

A Literature Review and Prospect on Influencing Factors of Knowledge Leakage

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ABSTRACT: Knowledge leakage refers to the unconscious or involuntary outflow of internal knowledge to external enterprises. With the development of cooperative innovation, frequent knowledge leakage has an important impact on enterprise competitiveness and innovation performance, and even leads to the loss of core technologies. Therefore, more and more scholars pay attention to this phenomenon. This paper sorts out the literature on knowledge leakage at home and abroad, systematically reviews and comments on the existing research results from the definition, formation and influencing factors of knowledge leakage. Finally, it points out the limitations of existing research, and proposes future research directions, in order to provide reference for the expansion research in the field of knowledge leakage.

KEY WORD: Cooperative innovation; Knowledge sharing; Knowledge leakage; Influencing factors

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I. BACKGROUND OF KNOWLEDGE LEAKAGE

According to the view of knowledge strategy, the core knowledge of enterprises is an important source of competitive advantage (Grant, 1996). Due to the continuous refinement of social division of labor and the increasing complexity of knowledge, a single enterprise cannot satisfy the demand by relying on its internal knowledge resources. It is necessary to acquire the required knowledge technology from the outside of the enterprise to complete the innovation activities (Jantunen et al., 2008). Based on this background, developing cooperative innovation, sharing different knowledge resources, gradually becoming the enterprises to create new value, reduce the cost of innovation and shorten the research and development cycle become the important strategy to rapidly improve the core competitiveness of enterprises (Teece, 1992; Cassiman, Veugelers, 2006). On the one hand, cooperative innovation provides a new way for enterprises to grasp the changing and important market opportunities. On the other hand, cooperative innovation between companies usually requires the sharing of knowledge among the employees of cooperative companies. When the process of knowledge sharing is not properly handled, this sharing behavior will bring considerable risks to the enterprise (Paavo et al., 2018). Enterprises participating in cooperative innovation will expose their core knowledge and technology to their competitors (Hamel, 1991), thus losing their technological advantages and bringing huge economic losses to enterprises.

The existing literature mainly focuses on the positive effects of cooperative innovation on the technological development, innovation performance and market competitiveness of enterprises, but the knowledge leakage caused by cooperative innovation is obviously not discussed. This paper will discuss the concept, formation process and influencing factors of knowledge leakage based on the frontier trend in the field of knowledge leakage research, and then analyze the deficiency of the current research situation of knowledge leakage, based on the analysis of the relevant literature on knowledge leakage at home and abroad. And prospects for future research, in order to provide a reference for future research in this field.

II. CONCEPT AND FORMATION PROCESS OF KNOWLEDGE LEAKAGE

2.1 The Concept of Knowledge Leakage

The research in the field of knowledge management is mainly focused on knowledge acquisition, knowledge sharing and knowledge transfer. The research on knowledge leakage is far from enough, and the definition of "knowledge leakage" has not been unified. There are many different terms used to refer to knowledge leakage, including knowledge permeation (MacDougal, Hurst, 2005), knowledge transfer (Bhattacharya, Guriev, 2004; Huang, 2004; Marti, Fallery, 2005), knowledge loss (Huang, 2004; MacDougall & Hurst, 2005), knowledge disclosure (Bhattacharya, Guriev, 2004) and knowledge leakage (Kuosmanen, 2004).

We classify the definition of "knowledge leakage" in the existing literature according to the object of knowledge leakage, which can be divided into two categories: core knowledge leakage, non-core knowledge leakage and core knowledge leakage. (See Table 1). Under the background of knowledge leakage, most

literatures identify "knowledge" as the core knowledge of enterprises and research the impact of core knowledge leakage on enterprises. Jiang et al. (2013) defined knowledge leakage as the intentional and effective misappropriation or unintentional transfer the private knowledge of the organization to the partner outside the scope of the alliance agreement. According to the definition of Jiang, private knowledge is the knowledge asset, ability and technology that provide the competitive advantage for the organization, which is not possessed by other organizations and has exclusive core knowledge. But one company's core knowledge can be seen by another as non-core, and vice versa. Therefore, when choosing knowledge management strategy, we should not only consider the consequences of leakage of core knowledge, but also consider the possible consequences of non-core knowledge leakage. Frishammar(2015) defined that knowledge leakage is the loss of knowledge that should stay within the boundaries, which leads to "weakening state" and makes the organization lose its competitive advantage and industry status. According to the definition of Frishammar, knowledge leakage includes both core knowledge and non-core knowledge. When the non-core knowledge of an organization becomes the core knowledge of competitors, the outflow of such knowledge will improve competitors' competitiveness and lead the enterprise in a "weakened state" (Anokhin et al., 2011).

