# Bibliometric mapping as a science policy and research management tool

Noyons, E.C.M.

# Part II Published Articles

In this part of the book, six articles published in the recent past are presented. They contribute to the discussion on science mapping as a policy supportive tool. Each article is included in the discussion for particular aspects (Chapters 4 to 9). Together, they build an overview of the activity at CWTS in the past few years regarding the development of S&T maps for policy supportive objectives. In Chapter 10, the path is sketched which CWTS is following at present.

In Chapter 4, the possibilities of *internal intrinsic* validation (See Figure 3-2) of structures based on quantitative data are discussed. Although no maps were involved in this study, it shows the strengths of this kind of validation. In the field of 'lasers in medicine', a structure is generated on a very specific basis: patent to publication citing patterns. The structure reflects the appliedness of parts of the field represented by patent applications. In general, the hypothesis that the number of citations to scientific literature indicates the 'science intensity' of patents is tested by investigating the characteristics of the scientific literature published by the patents' inventors. In the study, we found that in 'lasers in medicine', the number of cited scientific publications correlates to the 'science intensity' of patents, as measured by the character of the journals the inventor use for their publications. The main point made in this study, in view of the present discussion, is that a structure based on one particular characteristic (citations in *patents*) is validated by other data (scientific *publications* of the inventors). By including a validation established by experts, the structure is validated as well.

In Chapter 5, a basic mapping study is presented. In this study, we integrated both scientific publication data and technological patent data into a science-technology interaction evaluation of the field 'optomechatronics'. The study explores the possibilities of using data from both sides. One of the 'methodological' outcomes was that patent law may influence the results a great deal. In the studied field, we found a quite large subfield (*control/software engineering*), which was represented on the science map, but not on the technology map. The reason is that software is difficult to be patented under the European patent law. This does, of course, not mean that there is no technological activity in this part of the field. These outcomes show the importance of selecting the proper data (base) in view of the issue to be addressed, as well as the need for expert validation of the used data.

In Chapter 6, the basics of the present mapping procedures are presented. The study focuses mainly on an important issue concerning the contrast of the actor analysis on the one hand and analysis of field dynamics on the other. The evaluation of actor activity dictates a certain rigid structure during the period under study in order to fix more or less the definition of the field structure, whereas a visualization of the dynamics of a field is hindered by this rigid structure. In this contribution, we propose a method to fuse these clashing interests. Furthermore, we introduce the concept and

application of 'multi-level' maps. This aspect, together with the insertion of map-external information directly in the maps, considerably improves the applicability of bibliometric maps for policy-supportive aims.

In Chapter 7, an extensive actor analysis is presented based on the method presented in Chapter 6. The article presents the results in view of 'virtual' policy issues.

The study in Chapter 8, like the work presented in Chapter 4, does not include a mapping study as such, but rather an evaluation of research in information technology (IT), where the structure of the field is based on the views of experts. The study was performed for the Flemish Ministry and aimed at identifying the main developments in IT and at characterizing the activity of Flanders in this field. An important practical issue arose from the study. The procedure, applied to provide a field structure on the basis of IT experts beforehand, appeared to be rather complex. The organization providing IT experts, suggested a structure of the field. This structure definition was translated into sets of field specific classification codes. Each set of codes represented an IT subfield. Publications and patents were collected per subfield, on the basis of the codes. But during the process, the conclusion was drawn that a most important 'subfield' had been 'forgotten' by the experts. Once the publications in this subfield were added to the database, we found this particular subfield to be the most important one for the Flemish IT. This should illustrate that the application of expert input is a delicate matter. Although the integrity of the experts is not at stake, one may question the objectivity of the delineation procedure. A selection procedure on the basis of bibliometric principles and a structure on the basis of the mapping procedures, may have led to a similar conclusion, but then the results would be more 'objective'.

In Chapter 9, the internal intrinsic validation (see Figure 3-2) of the 'micro-electronics' map is illustrated. The structure based on classification co-occurrences is enhanced with all kinds of map-external statistics. This means that the statistics are based on data that were not directly responsible for the structure of the map. For instance, statistics of actor activities or publication sources (journals, conferences proceedings) are expected to show preferences of these sources for certain parts in the map. These statistics validated the structure to be relevant. The study also shows that the paper version of these mapping studies is not appropriate for practical use. Each information item included in a publication may be of interest for validation. Moreover, a user may have a variety of interests concerning the added information items. In order to provide all this information, we need a map for each information item with a reference system (to the proper information source and page) and piles of papers containing this information per subdomain. Browsing through these piles of papers rather frustrate the user than encourage or inspire him. For large amounts of publications this browsing for many information items becomes virtually impossible, or at least completely impractical. The digital version is in that respect an excellent alternative. The user can pick out his/her areas of interest directly without being confronted with all the other information.