

Construction Method of Integrity Mechanism of Scientific and Technological Achievements Transformation between Universities and Enterprises

Wei Shao¹, Wenjie Lu² and Jingwen Wu^{2,*}

¹Research Office, Shanghai University, Shanghai 200444, China;

²School of Management, Shanghai University, Shanghai 200444, China.

*Corresponding Author: jw_wu@shu.edu.cn

Abstract

Through the discussion of the role paths among the subjects of science and technology achievement transfer, the paper proposes an overall framework of the integrity mechanism of science and technology achievement transfer between Chinese universities and enterprises. And the paper formulates three integrity mechanisms for the key links under the framework: the integrity mechanism of science and technology achievement output phase - university research integrity file mechanism; the integrity mechanism of science and technology achievement transfer process - the credibility evaluation mechanism of enterprises, universities and intermediary organizations; benefits distribution of the integrity mechanism of science and technology achievement transfer - TPM agreement mechanism. Through the inner connection of these three mechanisms, the construction method of science and technology transformation integrity mechanism between universities and enterprises is studied.

Keywords

Transformation of science and technology achievements, university-enterprise cooperation, integrity mechanism construction, TPM agreement mechanism.

1. Introduction

Integrity mechanism is a concept that emerged after the national requirements for the construction of an honest society were put forward, and the term "trust mechanism" was commonly used before. From the legal point of view, integrity is a code of conduct attributed to civil law, which first originated from Roman law, and many western countries have followed the provisions of Roman law on integrity in civil law. Integrity is the most basic rule required by the state and society, and it is also an important element in the basic principles of Chinese civil law. From the perspective of the market, good faith is the basic code of conduct in the market economy. The market economy depends on the "trust". No trust is chaos, and the market economy of no "trust" is no "marketing". Therefore, good faith is the golden rule of modern market economy and the combination of rational commitment and the performance of the agreement between market entities. In general, there are four main factors in the integrity mechanism: the two sides of trust, called "trustor" and "trustee"; the third-party factor of trust, called "trusted third party "; and the above three factors as the subject of the environment, background and other circumstances, collectively referred to as the "environment". It is generally believed that the integrity mechanism of the transformation of scientific and technological achievements between schools and enterprises is divided into five links. First, the research and output phase of the results. Second, the output of scientific and technological achievements. Third, the introduction of scientific and technological achievements by

enterprises. Fourth, the practical application of scientific and technological achievements. Fifth, feedback and re-innovation phase.

2. The core elements of the integrity mechanism for the transformation of scientific and technological achievements between universities and enterprises

Four important factors are involved in the integrity mechanism: the trustor, the trustee, the credible third party and the environment. Introducing them into the process of science and technology achievement transformation between schools and enterprises, the four elements are as follows.

2.1. Trustor (Trustee) - Enterprise

In the integrity mechanism of science and technology achievement transformation between schools and enterprises are both the trustor and the trustee.

The enterprises are the trustors when they introduce the scientific and technological achievements at the beginning. Enterprises are the trustees when they introduce scientific and technological achievements and carry out benefit distribution and technology re-innovation with universities. Once the cooperation between enterprises and universities starts, the relationship of trust between enterprises and universities also starts to change. After the technology is applied to production, it is difficult for universities to control the economic benefits generated by the technology, and enterprises have priority in the benefit distribution. Once the enterprises transfer the profit through associated transactions, universities will lose their vested interests in profit distribution. Once the lack of trust between universities and enterprises in transformation of results arises, it will seriously frustrate the cooperation enthusiasm of both sides and destroy the win-win situation of cooperation. When the cooperation between universities and enterprises enters the stage of reinvention of scientific and technological achievements, it is generally the stage of joint development of both sides, with universities providing technical support and enterprises providing pilot sites and production practice funds, etc. At this stage, if the enterprises deliberately delay the deadline of fund payment, it will seriously affect the progress of the project. And the universities will face the risk of wasting the funds and human resources. In addition to the clear regulation of this issue in the contract of cooperation between the two parties, the basis of cooperation for universities is trust in companies.

