

Analysis of Patent Collaboration Patterns for Emerging Technologies: A Case Study of Nano-Enabled Drug Delivery

Jing Ma, Xuefeng Wang, Donghua Zhu and Xiao Zhou

School of Management and Economics, Beijing Institute of Technology, Beijing, China

Email: majing881003@163.com

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Introduction

For emerging technologies, such as Nano-Enabled Drug Delivery (NEDD), collaboration acquires a special significance for technology innovation and development. Companies, academic teams, and organisations play important roles in collaborative networks. A principal characteristic of emerging technologies is instability, and this requires companies and academic researchers to conduct more active research activities to catch up with the changes of technology and market. Collaborative networks accelerate the knowledge flow and technology diffusion (Singh, 2005). This can improve innovation efficiency and the development of industry.

Data and methodology

We conduct a case study with data from the Derwent Innovation Index (DII) in the field of NEDD. We develop a dataset from 2000 to 2012, and finally, we obtained 8426 raw records. The data are cleaned using VantagePoint software. We construct the network by using co-occurrence of assignees. For these collaborative patents, they are assigned to at least two organisations. With Social Network Analysis (SNA), we try to explain three questions.

Q1: who are the key assignees in this network and what are their characteristics?

Q2: how does this network evolve?

Q3: why do some organizations repeat their collaboration?

We use two indicators to assess these assignees, degree centrality and betweenness centrality. We also try to find a core component that dominates and analyze its evolution. During the analysis, we consider organisation type as a factor. And we want to validate whether attitudes toward collaboration differ among companies, academic teams, and other kinds of organizations that come from different countries. In this part, we conduct the analysis with the help of UCINET 6.

Results

For question 1, we calculate the degree centrality and betweenness centrality for each node separately, and the results are not parallel. In Table 1, most organisations with high degree centrality are academic or research institutes, including universities. This result inspires us that in NEDD these research institutes and universities form the basis of constructing the whole network. For betweenness centrality, the result shows that companies are more significant from this perspective. In the collaborative network,

they play the role of brokers more (Badar, 2013). And they are better at obtaining technology and knowledge from various sources for commercial and practical purposes.

Table 1 Top 10 assignees in terms of degree centrality

Assignee	DII Code	Degree centrality	Country	Type
CNRS CENT NAT RECH SCI	CNRS	59	FR	A
INSERM INST NAT SANTE&RECH MEDICALE	INRM	33	FR	A
US DEPT HEALTH&HUMAN SERVICES	USSH	33	US	G
MASSACHUSETTS INST TECHNOLOGY	MASI	26	US	A
UNIV CALIFORNIA	REGC	21	US	A
NAT AGRIC&FOOD RES ORG	IASC	20	JP	A
NAT INST ADVANCED IND SCI & TECHNOLOGY	NIIT	20	JP	A
INST PASTEUR	INSP	18	FR	A
UNIV TOKYO	UYTY	17	JP	A
UNIV WASHINGTON	UNIW	16	US	A

Notes: Country stands for where headquarter is.

For type, C is company, A is academic or research institute, and G is government department.

For question 2, we use the one giant component in the network with 750 assignees to analyze how the network evolves. We observe the changes of this giant component every two years. From 2000 to 2012, the number of nodes in the giant component rise from 105 to 750. At the same time, the network becomes more and more compact, with the number of ties increasing from 152 to 2370. Even though the density of the whole component in 2012 is only 0.84%, it has maintained continued growth. This reveals a further potential in this field that more extensive, deep collaboration will turn up.

For question 3, we list the key collaborations that repeat at least 5 times. These principal collaborations are generally divided into three groups -- merger and shareholding, academic, and industry-university-research cooperation. In fact, long-term and stable collaboration is localized and limited in this field. The whole field needs more extensive and deep cooperation.

Conclusions and discussion

Answering the three questions, we analyzed the topological properties and characteristics of the cross-organisational collaborative network in NEDD and figured out the key organisations from different perspectives. To further this study, more attributes of assignees and the direction of technology and property transfer should be considered.

References

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