Table 1 Knowledge leakage definition classification

Categories	Definition	Researchers
Core Knowledge Leakage	Intentional diversion or unintentional transfer of private knowledge of the organization to partners outside the scope of the alliance agreement	Jiang et al.(2013)
	Information or knowledge that is vital to an organization in an alliance may be lost or leaked, either intentionally or unintentionally, to competitors or unauthorized personnel	Annansingh et al. (2005)
	Risk of loss of the organization's proprietary technology	Lau et al. (2010)
Non-core Knowledge Leakage and Core Knowledge Leakage	Loss of knowledge that should stay within the boundaries, which leads to "weakening state" and makes the organization lose its competitive advantage and industry status.	Frishammar et al. (2015)
	The intentional or unintentional leakage of knowledge to an unauthorized third party	Tan et al. (2016)
	Involuntary or unconscious exchange of knowledge except for collaborative innovation	Alberti et al. (2017)

Although the phenomenon of knowledge leakage has been concerned and discussed in the field of knowledge management, the definition of knowledge leakage has not yet been unified. First of all, the term "knowledge leakage" is generally regarded as having a negative impact in the existing literature, but in Inkpen's(2018) research, "knowledge leakage" is defined as neutral. Knowledge leakage is considered to be negative, when enterprises can control and utilize the knowledge leakage phenomenon at the strategic level, knowledge leakage will inject new knowledge into enterprises and promote the development of enterprises. Secondly, the study of "knowledge leakage" in many literatures is a single dimension, that is, the flow of knowledge from the enterprise to other enterprises (Jiang et al., 2013; Adaileh, Alzeat , 2017). "Knowledge leakage" in Mohamed et al. (2007) includes both the outflow of external knowledge from the enterprise and the inflow of external knowledge into the enterprise. According to Frishammar's et al. (2015) study, the author proposed that knowledge leakage is a multi-dimensional concept. Finally, scholars have different ideas of "knowledge" in "knowledge leakage". Annansingh (2005), Jiang (2013) and Lau (2010) think that "knowledge" is the core knowledge of an organization, while Frishammar (2015), Kim (2016) and Alberti (2017) argue that "knowledge" should include both core and non-core knowledge.

2.2 Formation Process of Knowledge Leakage

Almost all researchers believe that the formation of knowledge leakage is closely related to knowledge sharing. Knowledge sharing refers to a person's willingness to share his own creation or acquisition of knowledge with others , which is a necessary condition for transforming personal knowledge into organizational knowledge (Bock, 2005; Foss, 2010). With the development of business environment, enterprises in the cooperative innovation relationship need to exchange knowledge with external partners in order to acquire knowledge, ideas and capabilities that will help improve their competitiveness (Tranekjer, Knudsen, 2012; Serenko, Bontis, 2016) .Knowledge exchange within the scope of cooperative partnership will help improve the innovation performance of enterprises, and is also an important link in innovation upgrading (Lazzarotti et al.,

2011; Lin , 2007; Ritala , 2015). Through case studies of nine international alliance, Hamel found that cooperation provides an opportunity for enterprises to acquire the knowledge and skills. Although knowledge exchange among enterprises can produce benefits, enterprises are also faced with the risk of leaking their core knowledge or trade secrets to their competitors intentionally or unintentionally. For small companies that have no experience or resources to protect intellectual property, the risk of knowledge leakage is far greater than others. Therefore, sharing or exposing too much valuable core knowledge among cooperative enterprises will have a negative impact on the innovation performance of the enterprise, affect the overall performance and future competitive advantage of the company, and even threaten the survival of the fragile new company (Alvarez, Barney , 2001).