2.2. Trustee (Trustor) - University

From the perspective of economic entities and moral constraints to analyze the position of universities in the transformation of scientific and technological achievements, universities are actually more in the identity of trustors. First of all, enterprises are relatively pure economic entities, and their characteristics of profit maximization determine that they are more likely to make "breach of trust" in the transformation of scientific and technological achievements. The prerequisite and ultimate purpose of all choices of enterprises is to enhance economic benefits. Therefore, in the transformation of scientific and technological achievements between universities and enterprises, compared with universities, the entry and exit mechanisms of enterprises are more perfect so that they can get rid of risks more quickly. Secondly, in terms of moral constraints, universities bear more moral constraints compared with enterprises, and the cost of "unethical" behavior is huge. Therefore, there are fewer cases of universities breaking promises in the transformation of scientific and technological achievements, mostly focusing on the falsification of technical achievements and the sticking of knowledge in the process of transformation.

2.3. Credible third party--Intermediary Organization

As a third party organization, it is oriented to the whole society. It serves other research institutes, research groups and even government departments. Here, for the need of the research, we only analyze its characteristics as a third party for the transformation of scientific and technological achievements between universities and enterprises.

Intermediary organization is one of the indispensable and important entities in the transformation of scientific and technological achievements between universities and enterprises. It establishes a platform for technology transaction between universities and enterprises, which greatly promotes the feasibility of transformation of scientific and technological achievements. In the mechanism, the main function of intermediary organization as a credible third party is realized through the following three ways: technology achievement transfer, technology achievement incubation, and option.

2.4. Environment

The situation of the environmental system has an important influence on the transformation of scientific and technological achievements, and multiple subjects such as government, research institutions and venture capitalists have direct or indirect influence on the environment. Among them, the government has the most influence on the environmental system because of its special status. It includes economic environment, policy environment, and legal environment.

2.5. The mechanism of action between the core elements

The four elements of the science and technology achievement transformation mechanism between universities and enterprises are interacting and influencing each other, forming a closely operating system. Firstly, enterprises, universities and intermediary organizations are all in the environment and are directly influenced by it. Secondly, the environment is constantly changed under the influence of enterprises, universities and intermediary organizations. Thirdly, there are action paths among enterprises, universities and intermediaries, which are reversible and related. There are four two-related paths among them: First, the path between universities and intermediary organizations. Second, the action path between enterprises and intermediary organizations. Third, universities and enterprises can realize the transformation of scientific and technological achievements through intermediary organizations. Fourth, skipping intermediary organizations, direct contact between enterprises and universities.

3. Construction of integrity mechanism of science and technology achievement transformation between university and enterprise

3.1. Guiding ideology and the principles to be followed for construction

With the further development of economic globalization and the continuous collision and integration of various ideologies, China has absorbed and introduced many advanced foreign experiences and achievements with an inclusive attitude, which makes us take less detours during the economic development. However, we are still conscious of the fact that the socialist market economy has its own characteristics and the socialist core value system is the ideology to match it. Therefore, in the construction of integrity mechanism, we can neither close the door nor imitate the Western experience completely. We should fully absorb the beneficial experience of the West, bring forth the new through the old and build a mechanism of integrity for the transformation of scientific and technological achievements with Chinese characteristics according to local conditions at the same time. The construction of this mechanism should follow the following principles: the principle of fairness, the principle of efficiency, the principle of gradual progress, and the principle of maximum extent.

3.2. The general framework of the integrity mechanism for the transformation of science and technology achievements between universities and enterprises

The process of transformation of science and technology achievements between universities and enterprises can be divided into three parts simply according to the output, transfer and benefit distribution. These three links are closely interlocked and inseparable in terms of mechanism of action. The integrity mechanisms in the three phases also influence each other, which together constitute the overall framework of the integrity mechanism of science and technology achievements transformation between schools and enterprises. The integrity mechanism of science and technology achievements transformation between schools and enterprises constructed in this paper is under the assumption of national policy support and market stability. Under the overall framework, the integrity mechanism in three important phases is carefully studied. First, the integrity file management mechanism of universities in the output of science and technology achievements. The credibility scoring mechanism in the process of science and technology results transfer. Third, the TPM agreement mechanism of benefit distribution after the output of scientific and technological achievements.

