]. Afterwards, power was converted into a percentage variable (%) through the formula of "status" (Katz, 1953) (T) using special software for quantitative network analysis, "visone". The status illustrates an informal or formal hierarchy, which is based on power relations. The formula of "status" (formula 1) includes matrix multiplication:

$$T = aC + a^2C^2 + \ldots + a^kC^k + \ldots = (I - aC)^{-1} - 1 \qquad (1)$$

Where T is a matrix including the status values of all elements, C is the matrix presenting the real network (of power exchange), and a the value of the exchange z. In our case, a is not constant. Thus, this algorithm becomes more complicated and is practically calculable only by special software (e.g., "visone"). We also measured the status of each dimension separately (trust status, incentive-giving status, irreplaceability status).

The practical meaning of status is that, if an actor X gains power from an actor Y, the actor Y from an actor Z and an actor Z from an actor J, then the actor X gains indirectly power from the actors Y, Z

[4] Other exchange relations we measured were: exchange of trust, recognition of irreplaceability, and incentives, namely the three dimensions of power. In 2.2.2 we have emphasized that in our analysis, power has been expressed though asymmetric relations: power is to concentrate trust, to give incentives and to be regarded by the others as irreplaceable (exchange of recognition). So, power cannot practically exist without (asymmetric) exchange. The information links can also visualise power centres: the most powerful actor imposes its own information as "important" and also controls to a large extent the communication. But information is a means to implement power rather than a power source (discussion to follow).

[5] P=0 has been not defined for technical and measuring-theoretical reasons; in "visone" (our network analysis software), 0 means "no relation". However, there is a relation of weakness, which should also be measured so that totally weak actors (P=1) are also included in status calculation. Otherwise, the whole network structure and the relative power position of all actors and the oligarchy would have been deformed. If we had defined P=0, it would have meant no existence of the actor of the network and this would be deceptive, because the actor, even with quite little power (P=1), still exists in the network. In other words, "weak participation" means for us more power than "no participation" at all.

[6] There are two equivalent medium situations:
- When an actor gains full trust (P=3) only
- When an actor gains incentive and irreplaceability (P=3) only

and J. In so far, actor X presents a certain specialization in this kind of exchange (in this case, an aptness in concentrating trust, incentive or irreplaceability recognition.). Through this dependence chain, the actor X can (mis)lead all others. In other words, the (power) status of each actor expresses its position in the hierarchy generated in the network through this power exchange. The practical meaning is presented in appendix I.

3.2 Independent variables

3.2.1 Actor-related factors

Communication-related indicators

We distinguish scientific and general information (Henning & Wald, 2000) based on the cross-assessment of the interviewees (see appendix I). The scientific information is a specific part of the general information that is supposed to be characterized by a higher image of objectivity.

We measured five information variables:

- "importance" (image) of:
  a. general information and
  b. scientific information

and

- control of:
  a. general information and
  b. scientific information

The fifth information variable is the occasional receiving of general information.

Information importance is quantified through using closeness centrality, while control through betweenness centrality. Because of their critical role in the quantification of the information they will be more extensively discussed.

The closeness centrality (%) of general or scientific information (CCGI and CCSI respectively) is defined as follows:

$$CC_{(i)} = \left[\sum_j d(j,i)^{-1}\right] \quad (2)$$

where $d(j,i)$ is the distance (shortest path) from actor *j* to actor *i*.

This practically means, how directly the others want to receive information from an actor (without intermediate paths) (see also Brandes et al. 2003); the more directly the others seek to receive information from a certain actor, the more "important" they consider it to regarding the specific kind of information. The "importance" of scientific information that an actor is supposed to have has proven relevant to the actor's trust status and, the importance of general information has additionally proved relevant to incentives and irreplaceability. According to Simon (1949) there is no objectively "important" information that produces these dimensions of power but rather who already possess power (trust or irreplaceability) can impose its information as "important" (the less powerful actors pay attention to the more powerful one). Namely, the information is used in the network as a means of implementing existing power rather than as a power source. This hypothesis seems to be verified by our findings. The relevance of CCGI is relevant to incentive-giving because the powerful actor - using plausible arguments- can draw the attention of the others away from possible competitors (other incentive-givers) and so impose its own offering as unique and legitimate (Heidenheimer & Johnston 2002).

The betweenness centrality (%) of general information (CBGI) is mathematically defined as follows:

$$CB_{(i)} = \sum \frac{|P_i(i,j)|}{|P(i,j)|} \tag{3}$$

where $P(i,j)$ is the set of all shortest paths between *i* and *j*, $P_i(i,j)$ is the set of shortest paths passing through *i*.

