Analyzing the impact of research policy with a ego network analysis

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Fuel cells have for decades been of interest to public policy makers. Driven by energy security, diminished pollution, or the possibility of obtaining a cheap energy source has made several governments to fund fuel cell research. Recent funding efforts have include The US Department of Energy spending excess of $2 billion between 1990 – 2000, The European Union $1.5 billion initiative to hydrogen-powered in 2008 and Japan's Hydrogen and Fuel Cell Research Funding exceeding $240 Million in 2012. The before mentioned are only a few of the funding scenarios offered (A fairly comprehensive list is available at http://www.fuelcells.org/InternationalH2-FCpolicyfunding.pdf). Similarly, the Finnish government launched a fuel cell initiative.

In 2007 the Finnish Funding Agency for Technology and Innovation, TEKES, launched a program to fund research on Fuel Cell development in Finland. Launched with the expectation of demonstrating fuel cell technologies and by these means creating user ready applications and value networks that would facilitate the creation of a fuel cell cluster in Finland. The program commenced as a seven-year effort in 2007.

Focusing on the impact of public policy on research network development, we study the development of Finnish fuel cell research through an ego network analysis. Making the assumption that the focused funding would rapidly develop the network at a country level.

As a dataset we gathered scientific publications from the ISI Web of Science by limiting the search to "fuel cell" or "fuel cells" appearing in the topic or title of a publication. This resulted in a bibliographic dataset of 47 837 publications. The dataset was further divided into to datasets, one five years prior (2003 – 2007) to the TEKES initiative and one since the initiative started (2008 – 2012). Year 2007 was counted as a prior year as the program was seen being unable to impact publication activity during its first year.

The datasets were studied with Bibexcel, Ucinet and NetDraw softwares to create a view on the contry level co-authorship. In addition, an ego network was created by

publications with Finnish authors. The two datasets where thereafter compared through ego network density measures and visualisations seen in Figure1 and Figure 2.
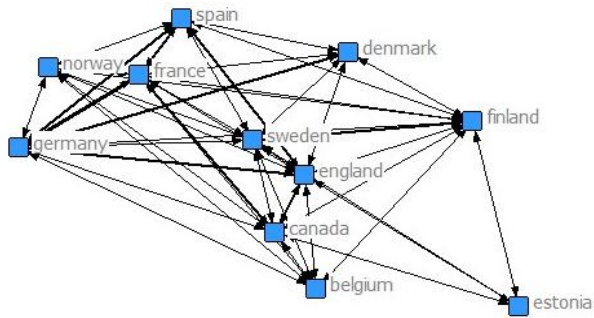

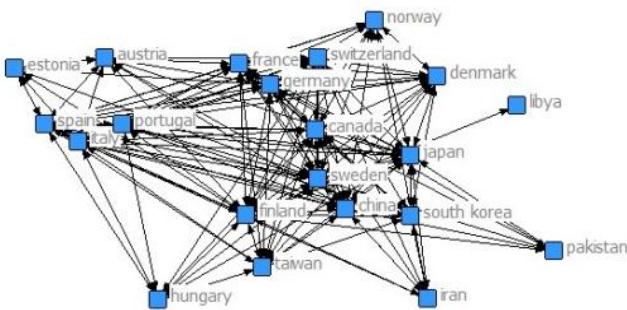Figure 2: Finland ego network - years 2003 - 2007.

Figure 1 Finland ego network - years 2008 - 2012.

The size of the ego network has increased significantly, introducing new countries to the Finnish research network. Using the ego network density measures we see that the density of the Finnish network has lowered from 75,56 to 61,58 between the datasets. Similarly the reach efficiency, two-step reach divided by size, has diminished from 24,48 to 14,64. Analysing the brokerage Finland holds in the network, the measures indicated a modest increase in normalized brokerage from 0,24 to 0,38.

Summarising, the results showed that the effect of increased funding was limited. Although volume increased significantly, other measures such brokerage did not have a similar effect.

The Finnish research network has increased in size and connections among nodes, but to which extent the development is the result of increased funding remains unknown. Doulbing the number of research partner countries can be argued to have a positive impact to the Finnish reseach effort. However, the trend of lowered density and reach efficiency can however be challenging – if added resources lower the relative output.

The study suggests that the focused funding and the rapid development of a ego network in a country level is challenging. Size might increase, but the density measures used to further analyse the quantitative data might show conflicting results.

This study is limited by its case study nature – focusing only o Finland. For a more comprehensive view, countries with similar programs funding fuel cells should be studied. In addition, a third dataset focusing on the time after the TEKES program could reveal further developments.