The role between the three main phases is studied in the flow of science and technology results in the integrity mechanism of science and technology results transfer as Figure 1.

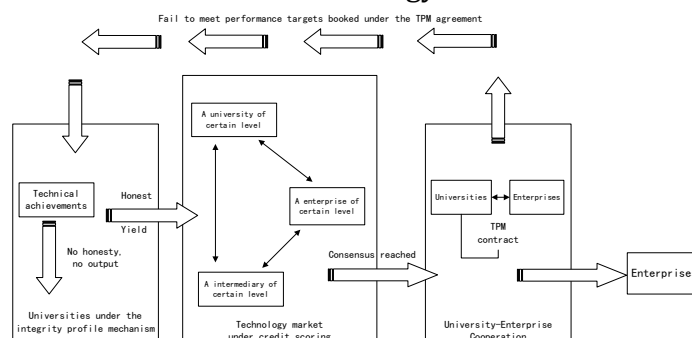


Figure 1. Operation model of the integrity mechanism of science and technology achievement transformation between universities and enterprises

Notes: \Rightarrow indicates the flow of scientific and technological achievements in the mechanism; \longleftrightarrow indicates the mutual relationship between subjects.

As can be seen from Figure 1, when the scientific and technological achievements operate in the university under the role of integrity file mechanism, if they do not meet the integrity requirements, then they will not be produced, like "no honesty, no output" marked in Figure 1. If they meet the integrity requirements, then they will be produced and can enter the technology market under the role of reputation scoring mechanism. At the stage of university-enterprise cooperation, enterprises and universities will establish a TPM agreement to estimate the economic benefits to be generated by the scientific and technological achievements. When the date specified in the TPM contract arrives, if the performance target agreed between the university and the enterprise is not reached, the scientific and technological achievements will be returned to the university and the research and development will be carried out again according to the agreement. If the performance target is reached as expected, the scientific and technological achievements will be traded and the transfer between the university and the enterprise will be completed.

3.3. Integrity mechanism of scientific and technological achievements in the output phase

The output of scientific and technological achievements is the first phase of the process of transformation of scientific and technological achievements between universities and

enterprises. The general phase of scientific and technological achievements output can be divided into four parts: topic selection and project application, management of the research fund use, research process supervision and evaluation after results output. The integrity supervision of these four phases is mainly based on two paths. First, the internal supervision and management of universities. By establishing the integrity file mechanism, universities manage the scientific researchers and scientific research results, and share the integrity file within the universities to carry out joint supervision with other departments. Second, the university committee and other subjects supervise and manage the academic activities of universities, and share the integrity files of universities nationwide through networking. The specific operation mechanism is shown in Figure 2.

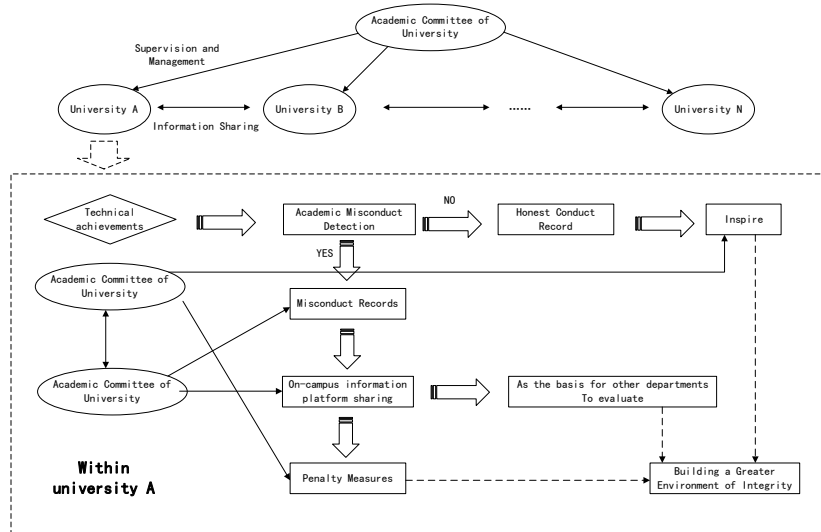


Figure 2. Integrity mechanism of scientific and technological achievements in the output stage - integrity file mechanism

⇔ Notes: indicates the two directions of science and technology achievements in the archive management mechanism of universities. → indicates the behaviors imposed by the science and technology management and science and technology supervision departments of universities on the bearers of science and technology achievements. -----> indicates the implicit roles brought by each path.