This practically means, in how many communication paths an actor plays the "go-between" and thus other actors will be lost if the actor quits the network (see also Brandes et al.2003). The CBGI thus indicates thus a form of control of information. This operationalizes the coordination as described by Simon (1949): coordination means that several participants in a network make the same decision at the same time, which may happen only if a central actor controls the information distribution. This indicator has proven favorable to the offering of financial incentives for reasons similar to those described above (see Heidenheimer & Johnston 2002).

The occasional reception (%) of general information (or abbreviation of indegree of need of general information GINEEDIN) is expressed as an indegree of each actor in general information (cf. Knoke & Kuklinski 1982).

$$Indegree_j = \frac{\sum_{i=1}^{N} Z_{ij}}{\sum_{i=1}^{N}\sum_{j=}^{N} Z_{ij}} \tag{4}$$

where Zij is the information sent ? from i to j and N is the number of actors in the network. Namely, this variable expresses how much information an actor receives from the first contacted actors in comparison to each other. It is named "occasional" because it is only the percentage of the first contacted actor and not for example a dependence chain like the power status or the closeness centrality. This indicator operationalizes the need of monitoring the whole situation which is a prerequisite for self-governance of the network (Ostrom et al. 1994, Ostrom 1999). The GINEED IN is positively correlated both with trust status and irreplaceability.

Behavioral indicators

- Radicalism (RADICALI)

This has been measured through cross-assessment (each actor has characterized all others) and expresses to what extent the organization uses legal and system-conform means or follows extreme practices like e.g. these of Greenpeace. This variable fluctuates from 1 to 3 in a metric scale. Radicalism has been regarded as a behavior which negatively affects the power of an association as it hinders the cooperation with the state (Krott 2001, Alemann 1996). We have specifically found that subversive actions negatively affect the trust status and the irreplaceability of an organization.

- Trustworthiness (TRUSTWOR)

The trustworthiness has been measured through cross-assessment. Trustworthiness is distinct from trust status. Trustworthiness is the average of the characterization of the first contacted actor to a certain organization regarding trust. In contrast to trust status which embeds an organization in an objective hierarchy (dependence chain) throughout the whole network, trustworthiness is a subjective impression of the other actors which have directly contacted this organization. Trustworthiness ranges from 1 to 3 in a metric scale and is an operationalization of what Buskens (1999) and Burkolter-Trachtel (1981) have regarded as reputation. It strengthens both the trust status and the irreplaceability of an organization.

Coalition indicator

- Partner strength (PARTNSTR)

This is the average of power of the partners that a particular organization has. It is measured as the power above in percentage. It operationalizes what in the literature is mentioned as coalition or political support (Henning & Wald 2000, Krott 2001). It proves to noticeably strengthen the trust status.

3.2.2 Network variables

Structural indicators

- Number of actors (ACTORS)

This is the number of actors that participate in the network. It has been mentioned as a descriptive dimension by many authors and has been expected to relate to the stability of a network (van Waarden 1992, Blom-Hansen 1997, Marsh & Rhodes 1992, Henning & Wald 2000, Jordan & Schubert 1992). Here we have found that trust status and the irreplaceability of an organization decrease with the "crowdedness" of the network in which it participates. This is understandable because the possibility of monopoly decreases with the proliferation of alternative contacts. Moreover, trust development decreases with size because participants cannot become "familiar" with so many actors.

- Potential lobbying (POTLOBB)

This expresses the percentage (%) of existing relations Z that are contacts from private to state actors and can thus develop in potential lobbying. This operationalizes what Henning & Wald (2000) have conceived as segmentation of a network. This means how many alternative contacts a private actor has established to the public sector. The more alternative contacts it has, the higher the chance to receive a convenient answer for a request, or obtain new financing resources etc. In our survey this has proven very favorable for the trust status and the irreplaceability of an organization.

$$potlob = \frac{\sum Z_{privateActors \rightarrow stateActors}}{\sum_{i}^{N}\sum_{j}^{N} Z_{ij}} * 100 \tag{5}$$

- Density (DENSITY)

The density means how much percent (%) of all possible contacts in the network have been already established, and is an indicator for the complexity of a network or of the extent to which all possible contacts have been exhausted (Knoke & Kuklinski 1982). This operationalizes what in relevant literature has been described as "structure" (van Waarden 1992) and is expected to relate to uncertainty and social entropy (O' Toole & Meier 1999, Meier & O' Toole 2001). This has proven to negatively affect the development of trust status and irreplaceability by each single association.

$$DENSITY = \frac{\sum_{i}^{N}\sum_{j}^{N} Z_{ij}}{N^2 - N} * 100 \tag{6}$$

where Z and N as defined above.

