Indicators to understand and support the internationalisation of science, innovation and related policies

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Introduction

Both scientific knowledge production and technological innovation are increasingly internationalised activities. Whilst science has long had an important international dimension, recent decades have seen an intensification of the trend away from national science systems towards a global science system. Innovation, especially but not only in science-based industries, is also increasingly internationalised. For example, recent studies have shown that for Germany, in areas such as biotechnology or pharmaceuticals half of the publications are produced in international co-operations. National policy-makers increasingly seek to drive and manage internationalisation of scientific and innovative activity to achieve STI and other policy goals. Many countries have produced high-level internationalisation strategies. Research performing organisations and funding agencies are also increasingly setting targets for international activities and attempting to redesign internal processes and inter-institutional co-ordination schemes in order to reach those targets. Finally, new forms of transnational, co-ordinated governance are emerging.

However, while policy ambitions rise, the evidence base on which to make strategy is often weak. Attempts to formulate strategies, set targets and design mechanisms presuppose an understanding of the scale, scope and effects of existing international activities in science and innovation and of the actions and incentives that can encourage and shape such activities. However only a few dimensions of internationalisation are at present well served by existing indicators. Based on a review of internationalisation strategy processes and indicator use in a number of (mainly European) countries this paper discusses this indicator lacunae and, based on the findings of a review of the literature on internationalisation processes and impacts, presents analytical concepts to underpin the development of STI internationalisation policies and strategies. It introduces a functional indicator approach along a stylised policy strategy cycle and proposed a portfolio of indicator 'needs', discussing the extent to which the construction and use of indicators appropriate to addressing each 'need' is feasible.

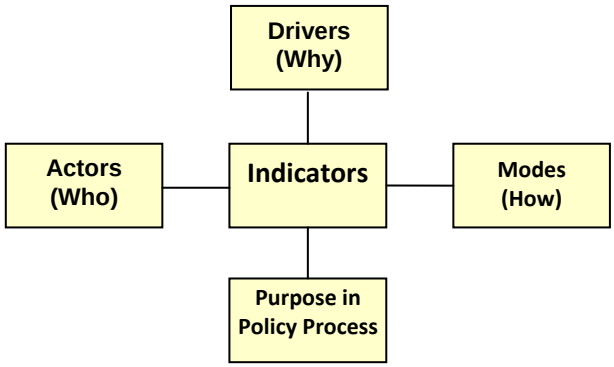
Rationales and drivers for internationalisation policy

Based on a review of the literature on internationalisation and drawing upon a review of internationalisation strategy formation in a range of countries (conducted by Technopolis and MIOIR) we identify two 'paradigms' or policy rationales informing the development of active STI internationalisation strategies. There is a narrower paradigm focused on internationalisation in the search for scientific and research excellence, and a broader paradigm in which STI internationalisation activities are seen as supportive of a much broader range of domestic and foreign policy goals. All policy rationales contain a good deal of interpretive flexibility but the causal mechanisms by which internationalisation is expected to achieve these broader goals are particularly fuzzy, and this fuzziness creates challenges for indicator definition, development and use.

Indicator needs in the policy strategy cycle

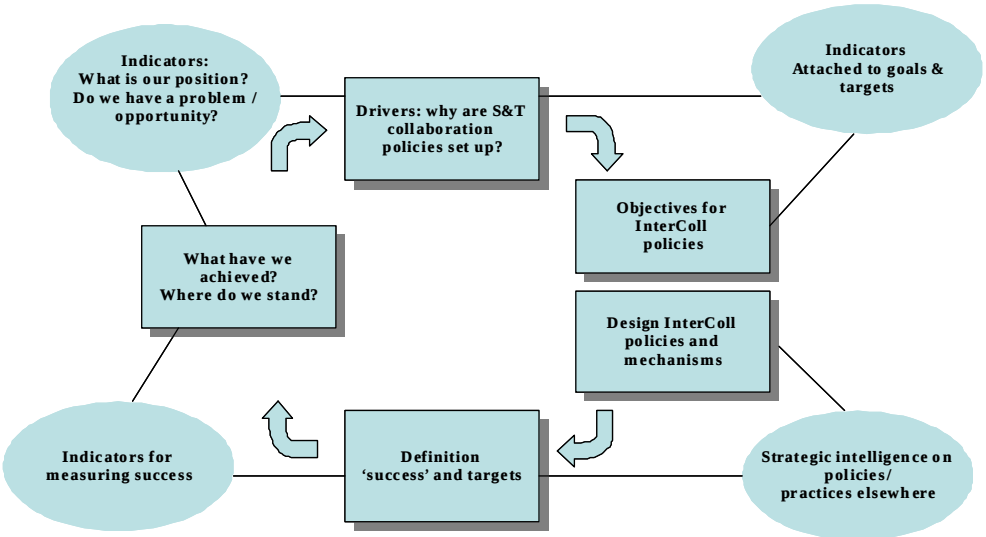
Indicators can in principle be conceptualised along a number of dimensions: **modes** of internationalisation activity (how), drivers of internationalisation activity (why), the **actors** engaged in or targeted by internationalisation activities/policies (who) and the various **purposes** or functions indicators are used for within the policy process (when).

Figure 1 Four dimensions of indicators use



The roles played by evidence and indicators will be different at different stages of the policy making process. Here a stylised policy strategy cycle approach is proposed, conceptualising indicator needs at four major 'stages', which correspond to major policy-making activities. While such a cycle is a simplified idealised understanding of policy making, and in reality the policy process is an at best boundedly rational and always complex, contingent and non-linear matter, it does help us to conceptualise key indicator requirements. Indicator needs throughout the policy (strategy) cycle are illustrated in Figure 2.

Figure 2 Indicator needs in a strategic policy cycle framework



Current indicator use is largely limited to one-off or ad-hoc 'contextual' studies, or to evaluations and impact assessments of specific internationalisation initiatives. We find little evidence either of the systematic monitoring of internationalisation as a phenomenon, or of the overall impacts of policy interventions on the broader policy goals behind internationalisation efforts. Most efforts focus

on a limited set of basic indicators – especially indicators of **co-publication, co-invention**, and **programme participation**. There is a high level of aspiration amongst policy-makers towards the more systematic use of a wider range of indicators in strategy-making for STI internationalisation but there has been little progress thus far. Based on our idealised policy strategy cycle we can hypothesise the following indicator needs in the policy process and, starting from these, we go on to discuss how they might be at least partially addressed:

- **'Status quo' analysis**
  - Analysis of the STI strengths and weaknesses of the country;
  - Analysis of scale/scope of existing international activities of individual researchers;
  - Analysis of scale/scope of existing international activities of research-performing and innovating organisations;
  - Analysis of existing policy interventions promoting STI internationalisation;
  - Analysis of governance structures (policy)

- **The international 'opportunity' environment**
  - Scientific and technological profiles of possible partner countries;
  - Analysis of specific organisational hotspots by field or sector;
  - Demand and market indicators;
  - Scale and nature of existing collaboration with possible partner countries
  - Nature of funding opportunities and policy orientation in possible partner countries

Finally we identify and briefly explore two further sets of indicator issues, connected with the remaining elements or stages of the policy strategy cycle, namely **target-setting** and **monitoring/evaluation**.