In this mechanism, two mutually independent implementation subjects required within the university are the scientific research management department and the scientific research supervision department. The management department carries out the punishment and incentive, and the supervision department carries out the supervision of integrity file management and the sharing work within the university, and the university-wide information sharing is used to realize the supervision and control of scientific research integrity issues by all departments of the university. Under the path of dual action of incentive and punishment, it can bring the implicit effect of building a large environment of integrity within the university.

3.4. Integrity mechanism of scientific and technological achievements in the transfer phase

When the scientific and technological achievements are successfully produced and transferred from universities to enterprises, they start to be in the economic environment. The related interested parties increase, and enterprises, intermediary organizations and governments are in the whole mechanism. At this time, the grasp of the problem of integrity should follow the market law and establish a credibility management mechanism oriented to the market and the government as the main macro-control subject.

Through the credit rating score to influence each other's transactions, as well as the degree of enjoyment of relevant preferential policies, using the market mechanism of the principle of survival of the fittest to monitor the integrity of the three interested parties. The operation of the mechanism is shown in Figure 3.

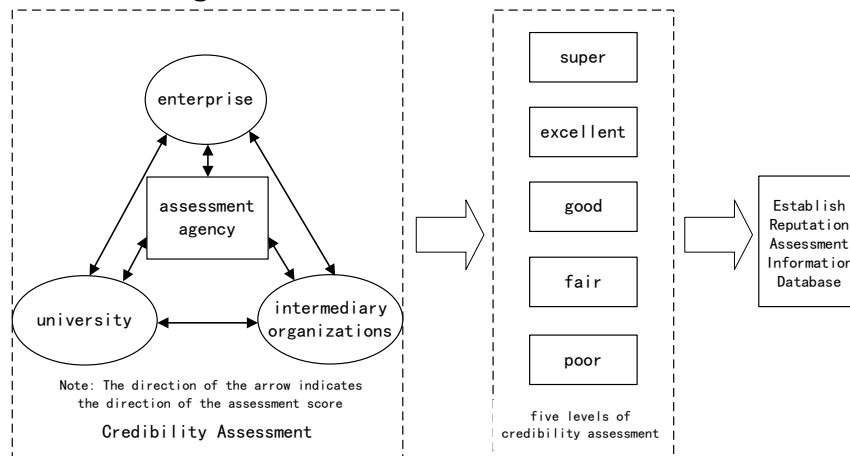


Figure 3. Integrity mechanism of scientific and technological achievements in the transfer process - credibility evaluation mechanism

As shown in Figure 3, in the credibility assessment stage, the three entities score each other based on experience, cooperation history and other factors. In order to avoid any breach of trust in the mutual scoring, there should be a government organization evaluation agency to check and balance through one-way scoring in this stage.

3.5. Integrity mechanism of scientific and technological achievements in the benefit distribution process

Lack of integrity in the process of benefit distribution is one of the main problems in the transformation of science and technology achievements between universities and enterprises. As universities and enterprises are at both sides of the transaction in the process of results transformation, each of them is prone to make a breach of trust in order to maximize their own benefits. The key to solve this problem lies in establishing a benefit and risk sharing mechanism between universities and enterprises, so that the conflict of benefits between universities and enterprises can be changed into the situation of "moving in and out together". In this way, we can fundamentally curb the fraud and concealment between universities and enterprises and achieve a high degree of integrity in the distribution of scientific and technological achievements between universities and enterprises.

TPM (Target Performance Mechanism) agreement refers to the fact that it is difficult to accurately judge whether the scientific and technological achievements provided by universities can realize economic benefits in the process of transformation of scientific and technological achievements between universities and enterprises. Therefore, both parties can only speculate the possible increase of economic benefits according to the available information, and sign a contract based on it. The most important feature of the contract is that it is a kind of betting agreement in which universities and enterprises respectively propose a price that meets their own benefits. Both universities and enterprises put the price discussion of scientific and technological achievements on hold temporarily.