- Oligarchy or power inequality (POWERINE)

The oligarchy fluctuates from 0 to indefinite. This is the concentration of power on few actors and it affects the individual power status of each actor. Here, it has been mathematically defined as follows:

$$Oligarchy = \frac{Status\ \max - Status\ \min}{StatusAverage} \tag{7}$$

The oligarchy can be visualized by "visone" using the formula of Status (1) as a pyramid (see figure 1). The sharper a pyramid is, the higher the oligarchy. The highest oligarchy was recorded in the Irish network and the lowest oligarchy in the Finish network.

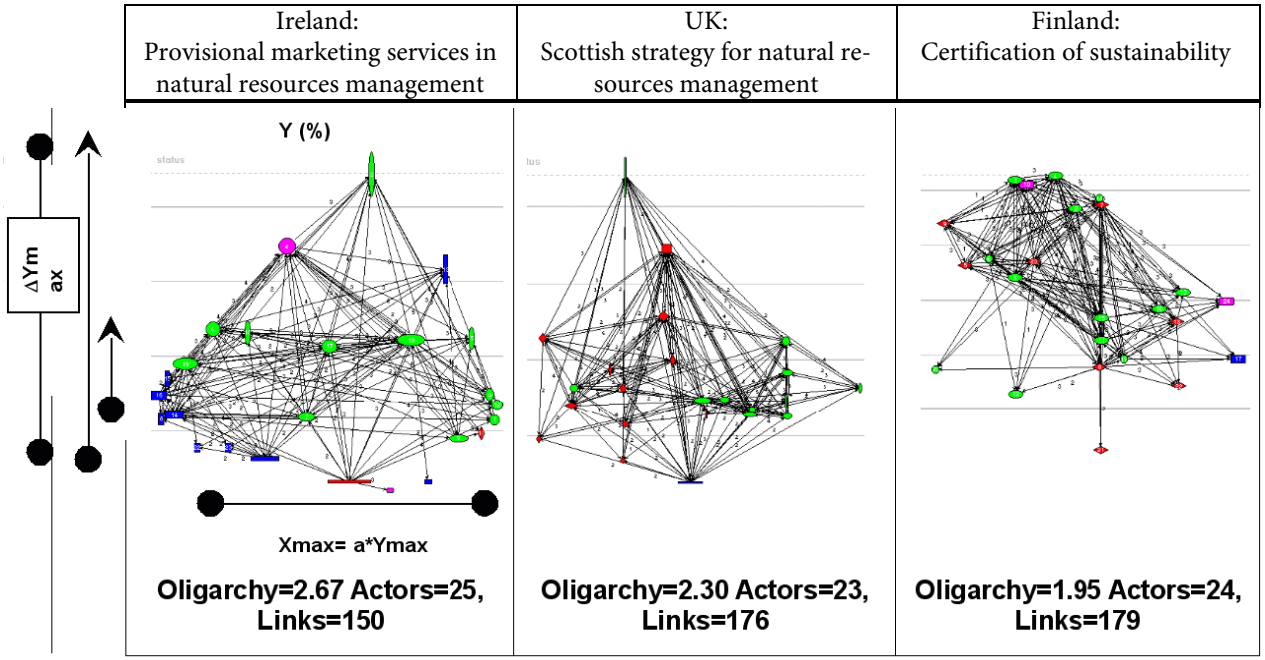

Figure 1: Examples of networks with different status oligarchies and pyramid sharpness

The practical meaning of the status axis (vertical y and horizontal x) can be critically discussed at this point; the practical meaning of the axis Y is clear: the higher an actor is layered, the higher its status. Namely, Y is a vector size (oriented distance from 0 to 100%). However, the X axis is not a vector but a scalar size. Consequently the horizontal placement of each actor does not give any direct information about the status or any other property of the actor. Brandes et al. (2001, p.12) have recognized this deficit in the status graphic of "visone". They have clarified that the only logic for horizontal positioning is the ergonomic optimization of the graphic: the actors are positioned in horizontal layers so as to ensure that long lines run vertically as much as possible and so that the number of crossings is reduced as much as possible. In this way, the graphic obtains a clear form.

