

# Research on Upgrade Path to Technology Innovation of Resource-based SMEs in China

**Xu Jie**

Sichuan Academy of Social Sciences, Chengdu, Sichuan, China, 610071

jie\_xuscu@126.com

**Abstract.** Complexity, diversity and coordination are features of technology innovation of resource-based SMEs in China. This paper studies on the key factors of macro-environment, cooperation among enterprises and enterprise interior, which influence the upgrading of technology innovation of resource-based SMEs in China. This paper constructs integrated system of technology innovation to analyse the upgrade path to technology innovation of resource-based SMEs in China, so that enterprises would improve their technology innovation and get a new way to accomplish sustainable innovated development.

## 1. Introduction

In the context of the complicated and changeable competition environment, the increasingly shortened cycle of technology innovation, and the emerging discontinuous technological changes, we need to consider the key factors and action mechanism of macro-environment, cooperation among enterprises and enterprise interior when studying on the upgrade path to technology innovation of resource-based SMEs in China. Based on the integration management theory, this paper comprehensively studies the key factors influencing on upgrading of technology innovation of resource-based SMEs according to macro-environment, cooperation among enterprises and enterprise interior in turn. In doing so, this paper constructs integrated system of technology innovation, and accomplishes the upgrading of technology innovation of resource-based SMEs in China through the effective integration of key factors in the system and the according effect.

## 2. Integrated system factors of technology innovation

In general, integration can be understood as the process of two or more than two elements (units, subsystems) into an organic whole. Integration is different from ordinary aggregation activities. The integrated units have been optimized and selected by themselves, and finally form an organism which can match and complement each other.

According to the system theory, the integrated system is the process of connecting integrated units in certain integrated interface and choosing proper integrated mode for the integrated subjects by way of regulation and restrain of integration mechanism in some integrated environment. The five key factors of integrated system are integrated environment, integrated interface, integrated unit, and integration mechanism and integration mode.

### 2.1. Integrated environment

The interaction of the rapidly changing external environment factors and system elements form the dynamic and open characteristics of the integrated system. Therefore, the construction of technology innovation integrated system to resource-based SMEs in China need to consider the effect of the



macro environment and industry environment. In recent years, China has proposed to build a resource-saving and environment-friendly style society as the goal of optimizing the economic structure and the transformation of economic growth mode. It not only brings significant strategic opportunities for the structure upgrading and sustainable development of the resource-based industry in China, but also provides a favorable policy environment for a shift from the traditional extensive production to intensive growth of resource-based industry through technology innovation.

### *2.2. Integrated interface*

Integrated interface refers to the interaction state and join relationships among elements in integrated system. The integrated interfaces of technology innovation integrated system of resource-based SMEs in China exist among three levels of enterprise interior, among enterprise and system environment as well as different units in all levels. As a medium to connect different integrated units as well as integration levels, the integrated interfaces orderly exchange and transfer all kinds of information, capital, technology and other resources and energy required by the integration process of each unit, each level and the whole system.

### *2.3. Integrated unit*

The integrated units are the basic elements of constituting the integrated relationship in system and determine the functional characteristics of the system. In technology innovation integrated system of resource-based SMEs in China, integrated units include three levels. The core ability of obtaining natural resources, technology creation and market integrate form ability integrated units in enterprise internal level. The associated resource-based enterprises which rely on cooperation of technology or product form integrated units in enterprise level. The units and organizations including government departments, colleges and research institutions, financial institutions and intermediary organizations which support the system for policy, technology, capital and information form integrated units in environmental level.

### *2.4. Integration mechanisms*

Integration mechanism refers to the existence reason and governance principles of integrated system. The existence condition of technology innovation integrated system lies in the main subjects and organizations that are closely related to the technology innovation of resource-based SMEs in China, establish homogeneity, correlation and fusion relations among the elements based on the common goal of integrated upgrading, and further form fundamental associated conditions of integrated upgrading. Governance principles take the integrated upgrading as target, select public property elements at all levels to form integrated subjects of complementary advantages and mutual match in reasonable structure.

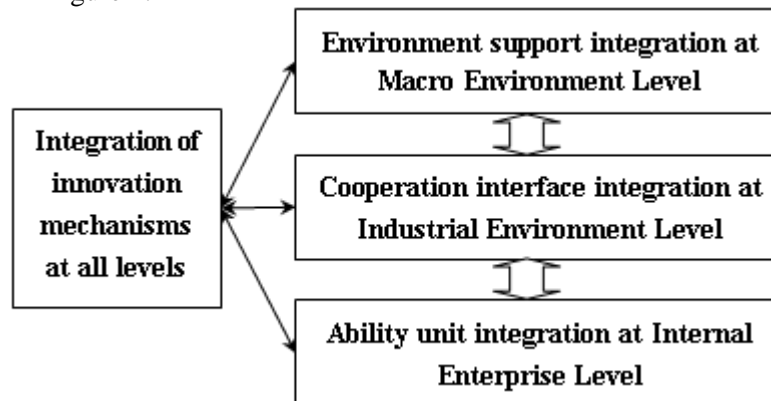
### *2.5. Integration mode*

Integration mode refers to the way of interactive contact like material and information exchange among the integrated units. It not only reflects the relationship among the integrated units, but also reflects the energy exchange relationship among the integrated units. The integrated units formed by the elements of impacting technology innovation within the enterprise generally belong to polymerization recombinant integration mode; the cooperation integration mode led by technology innovation form integrated relationship among the resource-based enterprises mainly belong to complementary integration mode; the resource-based enterprises as well as supportive organizations in overall industry and macro environment form reciprocal integration mode.

