

# Research on Enterprise Innovation Strategy Based on Technology Evolution

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**Abstract:** *Based on the internal mechanism of enterprise innovation strategy, this paper introduces the S - type curve of technology evolution, explores the integration of technology evolution and enterprise technology innovation strategy, and puts forward the enterprise innovation strategy selection scheme based on technology evolution life cycle.*

**Keywords:** Technology evolution; S-curve; Technology innovation strategy

## 1. Introduction

"Some countries have been using disruptive technology for a new round of technology revolution; we must keep up with this trend to promote China's manufacturing intelligence and networking, to enhance the new kinetic energy of real economy." Chinese Prime Minister Li Keqiang pointed out that "The urgency of fostering new kinetic energy must be further enhanced; we should overcome difficulties to accelerate the pace of transformation of old and new energy!" He repeatedly mentioned the 'S-curve' theory of technological evolution: when the old kinetic energy grew weak, the new kinetic energy rises can support the new development.

Entrepreneur investigation system of China State Council Development Research Center released the 'Chinese enterprises innovation trend index' shows that the current Chinese enterprises have entered the active phase of innovation, the developmental pattern of Innovation as main driving force will become the mainstream of Chinese economy. Whether an enterprise can achieve better innovation performance depends largely on the rationality and effectiveness of its innovation strategy. This paper introduces the related content of technology innovation strategy and technology evolution, and on this basis, discusses the S-curve of technology evolution in the research of technology innovation strategy.

## 2. Technology Innovation Strategy and Enterprise Strategy

Technological innovation strategy is the overall goal and key deployment of technological innovation established by a country, a region or an organization based on the correct analysis of the internal conditions and the external environment. With the advent of knowledge economy and economic globalization, technological innovation strategy has become the core of enterprise management strategy. Specifically, the technology innovation strategy is the important decision related to technological innovation made by enterprises to obtain competitive advantage and achieve innovation goals, and is the form of enterprise technology choices. These decisions include the acquisition, maintenance and utilization of technology, as well as the

level of technical capacity and the intensity of research and development inputs, these technological choices determine the application level of technology in the enterprise, as well as the platform of product innovation and process innovation.

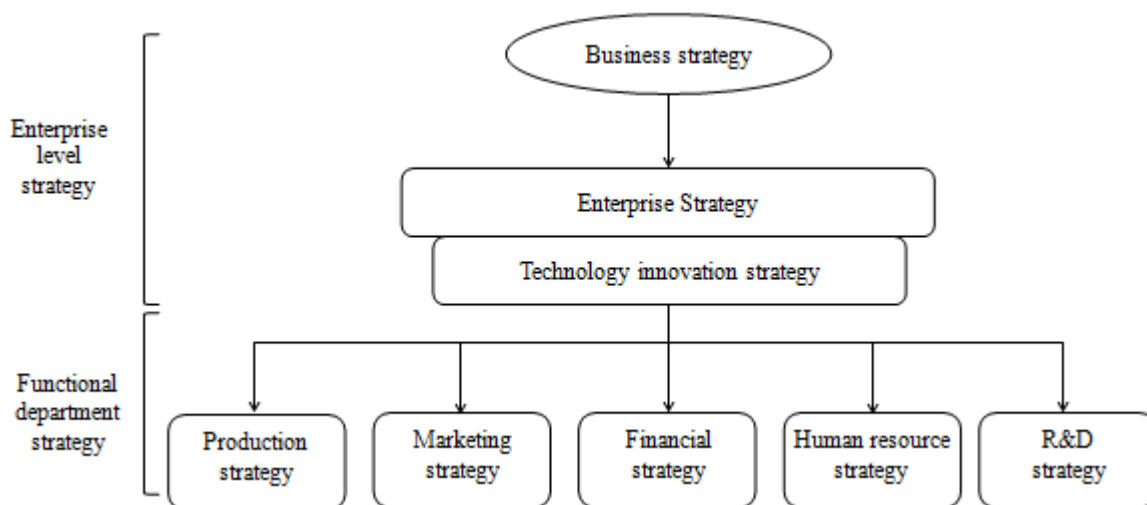
The strategy of technological innovation focuses on the Strategic technological choice of enterprises, that is, enterprises occupy, develop, use and give up what technology. The core of technological innovation strategy is how to build and enhance the core technical ability of enterprises; technology innovation strategy is the core of enterprise's overall strategy, which determines what competitive advantage an enterprise obtains. The depth of technological innovation strategy is related to the enterprise's current technology stock and the scale of resources investment, while the breadth involves the strategic posture of the enterprise and the new field it can enter. The relationship between technological innovation strategy and enterprise strategy is shown in Figure 1.