However, the X axis has a practical value for the political interpretation of the network: Considering a network in a certain scale, then we should compare the Xmax with the DYmax. Then, we will extract a coefficient a, where Xmax=a*DYmax. The higher the coefficient a is, the higher the proportion of actors that are placed on the respective status layer. Also, the shorter the distance b of the layer Xmax from the bottom of the pyramid is, the sharper the pyramid[7].

[7] Consequently, an alternative definition of oligarchy could be Oligarchy=*ΔYmax*(a /b).* This indicator would have the advantage that it includes the horizontal distance Xmax=a**ΔYmax*. On the other hand, such an indicator would not be so easy measurable because it needs geographical characteristics (a and b) and a standard scale of the graphics and it is not always so clear to be measured (e.g. in Finland). For this reason, we will continue to use the formula 7. However, it is noticeable that *ΔYmax*=*Status*max-*Status*min. Thus, if in a future research one proves that the quantity (a/b) is equal or analogous to the (*Status* average)$^{-1}$, then the two indicators will be homologous and replaceable by each other.

This indicator is an additional operational dimension of the "structure" introduced by van Waarden (1992), and an alternative dimension of "hierarchy" which has been defined by O' Toole & Meier (1999, 2001) as the inverted value of the number of horizontal links of a public service to other actors (linking pattern). The operationalisation of O' Toole & Meier resembles what we have above measured as intersectorality. However, the oligarchy seems to express more accurately the hierarchy of aspects of dependence on the superior actors. The oligarchy proves to have the same properties as these of intersectorality; it impedes the development of trust status and irreplaceability by each single association.

- Intersectorality (INTERSEC)
This is the number of sectors that are involved in the network; or in other words the number of sectors to which the involved actors belong to. It has been measured on basis of a standard sector list[8]. This operationalizes what Jordan & Schubert (1992) have mentioned as "scope of policy-making", and Ostrom (1999), O' Toole and Meier (1999, 2001) have connected with uncertainty and social entropy. Indeed, intersectorality has here proved to negatively affect trust status of an organization. This may be similarly explained as in the case of actor proliferation above: in a cross-sectoral labyrinth, an organization cannot become familiar enough with new chances and risks. Thus, its cooperation steps are only incremental ones as they are not based on trust (Nee 1998).

Administrative-instrumental indicators

- Relative importance of state (RELIMPST)
This is the ratio of the possibility of state monopoly to the possibility of private monopoly and can fluctuate from 0 to indefinite. In this way, the role of state and private actors does not depend on the absolute number of the actors and a comparison across all networks becomes possible (cf. Raab 2002, p.619). The possibility of state monopoly is the average irreplaceability of a state actor, namely the sum of the irreplaceability assigned by all the other actors to state actors divided by the number of sate actors. (This can fluctuate from 0 to N-1.) It has been measured through cross-assessment. Similarly, we have measured the possibility of private monopoly. This operationalizes what in the relevant qualitative models has been mentioned as power distribution, state dominance, autonomy of private actors etc (see van Waarden 1992 and Ostrom 1999). It has proven that the higher this indicator is in a network, the more difficult it becomes for the private associations to develop trust or to become irreplaceable.

$$RELIMPST = \frac{pos.st.m.}{pos.pr.m} \tag{8}$$

- Relative density of incentive (RELDEINCE)
This expresses the ratio of the exchange of material support between actors (i,j) to the total existing links (cf. Knoke & Kuklinski 1982):

$$reldenince = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} Incentive_{ij}}{\sum_{i=1}^{N}\sum_{j=1}^{N} Z_{ij}} * 100\% \tag{9}$$

This indicator operationalizes the "structure" mentioned by van Waarden (1992) in the sense of multiplexity of a network and has proven to impede the development of trust status; if material needs can directly be satisfied for a concrete return service (balanced exchange), then there are no conditions suitable for developing generalized exchange (trust-based promises). Namely, the incentive is a direct control means, which overpowers a long-term trust relation (Vogt 1997, cf. Eisenstadt 1995).

[8] Nature conservation, forestry, general agriculture, industry, consulting, general enterprising (except for industry or consulting), water management, tourism / recreation, hunting / fishing, science (units producing knowledge as first priority), energy, general culture and education, employment, regional / rural development

- Scientific information links (SILINKS)

This is the number of the links of scientific information exchange. It operationalizes the concept expert information introduced by Henning & Wald (2000) and has proven to impede the development of trust status (if there is pluralism of scientific information and everyone has contacts to expertise resources, then an actor can hardly be plausible using scientific arguments because it is easily controlled by the others).