In addition to the inevitable knowledge leakage brought about by knowledge sharing, employees' turnover, mobility, loyalty and other factors bring knowledge flow. Macdougall and Hurst (2005) found that deploying temporary knowledge workers (using knowledge in their brains to create value) is one of the most effective ways to invest in the intellectual capital of an investment organization. They transmit knowledge and best practices in the public domain to the organization. However, Matusik and Hill (1998) claimed that it is risky for temporary workers to participate in the creation of key organizational knowledge (organizational processes, documents, trade secrets, etc.), and that they will become a medium for leaking their own knowledge into the public domain. In addition, the core competencies of many enterprises depend on the skills of specific key employees, who retain the knowledge needed to complete their work. Organizational knowledge is rapidly lost when staff turnover is high or when morale is low and organizational loyalty is low. Similarly, when trained employees leave the workforce, organizations risk knowledge leakage (Farmer, 1994).

At present, the research on the formation of knowledge leakage is mainly based on the above two viewpoints: one is knowledge leakage caused by knowledge sharing, the other is knowledge leakage caused by employee mobility. In the context of collaborative innovation, enterprises need to share knowledge and personnel flow activities, which means that knowledge leakage is inevitable.

III. INFLUENCING FACTORS OF KNOWLEDGE

The research on the influencing factors of knowledge leakage is distributed at the level of alliance, organization and individual. At the alliance level, in order to avoid unnecessary knowledge leakage, two kinds of relationship management mechanism between companies is the most common: one is the contract constraint based on transaction cost theory, the other is the cooperative trust based on social exchange theory (Dyer, Singh, 1998; Lui, Ngo , 2004; Poppo, Zenger, 2002; Jiang, 2013; Parker, 2012). These two factors belong to the external influencing factors of knowledge leakage. The research at the organizational level and the individual level usually complement each other. By studying the influence of the change of the variables at the organizational level on the individual behavior, it has a corresponding impact on the knowledge leakage. In this paper, the two types of factors are collectively referred to as internal influencing factors. This paper will discuss the influencing factors of knowledge leakage based on internal and external aspects.

3.1 External Influencing Factors

Contract constraint and knowledge leakage: According to transaction cost theory, contracts restrict the opportunistic behavior of partners by refining the mechanism of reward and punishment and establishing long-term commitments to constrain the opportunistic behavior of partners, and reduce transaction costs and possible risks in trading (Reuer, Ario, 2007). Alvarez and Barney (2001) describe the contract binding mechanism as an important mechanism to reduce the opportunism of both parties. The contract stipulates the rights and obligations of both parties in detail, and explains the contribution, cooperation, dispute settlement, income distribution and other issues of principle of the cooperative members. The enterprises in the cooperative relationship are usually restricted by these contracts. Specifically, the contract reduces opportunism in the process of cooperation by prescribing specific penalties and related tort provisions. When partners find that pursuing short-term benefits or violating the terms of the contract brings greater risks and costs, partners will stop stealing knowledge and reduce knowledge leakage (Blomqvist et al., 2005). Without the restriction of contract, the partner may have a stronger incentive to steal knowledge beyond the cooperation agreement, thus increasing the knowledge leakage of the enterprise (Jiang , 2013; Parker , 2012).

Cooperative trust and knowledge leakage: Cooperative trust is considered to be a powerful force to promote the smooth cooperation among partners and constitutes the source of competitive advantage for companies participating in strategic alliance (Barney, Hansen, 1994). In the long run, the establishment of cooperation, mutual trust and win-win partnership will help to make up for the lack of contractual constraints. Since the contract is usually based on the distribution and punishment of economic benefits, when partners gain more from knowledge theft than they may suffer losses, the terms of contracts will lack restraint and easily cause knowledge leakage. Cooperation trust in strategic alliance includes goodwill trust and competence trust.

