Escuela Superior de Cuadros del Estado y del Gobierno
Revista Cubana de Administración Pública y Empresarial
RNPS 2458/ISSN: 2664-0856/Vol.I/No.1/mayo-agosto/2017/p.51-58

Artículo original

HOW CAN ENTERPRISES AND GOVERNMENTS PROMOTE TECHNOLOGICAL INNOVATION?

¿CÓMO PUEDEN LAS EMPRESAS Y LOS GOBIERNOS PROMOVER LA INNOVACIÓN TECNOLÓGICA?

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Recibido: 12/07/2017

Aceptado: 26/08/2017

Abstract

This paper elaborates on how to duplicate the genetic mechanism for technological innovation by analyzing factors involved in enterprises and governments 'promotion of technological innovation. Only with the formation of a logical system can technological innovation is sustained, which is exactly the answer this paper tries to seek out. With the strength of such a system, the power of management and the self-consciousness of culture, innovative enterprises and countries will be truly created.

Keywords: technological innovation, team, institutional logic

Resumen

Este artículo explica cómo duplicar el mecanismo genético para la innovación tecnológica mediante el análisis de los factores involucrados en las empresas y la promoción de la innovación tecnológica por parte de los gobiernos. Solo con la formación de un sistema lógico puede sostenerse la innovación tecnológica, que es exactamente la respuesta que este documento trata de buscar. Con la fuerza de tal sistema, el poder de la gestión y la autoconciencia de la cultura, las empresas innovadoras y los países se crearán de verdad.

Palabras claves: innovación tecnológica, equipo, lógica institucional

Objective

This paper tries to analyze the institutional logic promoting technological innovation in enterprises and governments, so as to help them cultivate and optimize innovative genes, make technological innovation their voluntary pursuit or even basic instinct, with the aim of creating innovative enterprises and countries.

Genetic analysis of technological innovation in enterprises

For many enterprises, the difficulty lies not in knowing the secrets of great enterprises, but the putting them into practice. Most enterprises are aware of the basic approaches to technological innovation, but only enterprises with special qualities and people of real courage have the capability. The author holds that the genetic factors in promoting technological innovation in enterprises generally include initial motivation, leadership skills, team management, processes of technological innovation, and strategies for technological innovation. These five factors are the necessary stepping stones in which ambitious enterprises have to excel. These represent not only the basic factors that guarantee technological innovation, but also the logic that determines whether technological innovation can be sustainable.

1. Initial motivation

The mechanism of innovation motivation is the sum of all kinds of relationships formed under the influence of innovators, motivational factors, as well as the environment they are subject to.[1] Any enterprise undertaking technological innovation is due to some initial momentum, such as strategic needs, competitive pressure, impulse to pursue profit, instinctive innovative consciousness, and changes in the market environment. Different enterprises will take on different features regarding the motivation for technological innovation depending on their business systems. But the most passive choice is inaction. Actually, among the many motives for technological innovation in enterprises, market demand is the primary one, followed by technological promotion, and then, other factors like policies.[2]

2. Leadership

Leadership is the bellwether of the technological innovation team, making up the core driving force and high-end engine behind science and technology innovation with its high moral standards, significant professional contributions, exceptional team effect, prominent leading roles, and great development potential.[3] The key figures in technological innovation in enterprises are the entrepreneurs as decisionmakers and the specific leaders in charge of the technological innovation team.

The research results of the Chinese Entrepreneur Survey System on entrepreneurship reveals that there is a high rating on “I value technological innovation and emphasize technological leadership and innovation”, “I dare to take innovative risks”, and “I like to seize opportunities with aggressive and bold actions”,[4] which shows the innovative spirit of entrepreneurs to be of crucial importance. Xu

Xiaoning, a Chinese economist, believes “the only important job for entrepreneurs is innovation” .[5] For many business leaders in any type of enterprise, promoting technological innovation means a real test of their innovation spirit respectively displaying “determination, perseverance, risk-taking, pressure-bearing, responsibility, etc.” A leader without ambition or courage can hardly pass the test. In reality, what innovation requires of a leader is: firstly, to be knowledgeable; secondly, to maintain passion; and thirdly, to take responsibility.