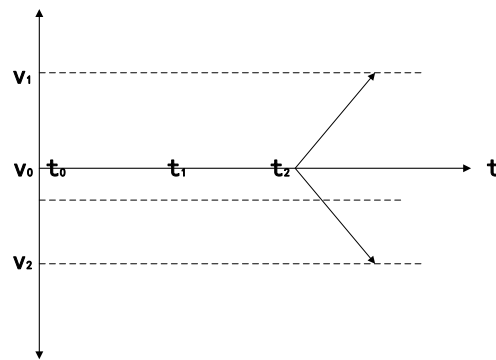


Figure 4. Transaction structure of TPM agreement in the transformation of scientific and technological achievements between universities and enterprises

The horizontal coordinate t in Figure 4 indicates time. The t_0 indicates the point of time when universities and enterprises start to understand each other and prepare to cooperate. The t_1 indicates the time when both parties sign the contract. And t_2 indicates the time when both parties agree in the contract that the performance target should be achieved. The vertical coordinate v denotes the value, and v_0 denotes the actual value of the scientific and technological achievements. v_1 and v_2 denote the two possible values of technological transactions, where $v_1 \geq v_0 \geq v_2$.

When time reaches t_2 , if the performance indicators agreed by both parties at t_1 are achieved, then the technology results will be traded at v_1 and the profit gained by the university will be $v_1 - v_0$. At this time, the enterprise actually buys the technology results at a price that exceeds the actual value of the results themselves and the enterprise loses. But the enterprise has the right to use the technology results and enjoys the economic benefits brought by them.

When the time reaches t_2 , if the performance indicators agreed by both parties at t_1 are not achieved, then the scientific and technological achievements will be traded at v_2 , and the enterprise gets profit $v_0 - v_2$. At this time the enterprise actually pays for less than the actual value of the scientific and technological achievements themselves, and the university loses. But at this time, due to the stipulations at the time of agreement, the university recovers the right to use the scientific and technological achievements.

The TPM agreement stimulates and supervises both the university and the enterprise. It has a good effect on eliminating the information asymmetry between the university and the enterprise in the technology market, reducing the integrity risk of both parties in the cooperation. At the same time, it also makes up for the lack of ability of universities in monitoring enterprises. It is an optional integrity mechanism for the benefit distribution between universities and enterprises in the transformation of scientific and technological achievements.

4. Constraints for the construction of the integrity mechanism of science and technology achievement transformation between universities and enterprises

The integrity mechanism of science and technology achievement transformation between universities and enterprises should be built based on the general background of social integrity, which puts forward a requirement for the construction of the current integrity environment in China. The social integrity system is a necessary condition for the construction of socialist market economy, but the construction of social integrity in China is still in the initial stage. At this stage, the society has improved its awareness of integrity and has an urgent requirement to build an honest society. However, as there are still many economic and cultural constraints at this stage, the integrity society is still to be built in terms of the general national context.

Therefore, the biggest environmental constraint for establishing the integrity mechanism for the transformation of scientific and technological achievements between universities and enterprises is the lack of a large cultural environment of integrity for support.

The integrity mechanism for the transformation of scientific and technological achievements between universities and enterprises has high requirements for the service technical intermediary organizations. Although Chinese intermediary organizations are developing well and the number of organizations is increasing, the quality of existing technical intermediary organizations still needs to be improved compared to the high requirements in the mechanism. A technical chain from information collection to evaluation and analysis to service support has not been built yet. The corresponding supporting infrastructure of university science and technology parks, high-tech science and technology parks, and incubation centers is also slightly inadequate.

Quantitative evaluation is an important part of the establishment and operation of a mechanism, which can clearly and explicitly assess the operation of the mechanism through quantitative indicators to ensure the health and stability of the mechanism in operation. However, as "integrity" is a relatively abstract concept, it is difficult to assign values to its evaluation indicators. The study is prone to "empty lectures" and "paper talk", which is difficult to guide the practice.