Goodwill trust is emotional, based on kindness, integrity and the welfare of others (Das, Teng, 2001). Companies that establish cooperative relationship based on goodwill trust believe that the partner will not carry out the opportunity operation, even if there is an opportunity. (Das, Teng, 1998; McAllister, 1995; Nooteboom, 1996). Goodwill trust plays an active role in reducing transaction costs, promoting cooperation, encouraging innovation and promoting knowledge transfer (Li et al., 2009). With the continuous improvement of the level of goodwill trust, the partners feel trusted and thus improve the cooperative relationship. At this time, the cooperative goals are gradually consistent. In order to pursue the success of cooperation, cooperative enterprises will not take measures to harm the enterprises and reduce the incidence of knowledge leakage. However, some scholars study found that the dark side of the good trust. Under the background of strategic alliances, excessive goodwill trust will increase the incidence of knowledge leakage (Wuyts, Geyskens, 2005). Due to excessive goodwill trust, enterprises tend to give up with partners to share confidential information monitoring, open frequent exchange of information. When goodwill trust is higher than the critical value, the possibility of a leak will increase knowledge. Jiang et al. (2013) proved by empirical data that there is an inverted U-type relationship between goodwill trust and knowledge leakage, that is, both low and high levels of goodwill trust can lead to a higher level of knowledge leakage. It is only at a moderate level that the probability of knowledge leakage is reduced.

Competence trust is rational evaluation that is the willingness of the trusted person to trust the other party based on the cognition of the trusted person's personal trustworthiness evidence. It is a kind of rational judgment. These evidences generally include the related ability of the trusted person. Cultural background, intention of good and evil, etc. (Jones, George, 1998). When the enterprise lacks the competence trust to the partner, that is, the enterprise thinks that the partner does not have the ability to understand and absorb the relevant technical knowledge, which can not guarantee the smooth development of the cooperative innovation. At this time, the enterprise will not be in the knowledge of major investment in protection. Because of the weakening of the protection mechanism, the partner will easily steal the core knowledge and technology of the enterprise, and will face a higher rate of knowledge leakage to the enterprise. With the increase of trust in the ability of the partner, the risk of knowledge encroachment will increase when the enterprise thinks that the partner has the ability to understand and absorb the knowledge of the enterprise (Jordan, 2004). Enterprises will strengthen the management and monitoring of core knowledge, and the opportunism of partners tends to be minimized at high monitoring level, and the rate of knowledge leakage will be reduced.

3.2 Internal Influencing Factors

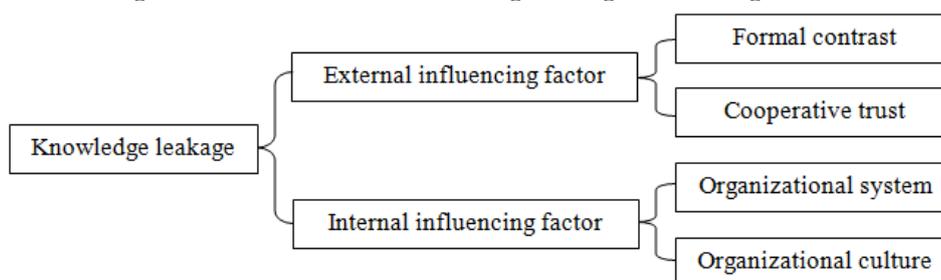
Baughn et al. (1997) proposed that the control of human resource management is an important means to protect knowledge capital, and the management of knowledge leakage needs to introduce the relevant mechanism of human resource management. Organizational flexibility mechanism and rigid system (Olander et al., 2016) are aimed at influencing employees' behavior and reducing the risk of knowledge related to employees, that is, the knowledge leakage caused by employees' intentional or unintentional knowledge leakage and the knowledge leakage caused by employee mobility.

Organizational system and knowledge leakage: According to the theory of planned behavior (Ajzen, 1991), compliance with the organization's knowledge and information security rules and regulations is the key to enhancing information security. Organizational system includes post design, incentive system and procedures to carry out various businesses. The more reasonable the organizational system design is, the less the risk of knowledge leakage will be. First of all, the enterprise designs the specialized organization in the interior, allocates the full-time personnel to engage in the knowledge exchange, strengthens the enterprise to the core knowledge monitoring, controls the organization knowledge and the information flow, is advantageous to reduce the enterprise knowledge leakage risk. Secondly, there is a strong correlation between the organizational incentive system and the incidence of knowledge leakage. Enable employee who perform well in knowledge protection to receive more material rewards and promotion opportunities within the organization than other employees. These policies can stimulate employees' enthusiasm for knowledge protection and awareness of risk prevention, and reduce the incidence of knowledge leakage in enterprises. Employees are also reluctant to disclose any knowledge for fear of being sanctioned (Liebeskind, 1996). In addition, whether the organizational process is reasonable or not is also an important factor that affects the knowledge leakage of the enterprise. Organizational process rationalization refers to the mutual inclusion and integration of organizational processes at all levels to ensure the acquisition, analysis and integration of market types and other types of knowledge between different functional units within an organization (Zahra et al., 2002). The more reasonable the organizational process is, the less the business conflicts in the daily work of the enterprise will be. This will be conducive to strengthen the communication between various departments of the enterprise, create a good organizational atmosphere, increase the sense of organizational identity of employees, and reduce the knowledge leakage of the enterprise.

