

Indicators for the dynamics of research groups

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Research subject and hypothesis

We explore the dynamics of research groups, as organisational units, in a historic approach, analysing the full history of output of a group, in all its domains of activity, and try to explain their development from the perspective of process-based organisation theory. Our hypothesis is that groups, optimising activities directed at realising their mission, follow a 'life-cycle' pattern if the environment is stable, or a 'deviant' pattern if the environment is more dynamic, e.g. a continued exponential growth from periodic opportunities to gain additional resources. We introduce indicators to analyse positioning and dynamics of organisational research units.

Methodology

In this contribution, we present a composite theoretical framework and a set of indicators for the longitudinal analysis of research group development. Empirical results for two cases of organisational groups from the same umbrella institute but operating in different scientific disciplines will be used to illustrate and critically evaluate the proposed theoretical approach.

In line with process-based theorising in organisation studies, we approach research groups as units of change that follow a particular sequence of events, steered by an internal mechanism, in conjunction with other external events and conditions (Scott Poole et al., 2000, p.36-37). The internal mechanism that drives the activities of a research group, we take to be its mission: the shared (implicit or explicit) ambition of the group members to realise specific results outside the group. According to its mission, a group will strategically position itself in a number of domains of activity, that can be characterised in the form of an activity profile (Laredo and Mustar, 2000). We hypothesize that each group will optimize activities directly contributing to its mission (we call these 'primary activities'), and undertakes 'secondary' activities to gain resources necessary for its survival, that contribute indirectly to the mission. Optimisation leads to (logistic) growth of output in primary domains up to a ceiling level that is given by the amount of available group resources (Price, 1963). Within each domain of activity, the group has to be accepted as a legitimate player and has to compete with other groups that produce and offer the same or similar types of output products. The success of a group in a specific domain of activity, depends on the level of acceptance and specialisation ('grade of membership') of the group as a producer of products in each domain (Hannah et al, 2007). Developments and conditions in domains of activity, e.g. dominant search processes in scientific fields and disciplines, also influence the focus of activities undertaken by a research groups (Bonaccorsi, 2008). The historical development of groups, can be explained by depicting events occurring within the group and in its domains of activity (its environment). In process-based organisation theory four different 'motor' are discerned, that contribute to the explanation (Scott Poole et al., 2000, p. 59):

- life cycle: linear and irreversible sequence of development stages;
- evolution: recurrent sequence of variation, selection, and retention events;
- dialectic: recurrent, discontinuous sequence of confrontation and conflict, and synthesis;
- teleology: recurrent discontinuous sequence of goal setting, implementation, and adaptation.

To analyse the historical development of groups, as coherent organisational units of activity, we use bibliographic data, taken from the web-site of a group. We inspected annual reports, and available (self-)evaluation reports of the groups, to detect specific events, processes and conditions, within and around the groups, that may be helpful to explain their development.

We propose the following set of bibliometric indicators to construct the life history of groups:

- Activity profiles, for consecutive years and periods in the history of the group, as:
 - linear graph of stapled output categories, depicting growth of activities in domains (journal articles, professional publications, reports, PhD-theses, etc.);
 - linear graph with calculated values of similarity (cosine) between these profiles, for years t with year $t-1$, depicting change/stability in positioning;
 - spider diagrams, for depicting profiles for longer consecutive periods of time;
- Activity focus:
 - Linear graph with values giving the relative change in focus in output categories in a domain, such as the percentage of new journal titles a group publishes in, or the percentage of new collaborating authors, or new clients commissioning reports, etc.;

The activity profiles of a group indicate similarities and differences in positioning strategies of the groups (leading to group types, as proposed by Larédo and Mustar, 2000). Profiles, and changes therein, can be related to the changing mission of groups, e.g. given in annual reports.