5. Summary

The paper defines integrity and integrity mechanism, explains the meaning of the integrity mechanism of science and technology achievement transformation between universities and enterprises. Then the paper analyzes the key contents of the five phases in the mechanism. By defining and analyzing the core elements in the process of transformation of scientific and technological achievements between universities and enterprises, the paths of the interaction between several core elements within the mechanism are visually demonstrated.

Three components of the integrity mechanism of science and technology achievement transformation between universities and enterprises are successfully constructed based on the above. The integrity mechanism of science and technology achievements in the output phase - integrity file mechanism. The integrity mechanism of science and technology achievements in the transfer phase - credibility assessment mechanism. And the integrity mechanism of science and technology achievements transformation benefit distribution phase - TPM agreement mechanism. A comprehensive integrity mechanism is established according to its internal linkage and a specific realization path is formulated.

References

- [1] Albahari A, Pérez-Canto S, Barge-Gil A, et al. Technology Parks versus Science Parks: Does the university make the difference?[[J]]. *Technological Forecasting and Social Change*, 2017, 116: 13-28.
- [2] Aragonés-Beltrán P, Poveda-Bautista R, Jiménez-Sáez F. An in-depth analysis of a TTO's objectives alignment within the university strategy: An ANP-based approach[[J]]. *Journal of Engineering and Technology Management*, 2017, 44: 19-43.
- [3] Balven R, Fenters V, Siegel D S, et al. Academic entrepreneurship: The roles of identity, motivation, championing, education, work-life balance, and organizational justice[[J]]. *Academy of Management Perspectives*, 2018, 32(1): 21-42.
- [4] Belitski M, Aginskaja A, Marozau R. Commercializing university research in transition economies: Technology transfer offices or direct industrial funding?[[J]]. *Research Policy*, 2019, 48(3): 601-615.
- [5] Beyhan B, Findik D. Student and graduate entrepreneurship: ambidextrous universities create more nascent entrepreneurs[[J]]. *The Journal of Technology Transfer*, 2018, 43(5): 1346-1374.

- [6] Cartalos O, Rozakis S, Tsiouki D. A method to assess and support exploitation projects of university researchers[J]. *The Journal of Technology Transfer*, 2018, 43(4): 986-1006.
- [7] Drivas K, Panagopoulos A, Rozakis S. Instigating entrepreneurship to a university in an adverse entrepreneurial landscape[J]. *The Journal of Technology Transfer*, 2018, 43(4): 966-985.
- [8] Fitzgerald C, Cunningham J A. Inside the university technology transfer office: mission statement analysis[J]. *The Journal of Technology Transfer*, 2016, 41(5): 1235-1246.
- [9] Good M, Knockaert M, Soppe B, et al. The technology transfer ecosystem in academia. An organizational design perspective[J]. *Technovation*, 2019, 82: 35-50.
- [10] Horner S, Jayawarna D, Giordano B, et al. Strategic choice in universities: Managerial agency and effective technology transfer[J]. *Research Policy*, 2019,48(5):1297-1309.
- [11] M'chirgui Z, Lamine W, Mian S, et al. University technology commercialization through new venture projects: an assessment of the French regional incubator program[J]. *The Journal of Technology Transfer*, 2018, 43(5): 1142-1160.
- [12] Ng W K B, Junker R, Appel-Meulenbroek R, et al. Perceived benefits of science park attributes among park tenants in the Netherlands[J]. *The Journal of Technology Transfer*, 2019: 1-32.
- [13] Pierrakis Y, Saridakis G. The role of venture capitalists in the regional innovation ecosystem: a comparison of networking patterns between private and publicly backed venture capital funds[J]. *The Journal of Technology Transfer*, 2019, 44(3): 850-873.
- [14] Sengupta A, Ray A S. University research and knowledge transfer: A dynamic view of ambidexterity in british universities[J]. *Research Policy*, 2017, 46(5): 881-897.
- [15] Van Weele M, van Rijnsoever F J, Eveleens C P, et al. Start-EU-up! Lessons from international incubation practices to address the challenges faced by Western European start-ups[J]. *The Journal of Technology Transfer*, 2018, 43(5): 1161-1189.
- [16] Wright M, Siegel D S, Mustar P. An emerging ecosystem for student start-ups[J]. *The Journal of Technology Transfer*, 2017, 42(4): 909-922.