Technological innovation strategy is a key component of enterprise strategy, should be consistent with the overall enterprise strategy. Technological innovation strategy should serve the overall strategy of the enterprise, while the technology innovation strategy can play a dynamic role in the overall strategy of the enterprise.

Enterprises must attach importance to the strategy of technological innovation. There are many companies, although they are important technology innovation finishers, but because they haven't considered the overall problem of enterprise technological innovation from the strategic perspective, leading to strategic failure and not get more benefits from technological innovation, or even lose the competitive advantage. For example, the British EMI company created a scanner, but did not build a defensive competitive advantage, leading to losing market imitators. American Xerox is an innovator of copiers, but in 1980s, Japan's Canon Co took up a larger share of the market. The most fundamental goal of enterprise technological innovation is to win the competitive advantage for enterprises and improve the profitability of enterprises. It is not limited to the increase in sales or the improvement of product performance, nor is it limited to new products or

services. It is more important to change the competitive position and establish the core competitive advantage.

Technological innovation is important, but for enterprises, technological innovation strategy is more important.



**Figure 1:** The relationship between technology innovation strategy and enterprise strategy

The importance of enterprise technology innovation strategy has been generally recognized, but the understanding of its internal mechanism is generally insufficient. Enterprises tend to innovation for innovation, with the mentality of ‘technological innovation’ eager to occupy new markets, and blindly introducing new technologies, the success of some companies’ technological entrepreneurship has become the driving force for enterprises to imitate and implement technological innovation. Therefore, how to grasp the appropriate timing and scale of technological innovation in practice has become the primary problem to be solved urgently for enterprises to implement technology innovation strategy.

activities in the range of technology paradigm, and it will derive a series of related technology. Different enterprises belonging to the same technology track may have different technical orientation, management direction and core competencies. Due to the existence of technology track, the process of technology evolution shows the characteristic of ‘path dependence’, and it is precisely because the technology track determines the possible direction and intensity of technology development, makes the understanding of technology S-curve and enterprise technology innovation strategy has platform and foundation.

### 3. Technology Evolution

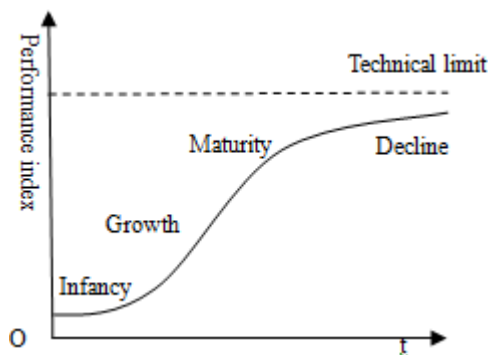
#### 3.2 TRIZ Technology Evolution Theory

From the concept of evolution infer intuitively, the so-called technology evolution refers to the process of technology changes with time. Although the development of technology show a random process from the beginning, but from its long-term development perspective, it shows certain regularity, that is, the evolution of performance parameters and time shows the law of S-type curve.