3. A team that promotes technological innovation

A good technological innovation team should be conducive to enhancing the spirit of cooperation, to strategic thinking, to product design innovation, to improving work efficiency, and so on.[6] The author

summarizes it as a "6-same" technological innovation team with a high degree of cohesion and effectiveness, namely, with the same dream and same ethics in mind, the same goal and same direction in pursuit, and the same means and same pace in action. Such a team is equipped with the following three innovative genes. Firstly, an active imagination. The human mind should not be a container but a torch; thus what wakes up innovators is not an alarm clock but the dream. It would be naive to continue obsessively trying to discover new things, while still "foolishly" pursuing established rules. Actually, innovators are always shining with the brightness of their imagination. Many people like magic, and the enlightenment that magic has cast on nurturing innovation is that it incredibly seems to "run counter to" common sense, forging a lot of unexpected things, and presenting these illogical things in fantastic ways. Therefore, when human beings are too cautious and do not dare to dream, innovation will be gone too. As is commonly known, it is easier for imaginative people to get along with themselves and see their own potential. They are more confident and are not susceptible to self-denial. It is imagination that opens up a window to resolution of many unanswerable questions and difficult issues. This involves thinking over questions with imagination, setting up goals in questioning, clarifying questions with goals in mind, and seeking out innovation paths among questions. Newton once said, complicate simple problems, you will find a new field; simplify complex issues, you will find a new law.[7] Thus people and institutions with active imaginations are in possession of a high-quality gene.

The second gene is perseverance and refined qualities. Innovation as a psychological quality exists in love of the unknown, having courage to take risks, independent judgment and action without shifting responsibility, calm acceptance of various results, not blindly worshipping authority, not blindly following old experience or the majority of people, and maintaining mental health. People with the above qualities are sincere and patient. They will not deceive others, society or themselves. In this way they are able to bypass moral hazards in innovation. Similarly, a team's qualities and perseverance will be test e din the process of technological innovation.

Thirdly, the spirit of challenge closely interwoven with the concept of tolerance of failure. Without a climate of tolerance of failure, innovator's challenge and adventurous spirit is bound to be strangled, which will lead to the loss of the gene. There is no shortcut on the path to innovation, so there should be a redefinition of tolerance of failure. Innovators are not underdogs. Consequently, tolerance of failure is not a gift from the strong to the weak. Setbacks and failures in innovation are like challenges in combat and scenarios in adventure, which are of positive rather than passive meaning. The core of tolerance of failure lies in actively experimenting on the right path while encouraging trial and error, which reflects an enterprise's vision, attitude, and obligation in meeting and embracing the future.

4. Process of promoting technological innovation (real interpretation of challenge and tolerance) Any innovation is a painful process. True innovation is like a flower which bursts into bloom and bears fruit only after going through a dark breeding period as a small seed and a hard growing period as a fragile seedling.[8] It is uncomfortable to endure the pain. Being acquainted with the criteria, getting to know the path, going from being able to watch to being able to do, from green hand to master hand, these are the basics for technological innovation. The author is reminded of one remark once seen in an exhibition hall during a visit to a famous conglomerate: "Industry is a building constructed, piece by piece, from thought and sweat." No gains will be achieved without such toil and moil. Why can't some enterprises well digest and absorb the advanced technology being introduced? It's because they haven't taken pains to ascertain the schematic diagram, technological road map, and construction plan of the advanced technology. When

RNPS 2458/ISSN: 2664-0856/ISSN: 2664-0856/Vol.I/No.1/mayo-agosto/2017/p.51-58

an enterprise comes into contact with a technology and assumes that it has fully understood it, in reality it may actually just see a vague image without really knowing the dynamic processes, and what's more, it may also lack the necessary construction drawings or workers. Without much experience in learning technology, it also lacks the skills to deeply and systematically explore others' technical backgrounds, technical details, or implementation techniques. Consequently it cannot learn well. This can be compared to cooking a dish. Why it is so many people cannot cook a dish with a recipe in hand? It is because they do not know the original taste and can hardly have the right feeling for it. Naturally they do not know which people the recipe will appeal to, how the recipe has come into being, how to add a little salt, add certain MSG, heat the oil to 70% heat, or fry the ingredients to medium well. Recipes are like textbooks, like a sum-up of cooking experience; people who do not cook need to fully understand and practice those basic steps and details in the book before achieving success. It is the painful process without any achievements that nurtures the ability of technological innovation and management of an enterprise. But many enterprises cannot endure this painful process.