4 METHODICAL ASPECTS

4.1 Strengths and weaknesses of complete network analysis

4.1.1 Strengths

Complete network analysis is the operationalization of the general system theory, which assumes that each element (actor) of a system (network) does not possess its own independent properties but these should be attributed to its interaction with other elements. The advantage of complete network analysis is that one can measure the relative position of each actor in a network and disclose latent structures (informal hierarchies like oligarchy)[9]. Moreover, subjective characterizations and other subjective characterizations that an actor is assigned in a network (such as "importance" of information, radicalism, and trustworthiness) can also be measured through cross-assessment. The significance of the aggregated results for power and other policy-relevant factors can be examined. Additionally, the bounding, which takes place through snowball procedure is quite close to reality and not arbitrary or dependent on personal feeling or observation of each surveyor. It is thus an "objective" and legitimate bounding[10].

4.1.2 Weaknesses

On the other hand, network analysis has the disadvantage of small sample size[11]. Each network usually includes from 15 to 35 actors. The ideal "solution" for this would be to open up and survey a much larger number of networks, but this requires much more personnel and communication costs as well as achieving the opening of a very wide number of existing networks. Nevertheless, even if the technical-economic difficulties had been overcome, it would have still remained disputable whether we can find an acceptable number of networks that can interest a special research terrain (e.g. European agricultural policy). Although the systemic approach focuses only on polities (structures) and not on politics (processes) or policies (contents), the generalization of the results from one policy sector on different ones remains questionable. This because, politics may be different in other sectors or perhaps the different processes or policy standards may be relevant to certain power dimensions (e.g. to financial incentives in a banking network). Therefore, including as many sectors as possible in a survey is desired (as said, each network includes at any rate actors of several sectors, but the main sector is this one to which e.g. the ministry responsible for the initial issue belongs to).

Another disadvantage of the complete network analysis is that it can be only based on snowball sampling which is characterized by self-selection (Heckmann, Royal Swedish Academy 2000, p.2).

[9] This method also improves the chance to minimize the effect of "tactical" and "misleading" answers, as an actor expresses a comment (even a negative one) on a third actor much more freely than on itself. Additionally, in complete network analysis there is also the advantage of mutual verification and of general overview (it is improbable that all actors lie).

[10] In certain disciplines the bounding is normatively defined and leads to subjective conclusions. For example, historical institutionalism seems to practise an arbitrary and normative bounding of events and "responsibilities" exactly like historians who often want to play the role of a national "public prosecutor" depending on personal observing and interests; why, for example, should only the Environmental Ministry be considered to be responsible for the lack of acceptance of a conservation area and not the Prime Minister too because he has appointed this environmental minister. And why not the EU that imposed the relevant directive…? etc.

[11] This is not a problem if we regard the particular networks as the whole population which we want to make generalizations on, but it is problematic if we try to generalise the results outside of these networks.

With self-selection we mean a non-random sample that depends on the individual decisions by the agents under study (participating actors that refer the surveyors successively to each other), or depend on administrative rules or decisions on the part of surveyors (selection of initial actor and successful character of policy issue)[12]. In snowball sampling the sample does not only depend on the – at any rate - arbitrarily defined population (environmental-related actors) but on the individual decision of them to participate. According to Heckmann, we have the problem that we can measure the power significance of actor- and network-related variables only for the actors that participate and not for them that potentially could participate in future.

We tried to overcome the shortcomings that the snowball sampling is considered to have as follows: the basic goal of 'randomness' is to assure the independence of data capture from subjective preferences or personal observation capacity of each surveyor and thus to increase the reliability (reproducibility) of the results. In a similar way, we tried to increase the randomness of the snowball samples (networks) selecting the first actor randomly[13]. Then, this actor was contacted and interviewed. The environmental issue was not selected by the researchers but by this actor ("please, mention an environmental issue that you have been successful[14] in the last two years"). Afterwards, with successive contacts and references ("please, mention which other actors you have contacted in the framework of this issue") the whole network was opened up. So, we have also achieved a bounding independent from the arbitrary definition of the researchers or of another single actor[15].