TRIZ determines the evolution law of S-curve. The S-curve evolution rule refers to the main parameters and performance of the system evolves in the form of an S-curve evolution, as shown in Figure 2. The evolution of technology system goes through 4 stages: infancy, growth, maturity and decline. These stages constitute the technical life cycle of the product. The stage of a product in the evolution of such products is its technical maturity, and the position of the product technology on the S-curve is an important part of the technology evolution theory in TRIZ.

#### 3.1 Technology Track

In the history of technological innovation theory research, R.Nelson and S.Winter first proposed technology has the characteristics of common connection, and in 1980s first proposed the ‘natural Track’ concept to describe the development trend of technological , such as the pursuit of economies of scale, economies of scope and continuous improvement of production processes. On this basis, another scholar Doci Giovanni put forward the concept of technology paradigm, expounded the concept of exclusive technical system standardization, and then put forward the concept of technological track. He believes that the technical track is the enterprise ‘conventional’ innovation



**Figure 2:** Typical S-curve of technology evolution

(1) The first stage—infancy. The technical system in infancy is characterized by slow progress in technical performance parameters, high patent levels, but few patents. The development trend of the system at this stage is that the ideal degree should be greatly improved, and the weakness or bottleneck that hinders the system entering the market should be emphatically identified and eliminated.

(2) The second stage—growth. The characteristics of the technological system that enter the growth period are the system decreases the expenditure while the main index of the system increases rapidly. The development trend of the system at this stage is that the system needs to be improved in its structure and components.

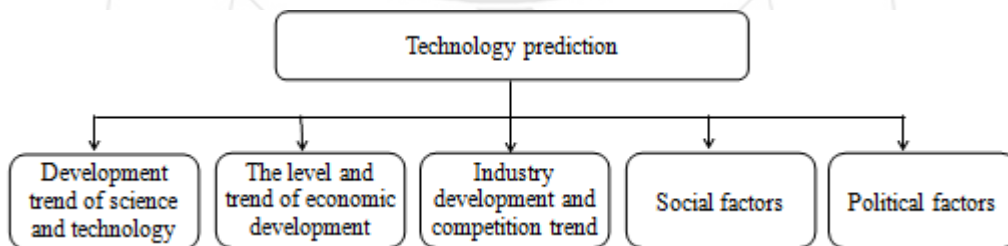
(3) The third stage—maturity. The technical system of this period has tended to be perfect, and the technical system at maturity is characterized by the best performance level, the number of patents is stably maintained at a high level, the patent level is very low; the production is still the same stability, the product has entered mass production, and gets huge economic benefits. The development trend of the system at this stage: it is mainly to solve the problem of reducing costs and developing service functions in the short and medium term. Operators should start to develop the next generation of products, formulate corresponding plans to ensure that when this generation of products technology fades out of the market, there is new product technologies to

undertake the important task of enterprises continue to develop.

(4) The fourth stage—decline. The technical system presented in the recession is characterized by the degradation of the function—the reduction of system function index and repayment ability, the gradual decrease of its performance parameters and economic benefits, the obvious decrease in output and income, the replacement of the market share previously occupied by the system; patent level and amount showed a rapid decline as well as the profit margin. At this stage of the development trend of the system: reduce costs and development services should be resolved in the near future, long-term development should be to predict, and the problems which restrict the development of technology change system principle should be resolved.

### 3.3 Technology forecasting and substitution

From a historical point of view, things continue to move forward, and technological innovation is the direct driving force to promote the development of things. Technology is evolving, predicting the future process of technological evolution, rapidly developing new generation products, meeting the challenges of future changes, and playing an important role in the improvement of the competitiveness of any manufacturing enterprise.



**Figure 3:** Factors involved in technical forecasting

Technical forecasting refers to the prediction and speculation of technological trends, technological inventions and technological applications. The main targets of technology prediction are: technology development trend, performance and result of new products, new process characteristics, application scope of discovery and invention, scope of technology popularization and application. The factors involved in the technical prediction are shown in Figure 3.

