# 25 : __ __ __

# Interorganizational Collaboration and The Locus of Innovation: Central connectivity


Professor Christian Bach, Alexandra Escalante
Department of Technology Management, School of Engineering
University of Bridgeport, Bridgeport, CT


## 1.Collaboration and Organizational Learning

### Introduction

In this case analysis, the authors contend that when knowledge is widely expanding, new information is needed, and availability of internal resources is limited or difficult to evaluate, organizations reach out to external alliances in search of relevant support to deal with uncertainty and issues arising from environmental changes. Four hypotheses were presented and tested on a sample of biotechnology firms over a five year period (1990-1994).

### Learning through Networks

**Hypothesis**

**Hypothesis 1**: Collaboration with alliances and experience would generate more alliances, and network expansion.

**Hypothesis 2.** Collaboration, experience, and network expansion increase central connectivity.

**Hypothesis 3**: Central connectivity and network collaboration experience increases firm growth.

**Hypothesis 4:** Central connectivity increases collaboration with alliances.

### The Biotechnology Industry

Biotechnology is a relatively young science based industry and the hypothesis has been derived in this context. The work of Watson and Crick in the field of molecular biology in the early 1950's had greatly contributed to subsequent developments in the field. Biotechnology can impact various other scientific fields. This type of technology has been commercially exploited with sales growing in millions.

## 2. The Method

**Data.** This empirical analysis was conducted to explain the organizational agreement system that shapes learning in biotechnology. The agreements were legitimate contracts that bounded companies together and involved mutual expensive investments. A relational database containing separate files for human therapeutics and diagnostics, the inter-organizational agreements and the parties involved were used. The data was compiled using Bioscan, an independent industry directory that provided information about different types of companies, their products and current research. Other industrial directories were also consulted to fill in the missing information gap. A sample of about 225 independently owned companies was gathered in the research-driven of Dedicated Biotech Firms (DBF) in the field of human therapeutics.

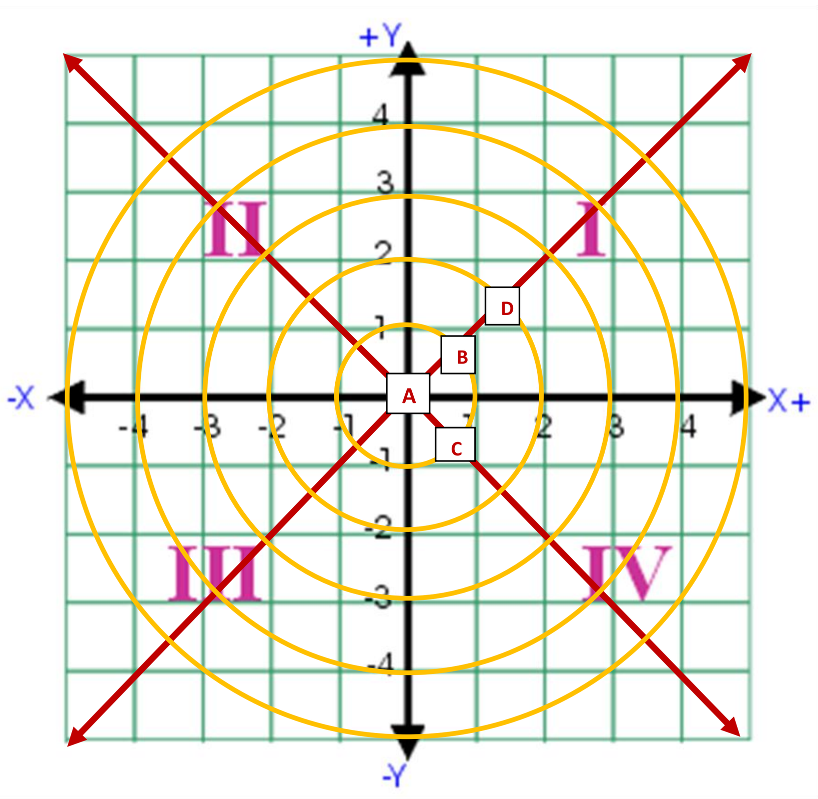


Figure1- Central Connectivity

### Operationalizations and Measures

**Dependent variables** are based on Hypotheses 1-4 which consists on the diverse increment of alliances, central connectivity and rate of growth indicated as follows:

**Number of R&D ties at time t + 1** - The number of active Research and Development (R&D) alliances of X firm.

**Number of non-R&D ties at time t + 1** - Passive R&D Companies. **Number of diverse ties at time t + 1-** The network portfolio diversity reflecting the number of times X firm engaged in collaborative activities per year and it's expressed by Blau's index of heterogeneity formula. Y= 1-∑p2 (each # of collaborative project squared per year).

**Central connectivity at time t + 1** -Connection between 2 DBF's was measured using UCINET IV and counted as either a direct tie (degree 1), when firms were directly connected and indirect tie (degree 2), when firms were connected through a common partner, As shown in Figure 1, firms B & C have a direct tie with firm A and connection level 1, but firm D has an indirect tie and a level 2.

**Membership in the main component at time t +1** - N groups of firms that are connected to an X firm in the group of degree 1 or distance 2.

**Degree of centrality at time t + 1** was measured depending on the number of N firms connected to an X firm, regardless the strength of their connection.

**Closeness centrality at time t + 1** was computed as the reciprocal of the sum of the degree of distance between firms and their direct access to other firms in the network.

**Growth at time t + 1** was measured using the size and company ownership status method. Size was determined by the total number of employees. Ownership status was verified by the firm publicly-traded condition.

