Identifying Potential R&D Partners: Combination of Technology Complementarity and Absorptive Capacity

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In current fiercely competitive environment, firms are compelled to integrate external technology to sustain their innovation capability through collaboration. In order to achieve desired innovation, it is essential for firms to identify potential appropriate R&D collaborators. Previous research on identifying potential partners mostly focused on technology similarity (Angue et al., 2013) or enterprises' acquisition and development ability (Jeon et al., 2017), but ignored the importance of technology diversification for innovation. Considering this, Wang (2012) explored complementary technology to identify potential R&D partners, yet neglecting the fact that too much heterogeneity hinders enterprises' absorption thus lower innovation performance. To bridge these gaps, we proposed a systematic framework to help enterprises choose appropriate R&D partners by combining technology complementarity with enterprises' own absorptive capacity.

As shown in Figure 1, the proposed framework involves three perspectives:

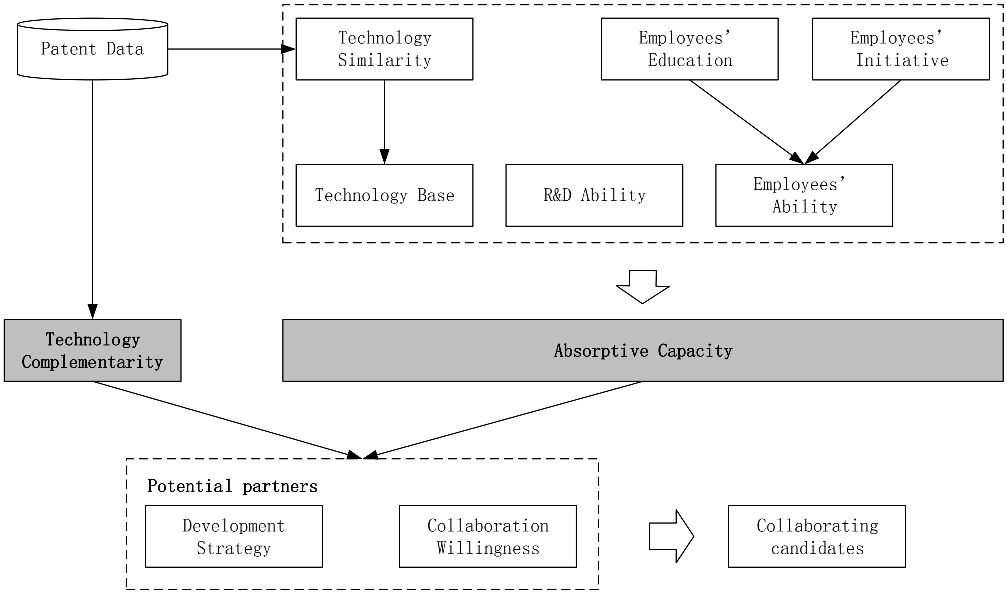

Figure 1 Process of identifying targeted R&D partners

(1) Measuring Technology complementarity

Wang (2012) have used association analysis to mine the interaction between different technologies at the USPC-class level and thus identify complementary technology. Different from this, we proposed an improved method to measure technology complementarity using IPC class based on its conception focusing on different narrowly defined areas of technology within a broadly defined area of technology that they share (Makri et al., 2010). The detailed measurements of technology complementarity is as follows:

$$\text{Complementarity}(\text{A} \leftarrow \text{B: technology complentarity of company B to A}) = \sum_{IPC_4^{i=1}}^{n} \left(\frac{NIPC_6\ B\ involves\ in\ IPC_4^i - NIPC_6\ both\ A\&B\ involves\ in\ IPC_4^i}{NIPC_6\ in\ IPC_4^i - NIPC_6\ A\ involves\ in\ IPC_4^i} \times \frac{PN\ of\ IPC_4^i}{PN} \right) (0 < Complementarity < 1)$$

In particular, n means the number of IPC4 in the certain technical field, IPC_4^i means technical class i at IPC4 level, $NIPC_6$ indicates the number of IPC6, PN is the number of all patents in the whole field, $PN\ of\ IPC_4^i$ indicates the number of patents involved in technical class i at the level of IPC4. Notably, technology complementarity of company B to A is quite different from A to B.

(2) Evaluating enterprise's own absorptive capacity

Cohen and Levinthal (1990) believed that enterprises' absorptive capacity is a function of prior related knowledge and is related to organizational learning ability, and consider

R&D investment as the indication of importance of absorptive capacity. We consider the firm's own absorptive capacity at three aspects: ①the technology similarity with external enterprises as knowledge base; ②R&D ability as potential absorptive capacity; ③employee's absorptive ability: employee's education as well as employee's initiative.

In this part, we use a firm's R&D expenditures and R&D intensity in recent years as a proxy to indicate its potential absorptive capacity and take employees' highest education degree as their education level. The employees' initiative indicates their attitude towards new knowledge, and it is expected to provide by their managers through questionnaire. The detailed measurements of technology similarity is as follows:

We denote patent portfolio in a certain field of company i as a technical class vector $V(x_i) = \{p_{i1}, p_{i2}, \dots p_{ij} \dots p_{im}\}$, m is the number of IPC6 involved in the whole field, p_{ij} denotes the number of patents of company i involved in technical class j. All companies' patent portfolios can be denoted as $X_i = \{x_1, x_2, \dots x_n\}$. We then use the cosine measure to calculate the categorical similarity between two patent portfolios x_i and x_k as follows:

$$\mathrm{CS}(x_i, x_k) = \frac{V(x_i) \cdot V(x_j)}{|V(x_i)||V(x_j)|}$$

Where $|V(x_i)|$ can be calculated below:

$$|V(x_i)| = \sqrt{{p_{i1}}^2 + {p_{i2}}^2 + \cdots + {p_{im}}^2}$$

(3) Exploring potential partners' collaborating willingness and development strategy

Tracing the aimed partners' willingness to cooperate and their recent development strategy can help firms locate potential collaborating candidates further. We explored aimed partners' collaboration intensity to judge whether they are willing to cooperate with others. The development strategy can be traced through recent applied patents and strategy information from their annual report and other reports.

This paper used a patent dataset of 3D printing as a case study. Finally, we will provide potential appropriate partners' information for enterprises with different kind of combination of technology complementarity and their absorptive capacity. Comparing with single-perspective methods, the framework proposed in this paper stressed the importance of both technology complementarity and absorptive capacity. By evaluating own absorptive capacity, appropriate partners with complementary technology can help extend their scope of invention search and create higher quality inventions.

Reference:

Angue, K., Ayerbe, C., & Mitkova, L. (2013). A method using two dimensions of the patent classification for measuring the technological proximity: an application in identifying a potential R&D partner in biotechnology. *The Journal of Technology Transfer, 39*(5), 716-747. doi:10.1007/s10961-013-9325-8

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*(1), 128-152. doi:10.2307/2393553

Jeon, J., Kim, J., Park, Y., & Lee, H. (2017). An analytic network process approach to partner selection for acquisition and development. *Technology Analysis & Strategic Management, 29*(7), 790-803. doi:10.1080/09537325.2016.1241873

Makri, M., Hitt, M. A., & Lane, P. J. (2010). Complementary technologies, knowledge relatedness, and invention outcomes in high technology mergers and acquisitions. *Strategic Management Journal, 31*(6), 602-628. doi:10.1002/smj.829

Wang, M. Y. (2012). Exploring potential R&D collaborators with complementary technologies: The case of biosensors. *Technological Forecasting and Social Change, 79*(5), 862-874. doi:10.1016/j.techfore.2011.11.002