The main contents of technological forecasting are: forecast time—a specific time or a certain period of time; forecast range—the way or plan to achieve a technical; forecast performance—a quantitative estimate of the main technical performance; estimate probability—estimate the probability or probability distribution of a time or parameter that appearance or reach of a certain technical function.

The growth rate of technical characteristics is related to the technical level that has been reached and has changed in the opposite direction. That is to say, the marginal investment

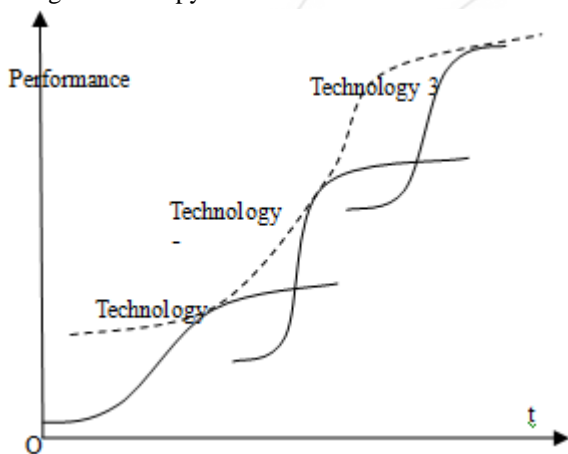
benefit of R&D is decreasing, especially when the technical limit is approached, the investment required to improve the performance is increasing dramatically. When technology approaches the limit, technology jumps is possible, and policymakers should be fully aware of whether the technology is close to the limit. The effect of technology investment has fallen sharply, which is close to the technical limit, which indicates that there are certain signs close to the technical limit, which is helpful to the formulation of enterprise technological innovation strategy.

Practice has proved that when a technology reaches the technical limit, there will be a new technology to replace the old technology, so that the technical parameters are further extended, that is, there is technical substitution phenomenon. The growth of every technology is an independent ‘S-curve’.

A technology in the import period of technological progress is relatively slow, once entered a period of growth it will show exponential growth, but the technology matured to the

top of the curve, there will be a slowdown in growth and lack of power. And at this point, new technologies will flourish below, forming a new 'S-curve', which eventually goes beyond traditional technology, as shown in Figure 4 solid line curves. Therefore, the transformation of new and old technology, together promote the formation of the peak of technological progress, thereby leading the development of new economy.

In general, the technical replacement is a gradual process, the new technology is completely accepted by the market users need some time, the cost of new products and some key technologies to improve also need for a process, so there will be the coexistence of old and new technology alternating phase, as shown in Figure 4. Such as VCD market and video recorder, LD disc machine market coexistence, as well as the current DVD market, VCD market coexistence. Technical substitution phenomenon provides an opportunity for enterprise development. As technology development is not continuous, enterprises can take advantage of the market, correctly grasp the trend of technological change, and directly to a higher level of technology to enter the market, so as to gain a competitive advantage and occupy the mainstream market.



**Figure 4:** S-curve of old and new technology

The development of a technology system is composed of two parts: one part is the gradual improvement of cell technology; the other part is jumping and mutation technology. If a series of different technologies as a whole system, and the composition of the system of different technologies as a subsystem, then the different technologies are small S-curve development, that is, each technology has its baby Period, growth period, maturity and recession. If the technical characteristics of the various stages of the development of the series curve and these small S contact, the entire technical series of technical characteristics of the development will form a large S-curve, as shown in Figure 4 is shown in dashed curve, and these entire small S-curve tangent large S-curve is the technology of the envelope curve. The development of the technical system can be predicted by the envelope curve method.

## 4. Research on Enterprise Innovation Strategy Based on Technology Evolution

### 4.1 Technology innovation model selection based on technology evolution

(1) Technology innovation mode of 'along track'. The innovative process developed along the S-curve track of technology evolution is a progressive, with a strong path dependence on technology innovation, help enterprises to promote technological innovation continuous, derivative and ductility, and to obtain and maintain the competitive advantage.