5. Technological innovation strategy closely integrated with R&D mode, business model and business operation mode

The technological innovation strategy is to integrate the R&D mode, business model, and business operation mode, which means technological innovation, has to be enterprise-focused. In the case of technological innovation in technical institutes, it is hardly possible to put the technology, products, market, and business model together rand logically make the new technology take root, bloom, and bear fruit. Technical success has to be reflected in product success, and product success has to be reflected in profits. Business leaders and technically innovative personnel with business acumen and market awareness should be aware that technological leadership, exclusiveness, and advancement should be based on the competitiveness, profitability, and market share of the enterprise or product; otherwise it will be a waste of capital and resources and result in self-destruction. Industrialization of scientific and technological achievements should be enterprise-oriented and center on value creation. Static state-of-the-art technology looks beautiful, but the criteria for judging new technologies should at least include both technical and market aspects, because companies, after all, are not purely technical institutes, and the value of new technologies and the success rate of technological innovations can only be tested in the marketplace. Otherwise, there will occur tragic results.

The author specifically summarizes the above five factors because the success of technological innovation in an enterprise is closely related to them. Each of these factors will determine whether technological innovation can be sustained, and will test the will and determination of the enterprise to carry on technological innovation, and temper the chain of innovation. The five factors are very specific interpretations of the general path of technological innovation in an enterprise. No matter whether the formation of the five factors is contingent or arises out of institutional necessity, they decide how far an enterprise can go on the innovation path, and whether an enterprise can "constantly put forward new ideas, new theories, new methods and new inventions, and enhance the ability to create value with innovation".[9]

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Logical questioning of the government on promoting technological innovation in enterprises

1. How to set the source of technology upgrade?

Some manufacturing industries in some countries importing technologies usually implement the digestion and absorption strategy: introducing foreign advanced technology—localization—selfdevelopment. The core of the strategy is to take importing foreign advanced technology as the target and localization as the means of digestion in the hope of finally achieving independent technological innovation. But the strategy locks the source of advanced technology in advanced foreign technologies and ignores the market demand for technology localization. As a result, even if the new technology being absorbed and digested fills a gap in China, it is very difficult to generate benefits and application value. This is because the imported technology is actually a product, in which the condensed knowledge and experience are "black boxes" for the importer and cannot be mastered simply by purchasing and using it.[10] Therefore, the sources of technological development should be diversified. As well, governments and enterprises must have a clear idea on what kind of new technologies should be developed. The advanced nature of a technology must meet the long-term goal of the enterprise. Any new technology, which digresses from the long-term goal of the enterprise, will lead the enterprise astray, and the wrong technical route will destroy the enterprise. It is important to avoid "putting bets on" a technological concept or technology track, and more importantly, the government should refrain from "locking up the technological track". Especially in the emerging industries, the government should control its own impulse to intervene.[11]

2. How should the government define the boundaries of promoting technological innovation?

The role of the government as an anchoring force to promote technological innovation in enterprises should be as follows: nurturing and playing the roles of "nanny", "insurer", and "security guard" in management of technological innovation, shifting the sense of superiority out of regulation into the sense of accomplishment out of service innovation.