5 CONCLUSIONS: STRENGTHS AND CHALLENGES

On table 1, we concisely present the advantages and disadvantages:

Table 1: Evaluation of complete network analysis

Complete network analysis	
Advantages	Disadvantages
- Disclosure of latent structures (oligarchy)	- Self-selection
- Operationalisation of power and measurement of relative positions and policy impact of subjective factors	- Small size
- "Objective" (legitimate) bounding of the network (by all the participants themselves)	- Weakness of telephone interviews

[12] Form this viewpoint, no sample should be considered to be "random" according to the strict definition of statistics because even in the random selection the whole population is defined by the samplers (Kuehnel & Krebs 2001).

[13] Concerning the definition of population, like in the so called 'random' sampling, we worked with a defined population. This was the actors involved in environmental networks and the networks they have built together in the selected countries (which were independent of the will or observation capacity of the samplers). We may have not known the exact names of these actors from the beginning but exactly the same process is followed in 'random' sampling: the population is defined and delineated as a whole and not in its single units. When a 'random' sampler says that he has defined the population, he means that he has bounded a certain group of units that present specific general properties e.g. final class of pupils at secondary school. The population is in this sense already an independent variable which simply does not appear in the multivariate analysis as such one because it is stable. The sampler does not know each single unit with "all" its peculiarities separately. In contrast, he is aiming to measure certain of these peculiarities in order to see whether they appear frequently "enough" so as to be considered correlated to each other.

[14] We have asked the first actors to mention an issue where they were successful according to their self-evaluation in order to encourage the answering. After a test we have ascertained that almost none was willing to accept a defeat and to mention an issue where it was "unsuccessful".

[15] Additionally, we have examined a dimension of policy, the intersectorality, as an independent variable which finally proved relevant to the power development. The "environmental" networks offer a good chance for measuring intersectorality because they are very cross-sectoral networks.

Because of the relatively "small" size of our sample, the results could be confronted with critical comments of empirical researchers or practitioners. These comments would be also not definitive and complete because they would be based on restricted parts of the reality (normative bounding according to the observation capacity or interests of each commentator) or on norms (feelings, prejudices or political tasks and values) that the practitioners often call 'experience'. The telephone interview is not considered to be the most reliable technique for data capture. Much more reliable in future research would be the employment of additional methods like document analysis, (participant) observation, and group discussion through conferences and workshops which should be designed and planed for this purpose in a research project of several years (e.g. 3-6 years). In these, not only researchers but also stakeholders of the networks would play a role. A diachronic observation of network interactions and developments and a comparison between different conditions would be possible and thus the results would become more reliable for further generalizations.

The following compromise could be acceptable at this point: the advantages of complete network analysis are obvious, but the disadvantage of the "small" size makes results open to empirical criticism. Thus, future policy research should be carried out on the advantageous way of complete network analysis but employing much more scientific resources in order to increase the sample size (e.g. from 12 networks and 234 actors to 100 networks and 2000 actors). Apart from that, the disadvantage of the self-selection characterizing snowball sampling and making thus its statistical properties ambiguous, can present a future research point for Heckmann's models.

5.1 Open questions for future research

The first question would be how we could improve the use of issue-oriented networks as a statistical sample as long as it can only be relatively small and not "random" according to the conventional definition. The main correcting strategy that we have followed in our work was to outweigh the disadvantage of the few cases with the advantage of the many variables and to open up the networks with successive contacts unknown to the researcher. In the future it would be useful to know the optimal balance between cases and variables so as to achieve the highest number of acceptable regressions in a number of networks.

A second question could be the application of the Heckmann's methods to network sampling. The improvement suggested by Heckmann takes the propensity of the missing actors to participate into account. This requires implementation of probability theory. The self-selection problem can be viewed as a problem of missing observations. Political power cannot be observed among non-participating organizations. To obtain unbiased estimates of basic structural parameters, the estimation procedure has to recognize that the sample of the participating actors is not the result of random selection, but the result of individual actors self-selection implied by success maximization. This can be a future project that could present an additional interest because the networks are systems and not additive samples (like working individuals in a labor market). Leenders (1995, p.208) suggested that statistical models, which can test theories of social networks, do not exist because of the interdependence that characterizes social networking. Therefore, networks can only be studied through complete analysis, meaning self-selection. Thus, we suggest that Heckmann's methods could be a solution.