(2) Technology innovation mode of 'jump track'. The innovation process of the development and evolution of S-curve track transition based on technological evolution is a fundamental technological innovation. The main factors that promote the technological transition of enterprises include: scientific research and major technological breakthroughs in specific industries; social consumption demand has undergone significant changes; domestic and foreign political and economic situation has undergone major changes.

(3) Technological innovation mode of 'fusion track'. The alternation of S-curve tracks in technology evolution requires multiple approaches and the integration of different technological paradigms. 'Fusion track' technology innovation is a kind of intermediate technological innovation, and it is a technological innovation process based on the integration and development of technology track. Enterprises need to recognize the extension, transition and jump of S-curve track.

### 4.2 Evolution of enterprise innovation path based on technology evolution

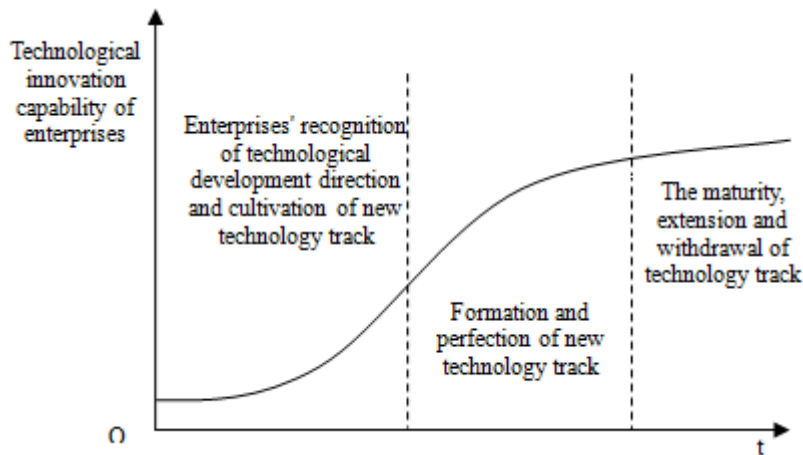
Technological breakthroughs, the accumulation of industry technology, the progressive expansion of market demand, the expansion of product lines and other factors together affect the formation and evolution of the technology track of the industry, but the majority of enterprises is the industry technology track 'drivers and vehicles', and can only be a follower of the technology track. Due to the rigidity of technical track, enterprises can only adhere to the existing technical track without the fundamental technological progress, which may cause enterprises to lose their competitive advantage. Based on this, enterprises who are interested in becoming the industry leader should become the founder and leader of the industry technology track.

The advocates of innovation are often the main innovation subjects with high dependence on foreign technology, and different innovation subjects can choose the implementation path of innovation according to their own conditions. This will inevitably require enterprises to experience three main stages of 'technology track identification and selection', 'technology track extension based on original innovation, integrated innovation, or imitation innovation', 'the

formation of mature technical sub-track and improve the corresponding technology track’.

The innovation ability of enterprises is influenced by the industry technology track; on the other hand, it is also

influenced by the technology learning, accumulation and development of the enterprises themselves. Enterprises can only do the best of relevant factors, especially to do what they can to become the founder and leader of the technology industry track (Figure 5).



**Figure 5:** Evolution of industry technology track and promotion of enterprise technology capability

#### 4.3 Selection of enterprise innovation strategy based on technology evolution life cycle

The enterprises with different technological innovation capability are in different stage of industry technology evolution S-curve track. It is very important to choose technology innovation strategy.

