EMBO reports

editorial

Top Doc

Newsweek magazine generated a near-hysterical wave of national satisfaction in Finland last year on the basis of the fact that it ranked the country first in its international league table of life-quality indices. In regard to the field of basic education, the *Dallas Morning News* reported in February 2009 that pupils in Finnish schools "have studied algebra, geometry and statistics since the first grade". (One might suspect that Finland's success in the league tables is due, in part, to the resulting extraordinary ability of its statisticians to massage data in its favour.)

The value of such surveys is not merely to enable politicians to gloat about their merits, but to provide a benchmark towards which all should aspire. By demonstrating that it is possible to combine social cohesion, economic prosperity and global responsibility, the high-scoring nations provide a model that less successful countries can use to guide their own development, catalysing changes in policy that benefit everyone.

The scientific and technological outputs of different countries represent only a small component of such assessments. Perhaps it is time for the scientific community to promote an exercise of its own, in order to gauge the merits of different countries in the achievements and promotion of science. This could create momentum for policy changes that would empower scientists everywhere to contribute more substantially to global progress. Each autumn, when the Nobel Prize Laureates are announced, specific achievements in science flit briefly across our screens, soon to be forgotten by the general public. But little attention is paid to how science is funded, practised or nurtured in different countries. Virtually the only times such issues are aired are moments of crisis when, as happened last year in the UK, the scientific community mobilized public and political support to protect science from the worst of the state spending cuts.

What parameters should be considered in order to create a globally valid ISM, or index of scientific merit? One oft-quoted (and almost infinitely massageable) statistic is the percentage of GDP that is spent on research and development. The European Union has established a goal for such spending to reach 3%; this figure is already exceeded by some of the Nordic countries, whereas some Mediterranean states continue to lag abysmally. However, this figure includes investment in product development by commercial companies, so to a large degree masks the state's actual expenditure on basic research and on the early-phase support of promising applications. Some measure of total spending and its distribution nevertheless needs to be incorporated into the ISM. Private sector investment in research should obviously be included; in molecular biology, two of the largest funders of research on both sides of the Atlantic are in the private or charitable sectors, namely the Wellcome Trust and the Howard Hughes Medical Institute, not to mention the increasing role of the Bill and Melinda Gates Foundation.

The output from such investment also needs to be measured in a robust and transparent manner. Much effort has been expended in recent years to create metrics that can judge the relative merits of individual scientists or the institutes and departments to which they are affiliated. It remains debatable how far these numbers, such as journal impact factor or personal *h* index are valid, although in aggregate they provide a baseline for measuring scientific achievements qualitatively as well as quantitatively.

Most of us share the goal of translating scientific knowledge into practical benefits, even if those benefits will only be realized in the very long term. The ISM should therefore incorporate a measure of the value of discovery to what is jargonistically termed 'innovation'. The number of patents filed, their actual utilization, and perhaps even the amount of GDP directly generated from patents granted in the preceding 10 or 20 years could all be included. The creation of protected intellectual property that leads nowhere is obviously not something to be encouraged; however, this might already be happening in some countries, driven by the current funding system and university policies.

In addition to recognizable achievements, such as major international prizes, the ISM should also take account of how far scientific knowledge is disseminated within society, both by the general education system and by the activities of journalists, institutions, funders and, most crucially, scientists themselves. This is vital not only to ensure the continuity of national support for science in democratic states, but also to provide mechanisms by which to exploit discoveries for societal benefit. Perhaps we could simply survey the esteem in which scientists are held in different countries, and the degree to which the public is informed or cares about what we are doing.

Other criteria also need to be thought about when judging which countries are the best ones in which to practice science. Where are scientists best remunerated? Where is a career structure in place that generates a viable mix of incentive and job security, and where are scientists and technical experts given the most freedom to accomplish creative works rather than implement useless administrative tasks? Where are young scientists given the best opportunities to develop their own ideas and projects, rather than wasting their most productive years grovelling to a senior professor who takes the credit for their work? Where does the legal framework best serve the interests of academic freedom, scientific originality and public accountability? Where is there the most appropriate balance of support for basic and applied research, and where are funding and career advancement most clearly based on transparent peer-review?

The results are not predictable, but would surely be a wake-up call for many politicians and scientists.

Howy Jacobs

EMBO *reports* (2011) **12,** 1. doi:10.1038/embor.2010.201

