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# Mechanism Design in Scientific Research Collaboration between Library Consortium and R&D Institutions

Haidong Yu [a, *]

[a]*Library, China Three Gorges University, 8 Daxue Road，Yichang 443002, China*

**Abstract**

Knowledge spillover not only has economies of scale, but also has economies of scope in scientific research collaboration. The paper set out to provide a framework of mechanism design of synergies gained from knowledge alliance made up of library consortium and R&D institutions. Firstly, it proposed that the formation the knowledge cooperation was mainly due to complementary resource advantages achieving, cost and risk sharing, and mutual learning. Secondly, it analyzed relational game in the knowledge alliance cooperation relations and proposed a conceptual model. Lastly, the paper put forward a relational mechanism which provided a theoretical reference for R&D institutions to enhance their knowledge alliance partnership.



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*Keywords:* mechanism design，library consortium，scientific research collaboration;

## 1. Introduction

Cooperation and resource sharing are the goal and orientation that libraries are always pursuing. Library consortium is the effective organization, which makes resource sharing between libraries come true, and is also the developmental pattern and direction for libraries in the digital era. Library consortium can make libraries win the day in the changeable informational circumstances, such as scientific research collaboration, but the instable factors and many risks existed in the library consortium are the obsession that makes the organizers and participants of consortium worried at all times, which influences the enthusiasm of partners and the collaboration benefits to a great extent. Therefore, it is an important problem to research the mechanism in library consortium and their corresponding preventing countermeasures.

There always exists knowledge transfer among R&D institutions by the help of medium platform of library

* Corresponding author. Tel.: 13618684632.
*E-mail address:* hustyhd@163.com



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consortium, which forms a knowledge alliance. In the knowledge alliance, knowledge transfer and innovation cannot be parted，the process of knowledge transfer is the process of dynamic knowledge innovation. The effectiveness of knowledge transfer directly affects the ability and effect of knowledge innovation. The knowledge alliance between members for knowledge resources is not balanced and there are certain knowledge potential difference，which forms the flow of knowledge. Alliance between members of the transfer of knowledge includes carrier layer, information layer, knowledge layer and ability layer. The patency of construction knowledge transfer channel can guarantee the virtuous cycle of knowledge. The knowledge flow is a dynamic process of circulation with the characteristics of the planning，the complexity and permanence[1-5].

Knowledge spillover not only has economies of scale, but also has economies of scope. From the perspective of knowledge spillover, the paper studied the relational game between library consortium and R&D institutions. Firstly, based on the existing researches, the paper proposed that the formation the knowledge cooperation made up of library consortium and R&D institutions was mainly due to complementary resource advantages achieving, cost and risk sharing, and mutual learning. Secondly, the paper analyzed relational game in the knowledge alliance cooperation relations and proposed a conceptual model. Lastly, on the basis of the above, the paper put forward a relational mechanism which provides a theoretical reference for R&D institutions to enhance their knowledge alliance partnership, and thus contributes to the sustainable development of knowledge alliance.

## 2. Model and case analysis

In scientific research collaboration, if library consortium wants to announce a new collaborative project, it first announces a constraint condition of the plan at the same time. After observing the library consortium's demand and plan, R&D institutions make some level of investment in R&D of that project. The output of R&D institutions' investment is innovation. The library consortium then checks the innovation of R&D and chooses a R&D institution to join scientific research collaboration. So the process of the game is that the library consortium first announces a reasonable benefit to R&D institutions' investment level, and then each R&D institution chooses an investment level. It thus forms a game.

Assume there are $n(n \geq 2)$ R&D institutions compete in the game, aiming at obtaining the contract of the collaborative project. R&D institution $i's$ probability of obtaining the contract is $q_i$, when its investment level is $\mu_i$, library consortium gives R&D institutions' investments in the contest according to an ex ante ratio $\lambda$, that is R&D institution $i's$ reasonable configuration function which is $y(\mu,\lambda)$. Assume that the expected valuation to R&D institution $i$ is $\tau_i$ and the optimal investment scale that the library consortium desired is $\mu$. The problem of the library consortium is how to judge $\lambda$ to ensure that every R&D institution's optimal investment level in the contest game is $\mu$, when there exists a functioning scientific research collaboration [6].

Definition. $(\sigma,\alpha,\mu^*)$ is a perfect Bayesian equilibrium (henceforth PBE) if:

(1) for any $i \in \Gamma$, any $t \in T$ and any $m_i \in M_i$, $G(\alpha(\sigma(t)),t)R_i(t)G(\alpha(\sigma_{-i}(t),m_i),t)$.

(2) if $m \in \sigma(T)$, then $\alpha(m) \in \arg\max_{a\in A} \sum_{t\in\sigma^{-1}(m)}^{n} \mu(t)u_0(G(a,t),t)$.

(3) if $m$ does not satisfy (2), then $\alpha(m) \in \arg\max_{a\in A} \sum_{t\in T} p(m)(t)u_0(G(a,t),t)$, where $p(m) \in \Delta(T)$ is arbitrary.

(4 )if $m$ satisfies (2), then $\mu^*(m) = r(\sigma^{-1}(m))$, otherwise $\mu^*(m) = p(m)$.

To make the calculation easy, we assume that R&D institution 1's valuation is $\tau$, while R&D institution 2's valuation is $\tau_H$ or $\tau_L$. Obviously, R&D institution 1 hopes his or her cooperative partner valuation is $\tau_H$. If R&D institution 2 knows its own valuation clearly while R&D institution 1 only knows that with probability $p$ R&D institution 2's valuation is $\tau_H$ and with probability $1-p$ it is $\tau_L$. This means that R&D institution 1's estimate about R&D institution 2's type is $[p,1-p]$. Define $P$ is probability of winning "bid" of each institution.

Firstly, R&D institution 2's optimal problem is

$$\underset{m_2}{Max}\ I_2 = (1-q_2)(\lambda^*\mu_2 - \mu_2) + q_2(\tau_2 + \lambda^*\mu_2 - \mu_2) \tag{1}$$