A Heckmann's insight is that observations are often missing because of conscious choices made by actors. The relation between reasons for missing observations and nature of non-missing observations thus takes on an intriguing theoretical structure. He suggested the following correction (also known as the two-stage method) (formula 10, 11 respectively):

$$P_i = x_{1i}b_i + E_{1i} \tag{10}$$

$$e_i^* = x_{2i}b_2 + E_{2i} \tag{11}$$

Formula 10 determines the power status of an actor, whereas formula 11 is a "participation equation" describing the individual propensity to participate. Thus, P_i is the observed power status for actor *i* if it participates and e_i^* a latent variable that captures the propensity to participate; $x_{1i}b_1$ and $x_{2i}b_2$ are vectors of observed explanatory variables, such as internal features like chairperson age or member number etc. E_{1i} and E_{2i} are finally stochastic errors representing the influence of unobserved variables affecting P_i and e_i^*. The parameters of participation interest are the b_1 and b_2. Based on these two equations, Heckmann further developed a method for the estimation of the influence of the unobserved variables on the sample. In a network sampling we could also estimate the non-networked actors, if previous research showed these vectors were important in case of policy networks.

A third research point could be a deeper qualitative analysis of the role of the information and other possible organizational and network factors in the generation of financial incentive. It is already remarkable that non-financial factors appear as directly relevant to the incentive. Further research on the incentive could be also useful in corruption research.

A fourth question could concern the geometric meaning of the status oligarchy as presented using "visone" in figure 1. Apparently, the sharpness of the pyramid is related to oligarchy and the visualization of status is thus useful to make a quick comparative estimation between networks. But the further mathematization of sharpness and its exact relation to oligarchy can be a point for further research.

Finally, a fifth question would be how we could distinguish the "scientific" from the rest "general" information without being dependent on the cross-assessment of the actors. For this purpose a clear definition of science would be necessary (for example maximum acceptable limit of norms that are mixed in objective facts). Through a cross-assessment as we have practiced in this survey, one can rather measure "scientific image" of each actor than science as an objective entity.

APPENDICES

I. Practical meaning of power values

Trust (1,2,3)	Incentives (0,1)	Irreplaceability (0,1)	Power value	Meaning	Aggregation
1	0	0	1	Lowest authoritative and instrumental power – mere existence in the network	1= Only existence
1	1	0	2	Only part of instrumental power	Only part of one power form 2=1*part
1	0	1	2	Only part of instrumental power	
2	0	0	2	Only part of authoritative power	
1	1	1	3	Only total instrumental power	One total power form or parts of two forms 3=1*total or 3=2*parts
2	1	0	3	Part of authoritative power and part of instrumental power	
2	0	1	3	Part of authoritative power and part of instrumental power	
3	0	0	3	Only total authoritative power	
2	1	1	4	Part of authoritative power and total instrumental power	One total power form and part of one other form 4=1*total+1*part
3	1	0	4	Total authoritative power and part of instrumental power	
3	0	1	4	Total authoritative power and part of instrumental power	
3	1	1	5	Total authoritative power and total instrumental power	Both total power forms 5=2*total

II. Operationalisation of variables

Variable	Question
Issue	1. Please mention an environmental-forest policy affaire (issue) of the last 2 years, in which your association was successful
1. Power %	2a. Please, mention all associations, services or other institutions, with which you have cooperated in this affaire (Z+) 2b. Please, mention which of these associations, services or other institutions were for you irreplaceable+. 4. Please, mention which of them could you trust (V+): 1 'not at all', 2 'to certain extent', 3 'completely (let make a decision for you)' 7. Which of these actors provided you relatively often with cheap equipment, personnel, members or other kind of material support? (A+)
2. Closeness centrality of general information (ccgi) %	5a. Which of them provided your organisation with enough information (I+)
3. Betweeness centrality of general information (cbgi) %	5a. Which of them provided your organisation with enough information (I+)
4. Closeness centrality of scientific information (ccsi)%	5b. Please, mention 3 of them which provided the scientifically most important information
5. Occasional reception (%) of general information (gineedin)	5a. Which of them provided your organisation with enough information (I+)
6. Radicalism (radicali)	8. How radical-activist do you find each of the other associations? (Ex+) - As radical-activist as Greenpeace or more 3 - only exceptionally 2 - not at all (1)
7. Trustworthiness	4. Please, mention which of them could you trust (V+): 1 'not at all', 2 'to certain extent', 3 'completely (let make a decision for you)'
8. Partner strength (partnstr)	2a. Please, mention all associations, services or other institutions, with which you have cooperated in this affaire (Z+). 3 . Please, mention which of them you had a conflict with (K+). 2b. Please, mention which of these associations, services or other institutions were for you irreplaceable+. 4. Please, mention which of them could you trust (V+): 1 'not at all', 2 'to certain extent', 3 'completely (let make a decision for you)' 7. Which of these actors provided you relatively often with cheap equipment, personell, members or other kind of material support? (A+)
9. Intersectorality (intersec)	2a. Please, mention all associations, services or other institutions, with which you have cooperated in this affaire (Z+).
10. Potential lobbying (potlob)	2a. Please, mention all associations, services or other institutions, with which you have cooperated in this affaire (Z+).
11. Actors (actors)	2a. Please, mention all associations, services or other institutions, with which you have cooperated in this affaire (Z+)
12. Density (density)	2a. Please, mention all associations, services or other institutions, with which you have cooperated in this affaire (Z+)
13. Relative density of incentives (reldenince)	7. Which of these actors provided you relatively often with cheap equipment, personnel, members or other kind of material support? (A+)
14. Possibility of state monopoly (pos.st.m)	2a. Please, mention all associations, services or other institutions, with which you have cooperated in this affaire (Z+). 2b. Please, mention which of these associations, services or other institutions were for you irreplaceable+.
15. Possibility of private monopoly (pos.pr.m)	2a. Please, mention all associations, services or other institutions, with which you have cooperated in this affaire (Z+). 2b. Please, mention which of these associations, services or other institutions were for you irreplaceable+.