Organizational culture and knowledge leakage: In the existing research, most scholars are concerned about the influence of organizational culture on knowledge transfer, knowledge transformation and knowledge creation. Only a few scholars have studied the influence of a certain type of culture on knowledge leakage. For example, a trust-oriented organizational culture can reduce knowledge leakage by reducing employee turnover (Olander , 2016). Trust in an organization can be divided into two levels: one is trust between people, which is based on the understanding of each other after the interpersonal interaction among the members of the organization; the other level is the trust relationship of employee and organization, which is based on the overall impression formed by the employees' decision making and action to the decision maker of the organization and the mechanism of organizational governance, and the incentive system (Marlowe, 1997). To establish a good organizational culture in their daily work and training, to enable the members of the organization to conscientiously fulfill their obligations to protect intellectual property rights, and to raise the awareness of risk prevention and reduce the incidence of knowledge leakage in enterprises. (Olander et al., 2016)

Through literature review, the structure of knowledge leakage influencing factors can be obtained, as shown in figure 1. For the study of the external factors of knowledge leakage, the academic community has basically reached a unified view that contract constraints can reduce the opportunistic behavior of partners, and that cooperative trust relationship can help to reduce knowledge leakage. In most studies, the knowledge leakage that scholars often explore is the flow of enterprise knowledge from inside to outside, but the internal influencing factors of knowledge leakage are not perfect. A few scholars mentioned the organizational system and organizational culture in the qualitative research. Olander et al. (2016) collected samples from 80 enterprises to analyze the relationship between trust and knowledge leakage among employees.

Figure 1 Structure of knowledge leakage influencing factors



IV. LIMITATION AND FUTURE RESEARCH DIRECTION

With the development of enterprise cooperation and innovation, knowledge leakage has become the focus of academic and enterprises. This paper combs the research of knowledge leakage from three aspects: concept, formation and influencing factors. From the point of view of the quantity and research of literature combing, the discussion of knowledge leakage is relatively scarce.

Scholars' studies on external influencing factors of knowledge leakage have basically become mature. Most scholars agree that contract constraint can reduce the opportunistic behavior of partners and cooperative trust relationship can help to reduce knowledge leakage. However, there are still some shortcomings in the study of internal influencing factors: 1) In the research methods, many scholars use qualitative research methods to explain the influence of internal factors on knowledge leakage. Lack of systematic quantitative methods to explore the specific rules of the impact of organizational system and organizational culture on knowledge leakage. 2) In the study of variables, scholars explore the impact of organizational variables on knowledge leakage, but in fact, Organizational leakage is an involuntary or involuntary outflow of employees, but there is little research on individual variables in current studies.

Knowledge leakage mainly studies the outflow of knowledge from the inside to the outside of the enterprise, and the individual in the organization transmits knowledge intentionally or unintentionally, so it should clarify the internal influencing factors of knowledge leakage. Organization is a multi-level, interlocking complex system. If we only adopt macroscopic or micro-view, we can not accurately explain and understand the influencing factors of knowledge leakage. Future research should strengthen the study of the influence of organizational and individual variables on knowledge leakage, such as organizational identity, employee mobility, etc., combined with variables at the organizational, national (regional) level, such as organizational culture, organizational system and market environment, etc. It is convenient for researchers to better understand the internal influencing factors of knowledge leakage, and it is helpful for organizations to customize the knowledge management strategy which is more suitable for the development of enterprises according to the research results and from the perspective of knowledge leakage.

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