Firstly, the government cannot directly force the market and the enterprise to make choices. The space for innovative imagination should be left to the enterprise, because the government's choices are often not the optimal choice, and in policy-making projects the government is often forced to do something, and the parties involved are apt to gain quick success. Governmental departments must strictly follow the negative list and power list to prevent the subjective initiative from becoming an objective impediment. The government's concern should be to provide enterprises with macroeconomic management information on economic operations, to provide relevant policies and information on the developmental direction of the industrial system, and to provide policies and information on the adjustment of the economic development and industrial structure due to energy and environment issues, which are the strengths of the government and where their obligation lies. The government should focus on facilitating the evolution of the industrial system and promoting technological innovation in enterprises with external constraints. It is necessary to "clarify the border and scope of the government's intervention in national science and technology policy-making, highlight the 'leverage effect' of governmental intervention, abide by the laws of scientific and technological development, create an innovative and orderly market environment for science and technology, and provide good governance in science and technology innovation".[12]

Secondly, the government should strive to nurture and play three roles in scientific and technological innovation: “nanny”, “insurer”, and “security guard”. Successful companies, having greater vision than the government, should be encouraged to be “nannies” as well, so as to prevent corruption and monopolies. The government can encourage them by providing tax incentives for venture capital and venture capital funds. The companies will be motivated by profits, and the government will draw less suspicion of direct market intervention. Meanwhile, the government should encourage and support various types of insurance and venture capital institutions to be “insurers”, providing basic economic and social security for innovators, so that innovators can make a comeback in case of failure. Of course, the government is duty-bound in this respect. The government should also encourage trade associations and intermediaries to work together as “security guards” to maintain the market order and punish those who breach rules and regulations. To this end, the government must become the most reliable “security guard”. Still, the government should encourage enterprises to participate in relay innovation in the industrial chain. “The stages of relay innovation are: confirming the demand, locking the target, cooperation negotiation, handshaking, and ability inheritance”.[13]

Thirdly, all policies and laws should stand up to all parties’ “impact” test, with compatibility and maneuverability being taken into consideration. Policies should be different from laws: a policy is to adjust short-term behaviors, while a law is to ensure the development of long-term strategy and concept. “In formulating industrial policies to stimulate enterprise innovation, the government should differentiate innovations based on their difficulty, depth and potential value: increase early support efforts for technological innovation projects containing higher technology, promote substantive business innovation, and provide reasonable guidance and appropriate support to enterprises engaged in low-level technology innovation. When providing subsidies in the late stage, the government should screen the innovation achievements, raise the selection criteria and improve the overall quality of innovation”.[14]

3. What is the focus of the government’s reform of science and technology system?

Currently, some rules regarding application of technological innovation projects are still quite stereotypical in China with complicated procedures. Some of the topics of technological progress may not come from the enterprise or the market demand. Most research work in colleges and universities is isolated without participation of enterprises or industries, and many of the achievements cannot be directly industrialized. Moreover, the immense “pilot test death valley” between the achievements and mature technologies stays unfilled, making the gap between achievements and industrialization even greater.[15] Therefore, to promote technological innovation in enterprises and prevent technological innovation and industrialization from turning into two separate things, the government must first straighten out the relationship between technological innovation, achievement evaluation and the market before streamlining the link of “transformation of achievements”.

Conclusions

How to build the institutional logic for technological innovation in enterprises and governments? The last question the paper raises is how can the operating mechanism of technological innovation be duplicated? How can the genetic mechanism of technological innovation in enterprises be formed? How can technological innovation to managerial innovation be promoted, turning innovation into cultural

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selfconsciousness of enterprises and governments with institutional and managerial power, creating truly innovative enterprises and countries so as to "gain the space for institutional recognition, amplifying the power of the mechanism to infiltrate, and injecting improved genes into iteration of the mechanism"?[16]

How should enterprises and governments encourage innovation? Idealism is the spiritual power of doing business. Effective incentive is the physical power of doing business.

How can the two be effectively combined?

With the formation of a logical system, technological innovation can be sustained. This is exactly the answer this paper seeks. "Institutional innovation is the basis for technological innovation, with the former ensuring the latter has the soil to grow. Therefore, to emphasize technological innovation, to obtain lasting technical superiority, we must lay a good foundation of institution".[17]

Only with the power of the institution, the power of management, and the power of culture, can we pursue everlasting innovation.

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