# Science maps as ways to indicate knowledge transfer

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## Extended abstract

Recent developments in the field of science mapping induced a variety of applications within evaluative and structural scientometrics. The *Science Overlay Map* technique (or toolkit) has been introduced by Rafols, Porter and Leydesdorff (2010), upon a mapping exercise of global science in terms of Web of Science Subject Categories or SCs (Leydesdorff and Rafols 2009). Via this toolkit, any collection of (WoS-indexed) publications can be represented as an overlay on the global map (hence its name), representing, therefore, its field composition and position on the scientific landscape. Consequently, all countries, institutions, researchers, research topics or any other meaningful aggregations can be profiled and compared through this structural model.

An outstanding feature of the overlay toolkit is its capability to convey structural information on research profiles. The global science map (basemap) involved in profile mapping is a proximity network of research fields (SCs), based on the bibliographic coupling of Subject Categories. Consequently, overlay maps for any aggregate of papers not only encode for the distribution of the aggregate over current fields of science, but also for the relation (cognitive distance) of the fields included in the overlay map. This feature led to a growing interest in applying the model in *Interdisciplinarity Research* (IDR). In IDR a special focus is given to measures that summarize the multifaceted information within overlay maps, in order to quantify the multi- and/or interdisciplinarity of research profiles. The most popular overlay-based measure so far is the so-called generalized *Stirling index* (Stirling 2007). The Stirling index can be readily interpreted as a measure of multidisciplinarity, capturing at least three aspects of cognitive diversity: the variety, the balance and the disparity of fields within research profiles (Leydesdorff and Rafols 2009).

This index is rather flexible, as each parameter can be evaluated with different indicators: SCs can be weighted along by their relative frequency within the aggregate, but also with e.g. the impact of the associated papers; similarly, the distance term can be interpreted with a series of network measures, allowing for a variety of aspects to be quantified (Soós and Kampis 2011, 2012).

Applying the *science overlay toolkit* and the Stirling index for knowledge diffusion here, we are modeling the development of a scientific topic via dynamic overlay maps, upon which two new derivatives of the Stirling Index will be introduced. The *Mean Overlay Distance* (MOD) and *Overlay Diversity Ratio* (ODR) will be argued to account for ingredients of diversification/integration that the Stirling index fails to capture. As a case study, we demonstrate our approach on a large-scale corpus covering a historical topic from the life sciences, namely, the *species problem.*

An important conclusion to be drawn from our comparative study is that, when looking for the patterns of knowledge transfer, the set of old and new measures exhibit a complementary

relation, addressing different dimensions of science dynamics. While the MOD measure can better reveal the *amount* of „shift" in field composition, the ODR measure indicates the *direction* of the transition (i.e. whether it is a case of diversification or integration). The MOD and the ODR measures, therefore, jointly define a „full vector" representing the change along the timeline.

An equally relevant feature of the new toolkit proposed in this study is its capability to model a variety of dimensions of science dynamics, accompanied by its applicability in a wide range of research domains. As a direct follow-up of the present use case we are currently working on the modelling of the development of individual, institutional etc. research profiles referred to as „thematic mobility" in the context of monitoring academic careers. A still further case is an evaluative application of the new indices in assessing citation impact not only through quantities (i.e. "times cited"), but by quantifying also the scope of citation impact over the very scientific landscape.

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