III. Network matrix

Actors ➔ / ⬇	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	..	..	..
1.	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx
2.	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx	ZKVIAEx
.																			
.																			

Key: Z: general contact, K: conflict, V: trust, I: information (general or scientific), A: incentive, Ex: radicalism

IV. Descriptive statistic of all data

Descriptive statistic of all networks	Minimum	Maximum	Average
Organizational factors			
POWER	0.00	15.62	4.9716
TRUST	0.44	13.84	5.0584
INCENTIVE	0.00	100.00	5.1276
IRREPLACEABILITY	0.00	40.00	5.1179
RADICALISM	1.00	3.00	1.3202
TRUSTWORTHINESS	1.00	3.00	2.3424
PARTNER STRENGTH	1.97	13.66	6.3852
CCGI	.00	23.08	5.0141
CCSI	.00	60.00	5.0825
CBGI	.00	75.00	5.0410
GINEEDIN	.00	53.85	5.0496
Network factors			
ACTORS	11.00	38.00	23.2179
POTENTIAL LOBBYING	4.73	63.16	21.9933
RELATIVE IMPORTANCE OF STATE	.35	4.21	1.7791
INTERSECTORALITY	4.00	11.00	6.6197
OLIGARCHY	1.20	2.67	1.9399
DENSITY	19.76	52.73	28.6099
RELATIVE DENSITY OF INCENTIVES	2.63	23.51	15.6929
SCIENTIFIC INFORMATION LINKS	4.00	38.00	21.9744

V. Stepwise regressions

	Dependent variables					
	Trust status		Incentive status		Irreplaceability	
	Standardized Coefficients	P	Standardized Coefficients	P	Standardized Coefficients	P
Actor-related variables						
RADICALI	-,230	,005	-,043	,709	-,221	,020
……..	……..	..	…….	….	……	…
TRUSTWO	,244	,003	-,006	,959	,227	,016
……..	……..	..	…….	….	……	…
PARTNST	,448	,000	,113	,464	,164	,209
……..	……..	..	…….	….	……	…
CCGI	,505	,000	,243	,003	,371	,000
……..	……..	..	…….	….	……	…
CCSI	,159	,003	,020	,794	,077	,284
……..	……..	..	…….	….	……	…
CBGI	,074	,103	,249	,000	,132	,029
……..	……..	..	…….	….	……	…
GINEEDIN	,145	,001	,107	,091	,162	,005
Network-related variables						
INTERSEC	-,228	,020	,017	,902	-,238	,038
……..	……..	..	…….	….	……	…
POTLOBB	,327	,000	-,057	,612	,367	,000
……..	……..	..	…….	….	……	…
RELIMPST	-,245	,003	-,063	,593	-,372	,000
……..	……..	..	…….	….	……	…
ACTORS	-,447	,000	-,172	,200	-,241	,028
……..	……..	..	…….	….	……	…
POWERIN	-,407	,000	-,097	,535	-,520	,000
……..	……..	..	…….	….	……	…
DENSITY	-,251	,003	,052	,658	-,329	,001
……..	……..	..	…….	….	……	…
RELDEINCE	-,256	,000	-,030	,640	-,111	,069
……..	……..	..	…….	….	……	…
SILINKS	-,239	,000	-,009	,895	-,075	,235

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