Discipline Mapping

Mari Jibu[1], Wataru Souma[2], Yuji Fujita[3], Kazuhisa Takei[3]
[1] Department of Database of Information and Knowledge Infrastructure, Japan Science and Technology Agency (5-3, Yonbancho, Chiyoda-ku, Tokyo 102-0081 JAPAN)
[2]College of Science and Technology, Nihon University (7-24-1, Narashinodai, Funabashi-shi, Chiba 274-8501, JAPAN)
[3]Turnstone Research Institute (1-20-12, Nishimikado, Kamakura, 248-0004, JAPAN)

1. Introduction:

Measuring Innovation is one of the most important issues for evidence-based innovation policy making. Innovation is "a highly interactive and multidisciplinary process" and measuring innovation looks at "how the scientific and research landscape is being configured by convergence, interdisciplinary and the new geography of innovation hot spots", according to Innovation Strategy proposed by OECD[1]. The scientific and research landscape is called "Maps of Science" or "Mapping science." Those maps are available for illustrating how cross-disciplinary discussions verify the state of progress, using co-citation analysis, clustering, network of scientific journals and online behavior of scientists accessing of different media. Here we show mapping science which is the relational network of subjects indexed in Thomson Reuter's Web of Science. Inter subjects distances are calculated according to their co-subjects similarities.

2. Analytical Method

2.1 Analysis

This dataset, containing around 39,277,701 papers and 728,797,305 citation links, was extracted from Thomson Reuters "Web of Science" from 1981 to 2011. Each paper is tagged by at least one (possibly more) of the 272 subjects as its attribute. We counted the number of the papers those have more than one subject tags; which serves as the size of inner join between two subjects. The result should be a size of 272*272 table, obviously. The distance index between two subjects was obtained as the Jaccard index, using following formula.

$$\mathrm{J}(\mathrm{A},\mathrm{B}) = |A \cap B| / |A \cup B|$$

where J is the Jaccard index, A and B are subjects.

2.2 Visualization

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[1] OECD, The OECD Innovation Strategy Getting a Head Start on Tomorrow (2010)

There are two steps as following: The first step is to obtain the "distance" between the objects to be plotted (usually onto an Euclidean plane). The second step is to generate the coordinates which reflects the "distances" obtained in the first step. We converted the index values, J to have the uniform distribution and obtained the lot coordinates, applying classical multidimensional scaling[2].

3 Discipline Map:

Figure1 shows discipline mapping which Scalable Vector Graphics[3] is used.

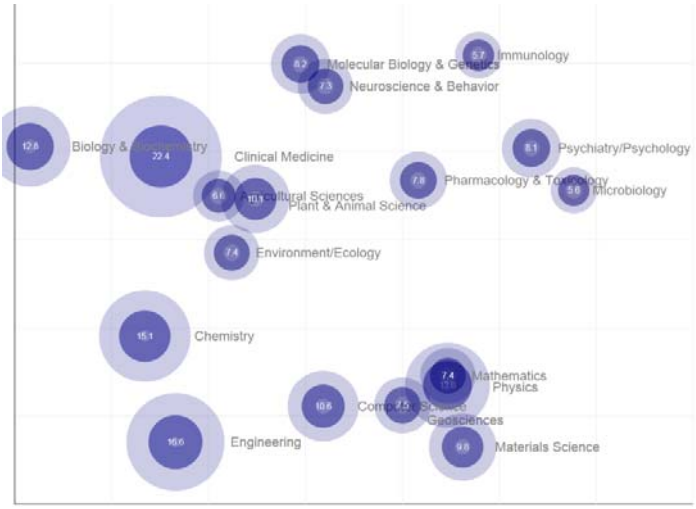

Figure1. Discipline mapping

Legend: Nodes: Subject, Node area size: Number of papers published

Source: Thomson Reuters "Web of Science"

Pairs of subjects, such as Mathematics and physics, Agricultural Science and Plant & Animal Sciences, have regions of contiguity. A region which was a region of overlap between two established subjects can develop into an independent subject, for example, mathematics and physics can develop into mathematical physics.

4 Conclusion:

This discipline map provides a very graphic means of perceiving the influence relationships between subjects, interdisciplinary area. However, those interdisciplinary areas are evolving over time, we have to track the evolution of interdisciplinary over time and provide essential indexes for future investigations.

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[2] Borg, I., Groenen, P. (2005). *Modern Multidimensional Scaling: theory and applications* (2nd ed.). New York: Springer-Verlag. pp. 207–212.

[3] http://www.w3.org/Graphics/SVG/ (Accessed July 30, 2012)