### Independent variables

**Collaborative R&D experience at time t +1** was computed from the time the firm established the alliance minus the first date.

**Non-R&D network experience at time t + 1** was counted from the time the firm established a tie for any non-R&D purposes.

**Control variables** for age and size were used to prove diversity and centrality validity as well as to minimized errors, and in order to assure that they could be treated as outcomes rather than predictors of the way in which networks behaved.

### Statistical methods

Variables were measured within the firm using a regression statistic analysis. DBF were observed for a five years time period instead of using a random sample. To reduce the effect of conditions that could not be determined or observed at the time, fixed variables were used to control two assumptions the were considered : *1st assumption:* Learning gradually occurs within organizations and the actors are the recipient of knowledge. For instance, large firms have more R&D connections and diverse portfolio network because of previous successful experiences. To reduce the unobserved differences among firms, a dummy variable for each firm was used to control the deviation between the dependent and independent variables within firms. *2nd assumption:* Learning engages firms and networks in a joint co-evolution. Using a "fixed-effect specification equation, variables were fixed to isolate the effect of the firm and the year.

## 3. Results

The findings supported the following:

| Hypothesis | R&D ties | non-R&D ties | Diverse ties | Central connectivity | Experience | Growth |
|---|---|---|---|---|---|---|
| 1 | + | = | = | | + | |
| 2 | + | | + | = | + | |
| 3 | | | | + | + | = |
| 4 | = | | | + | | |

Table 2- Hypothesis Results

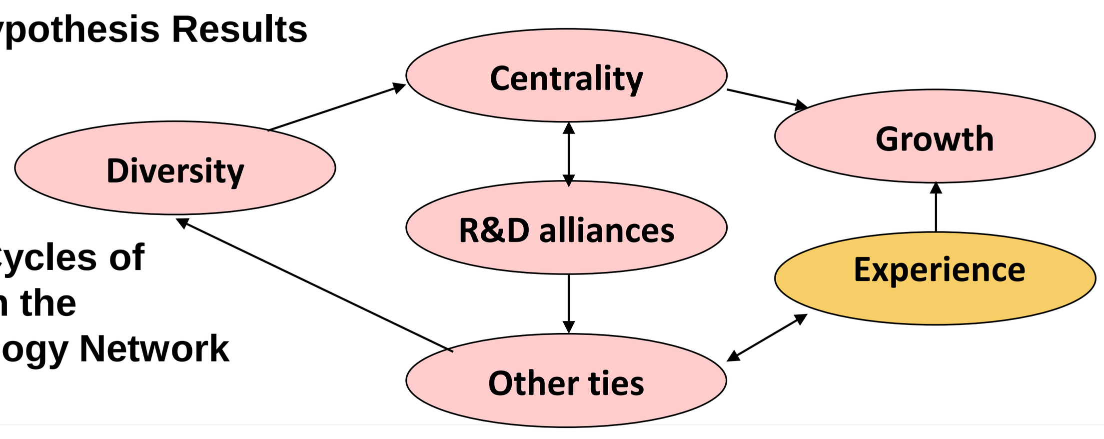


Figure 3- Cycles of Learning in the Biotechnology Network

***Hypothesis 1:*** The positive effects of R&D collaborations was shown on finance, marketing, clinical, investment, and supply. It supported that collaborative R&D and experience generates diverse ties and an increment on diverse ties. It did not show that an increase in experience would increase the number of Non-R&D ties.

***Hypothesis 2:*** The positive effect of central connectivity is shown by the degree of closeness and centrality as well as membership component of the R&D, Non-R&D and diverse ties.

***Hypothesis 3:*** The degree-centrally had a positive correlation on the firm growth showing an increase in the firm size and publicly traded status.

***"Hypothesis 4:*** The number R&D ties were considerably elevated. The coefficient of correlation between closeness centrally and R&D ties were significantly high scoring at or beyond the 0.5 level.

**Firms with ties:**

- Were older and larger, suggesting that firms with ties tend to grow faster than firms without ties
- Opted to continue a relationship with their old alliances after their agreement ended.
- Initiated different projects with the same alliance
- Showed significant growth
- Increased new diverse ties
- Were publicly traded at a larger percentage than firms without ties

**Firms without ties**

- Dropped by 50%
- Were rare

## 4. Conclusion

This analysis supports the notion that collaboration has a significant effect on the growth of networks when relevant information is widely expanded, but unavailable within the internal environment. The authors emphasize that a collaborative interconnectivity between networks fosters knowledge, helps firms co-evolve in the learning process and triggers innovation. At the time this study was completed is was still early to make additional predictions in the Biotech science field. Many of the founding firms in the business did not yet reach the 20 years. The result of the study was limited to companies that started after 1990. Therefore, the networking pattern that developed within the five years period encompassing the study was yet unknown. Current results show that biotech firms can benefit from generating alliances, but the tangible outcomes of the network ties can not be simply determined. The findings show that age and size did not affect the pattern of collaboration. Age did not predict experience, and size was only an outcome in the networking process. Some of the benefits of the general practice of collaboration include: increased collaborative project management skills, competencies, new project awareness, central connection as well as enhanced reputation (Powell, Koput, & Smith-Doerr, 1996). Although the study was conducted about fifteen years ago, increasing literature continues to corroborate with the fact that "*Collaboration is the new competition*."


Powell, W. W., Koput, K. W., & Smith-Doerr, L. (1996). Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology. *Administrative Science Quarterly, 41*(1), 116-145.