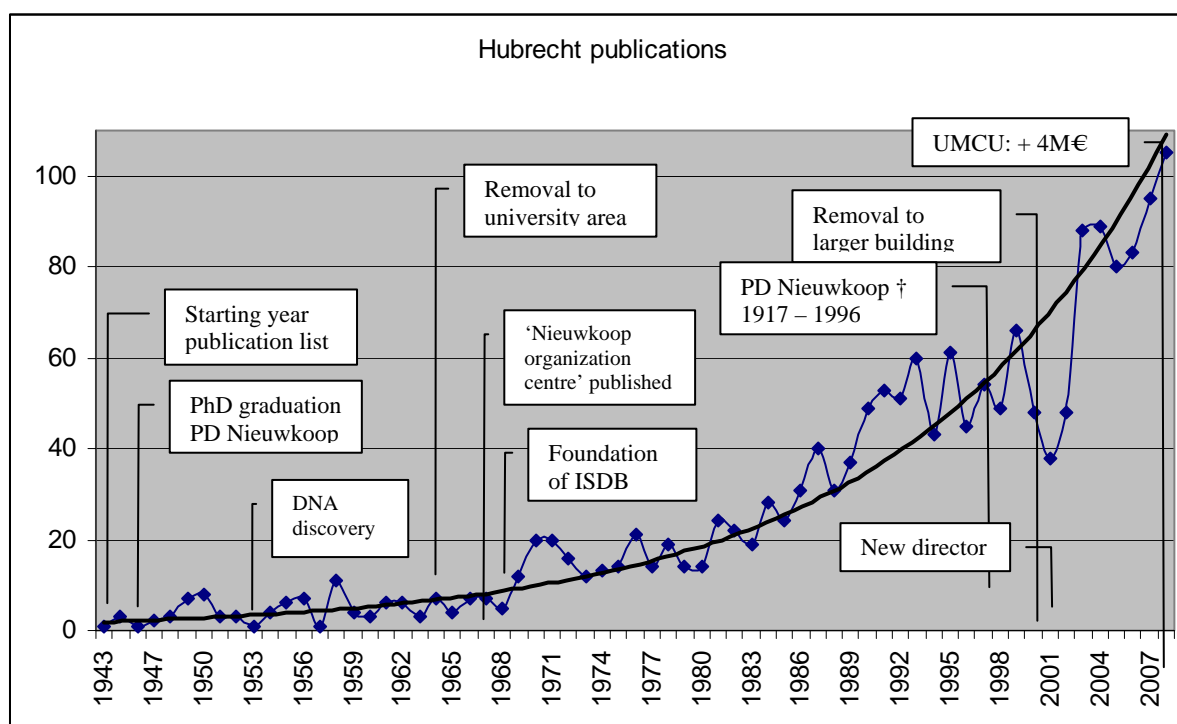
As a heuristic to analyse results, we hypothesize 'ideal-type' lines of development of groups. That is, the pattern of development of groups one would expect in case their mission remains unchanged and the vital conditions in their domains of activity remain stable. In such cases, the groups activity profile would stabilise after an initial period, and focal change in product output categories would stabilise at a level depending on the groups specialisation, and the production of output would follow an S-curve, growing towards a ceiling of resources, and may thereafter gradually decline as a result of aging and fatigue, in absence of reproduction. We then compare the actual results of the bibliometric indicators for each group with the ideal type lines of development, in order to detect possible deviations from these patterns. These deviations, if present, are then taken pointers to specific events that influenced the groups activity. These events may be found in annual reports or evaluation reports, or could be found in changing conditions in one or more of its domains of activity, e.g. in scientific fields.

Existing and expected results

In our project on the bibliometric history of groups, we earlier analysed two groups in the area of science studies, CWTS and CSI, that showed a development pattern in line with life cycle development in a stable environment (Braam and van den Besselaar, 2008). We here present results on the history of a research laboratory in a much more dynamic field of science: the Hubrecht Institute for Developmental Biology and Stem Cell Research (established in 1916). Bibliographic data on the Hubrecht Institute output were collected for the period 1943-2008 from publication lists on the institutes website. Information on the institutes history was also taken from its website, and from annual reports and documents on evaluation of the institute.

The question we explore for this presentation, is to what extent the dynamics of groups, or labs, deviates from the so-called life cycle development, and is depending more on what is happening in dynamic scientific fields wherein groups are active, i.e., if influences from the scientific domain dominate. The results we found, indicate that although in stable fields the life cycle theory may hold, this is not the case in more dynamics areas of science. Groups (or labs) in such areas will follow a continued growth path, resulting from a periodic raise of its ceiling of resources, apart from minor fluctuations by local changes of conditions (see fig.1).

Figure 1. Hubrecht publications, all output categories, by year, with exponential curve fitted



The approach, and the found results, are important for understanding organisational research units, as the local constituent parts of the science system, and may be of help in improving decision making in research management and in science policy, by advancing a theoretically grounded framework for positioning indicators at the level of research (units in) organisations.

References

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