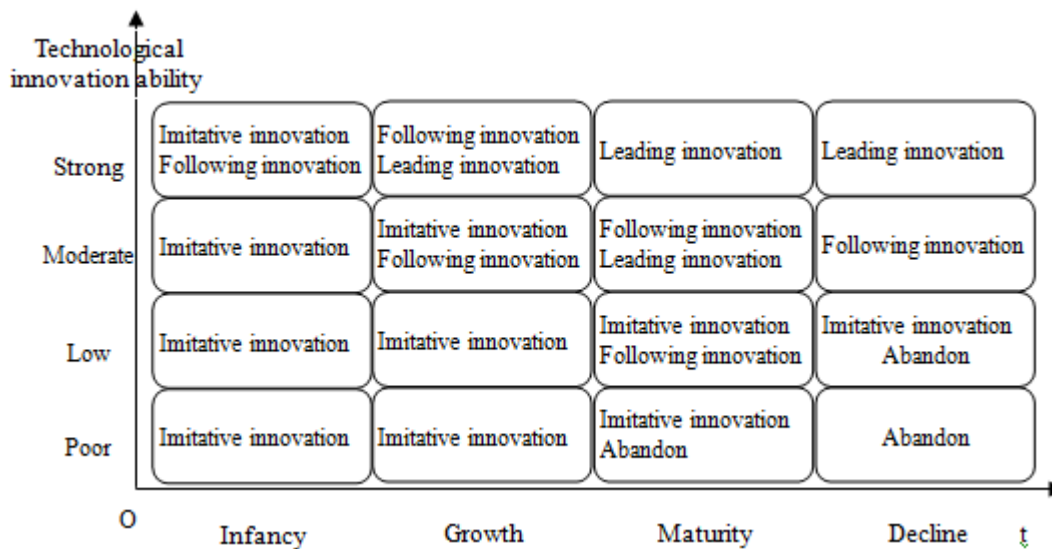
(1) The infancy of technology evolution. In the infancy of technology evolution, due to the slow progress of technical performance parameters, the whole market is basically in the period of complete competition. The enterprises are still in the exploratory stage for the development of technology; even if the enterprises with strong technological innovation ability, in the initial stage, they have to imitate and follow the advanced technology of foreign counterparts, and continue to develop, learn and grow in the process of imitation and follow. For enterprises with moderate, low and poor technological innovation ability, their own technological innovation ability cannot meet their R & D needs in the breeding stage of the industry, and if they want to develop, they must rely on imitation innovation.

(2) The growth period of technology evolution. In the technology evolution of the growth period, the enterprises has a certain understanding and research for the development of technology, this time with the early development of the enterprise the industry started to have a "leader", the product market has been gradually transferred to the monopolistic competition. For the enterprises with strong technological innovation and medium ability, it is necessary to make some improvements in the technology innovation strategy to

adapt to the changes of the environment. Enterprises with strong technological innovation ability can continue to follow and lead the strategy in order to stand firm in the competition and remain invincible, of course they can also take the lead in innovation to achieve leapfrog development once the most advanced and promising technology directions are found and breakthroughs are made. The enterprises with moderate technological innovation ability can adopt the imitative innovation strategy as well as the follow innovation strategy.

(3) Maturity of technology evolution. In this period, the non-technical factors in the technology industry have been basically fixed, and the pattern of monopolistic competition market has basically formed. If the enterprises with strong technological innovation ability want to maintain the leading position in the market, obtain larger market share and higher monopoly profits, they will inevitably choose the leading innovation strategy, and take the lead in developing new products.

(4) The declining period of technological evolution. Many examples in the process of enterprise development have proved that if the existing enterprises with strong technical ability cannot grasp the opportunity of innovation, they will turn from leader to loser. Therefore, at this critical moment, enterprises with strong technological innovation ability must seize the opportunity to implement innovation and develop new technologies. Enterprises with poor technological innovation ability must abandon the technology and pursue technology in infancy or growth period.



**Figure 6:** Scheme selection of technology innovation strategy

In summary, the technology innovation strategy selection plan of enterprises in different technology evolution stages is obtained, as shown in Figure 6. Because of the different technology evolution period, enterprises with different technology innovation ability can adopt cooperative innovation strategy to achieve the purpose of resource sharing or complementary advantages, so it is no longer repeated in Figure 6.

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## Author Profile

**Yang Qinghong** has been studying for a master's degree at the school of economics and management of Xidian University since 2015. The research field is management innovation and science-technology human resource management.