## **3. Integrated system structure of technology innovation**

The upgrading process of technology innovation of resource-based SMEs in China means the wholly effective integrity of integrated system of technology innovation so as to gain integrated effect by every level of factors inside the system. The framework of integrated system of technology innovation

is shaped according to the analysis of the above factors, considering the supporting environment, cooperation among enterprises and management system of enterprises in the logic of “from outside to inside”. As shown in Figure 1.



**Figure 1.** Technology Innovation Integrated System Structure

The constitution of technology innovation integrated system are process of the integrated units containing elements, structure, function supported by the three levels, which are technology innovation elements of environment, enterprises and enterprise internal. The units integrate to form effective synthesis integrated system through the nonlinear interaction in order to obtain the integrated effects for achievement of technology innovation of resource-based SMEs in China.

#### 4. System integration path

The resource-based enterprises in China analyse integrated paths influencing different levels of factors according to integrated system of technology innovation, so that they will accomplish the upgrading process of technology innovation.

##### 4.1. Environment support integration

The complexity and synergy of technology innovation for resource-based SMES result in the obvious dynamic open characteristics that the technology innovation integrated system form. The technical complexity and enterprise technology environment dynamic evolution makes the enterprise must change the original type which is single and enclosed technology innovation to integrated type technology innovation that seek related organizations in external environment to support.

In the environment level, government departments, colleges and scientific research institutions, intermediary organizations and financial institutions are the integrated units and the supporting subjects, which have their own position and role. While the enterprise as the centre of gravity, colleges and research institutes are the main parts to provide talent and technology; The government departments provide related policy support, and guide the other supporting units in the environment level to complete integrated upgrading process; Financial institutions are the subject to provide funds; Intermediary organizations are the main part to provide the information for enterprise, university and research institutes to communicate with each other, and other intermediary service either. The integrated units interact with each other, and formed interaction effect through the integrated system.

##### 4.2. Cooperation interface integration

Cooperation interface integration refers to the integration of the same or complementary enterprises, which are in the same direction of the core product value chain, integrate for pursue the same market opportunities. In the technology innovation integrated system, the range of technology innovation is no longer limited to the enterprise internal, but the associated subjects which formed in technology innovation activities relying on technology or products should be more considered. With connection

effect of the integrated interface, in order to pursue the innovation management utility maximization, enterprise should keep a target consistent or compatible with the associated subjects through the effective integration activities, and complete the cooperative integration process successfully.

The integration goal of cooperated enterprises technology innovation mainly is to form the communication platform through integrated interface. The integrated interfaces that connect enterprises make the technology innovation knowledge and achievements effectively accumulate, inherit, diffuse and increase. They also promote cooperation technology innovation between the enterprises, which lead to productivity greatly raised. Basically, the interface integration way is to constitute effective communication net through the innovation integrated system and realize interactive innovation.

#### *4.3. Ability unit integration*

Ability unit integration is the ability of enterprises. They are unique, valuable, irreplaceable, non-tradable, extended material resources. They are abilities to integrate resources, skills and knowledge. The promotion of technology innovation ability is the direct driving force to move the enterprise technology innovation level. From the angle of resource application, natural resources acquisition ability, technical creation ability and market integration ability constitute the enterprise ability system of resource-based SMEs. The way to promote and optimize the technology innovation ability of resource-based SMEs is to integrate the core abilities of enterprise ability system.

In the enterprise internal level of resource-based SME technology innovation integrated upgrading system, the three core abilities are the integrated units, which are natural resources acquisition ability, technical creation ability and market integration ability. The integrated upgrading path in enterprise internal is, in order to optimize the enterprise technology innovation level, to integrate the key abilities by using the accumulation integration mode. Basically, the point of ability integration is to improve the function of ability units with integrated effect, and form the accumulation competitive advantages of enterprises by enterprise inside resource integration and process upgrading, so as to realize the enterprise technology innovated management upgrading process with the enterprise internal ability integration.

#### *4.4. System integration*

Combined with the enterprise management practice, the system integrated upgrading path of resource-based SMEs technology innovation is: with the effect of both external environment and internal integration mechanism on the system, the elements of each level should integrate on the enterprise strategic decision level, by collecting the technology innovation resources (such as ability, assets, technology, etc.) from the enterprise internal to external organizations, and integrating each link and related elements which are related to the technology innovation activities in appropriate way, and to form a comprehensive upgrading path of enterprise technology innovation.

### **5. Summary**

The integration theory provides a new angle of view for enterprise management. To construct integrated system of technology innovation based on the idea of integration means, to take into consideration, wholly and comprehensively, the total upgrading of technology innovation of resource-based enterprises in China. It optimizes and selectively arranges the technology innovation in every single point of view, helps them to joint under the most reasonable structure, and finally forms an integrated system of proper factors which complements each other. It accomplishes the upgrading of technology innovation of resource-based enterprises in China through the effective integration of levels in the system, and provides systematic and comprehensive way of thinking for the theory research and practice of the upgrading of technology innovation of resource-based enterprises in China.

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