Wang, Yuqiu

Article

Promoting innovation ecosystem from knowledge supplying side

Management dynamics in the knowledge economy

Provided in Cooperation with:
National University of Political Studies and Public Administration, Bucharest

Reference: Wang, Yuqiu (2017). Promoting innovation ecosystem from knowledge supplying side. In: Management dynamics in the knowledge economy 5 (1), S. 137 - 147.

Management Dynamics in the Knowledge Economy
Vol.5 (2017) no.1, pp.137-147; www.managementdynamics.ro
ISSN 2392-8042 (online)

Promoting Innovation Ecosystem from Knowledge Supplying Side

Yuqiu WANG
Linyi University
Shuangling Road, The Professor Garden 93#101, Linyi City, 276005, China
wangyuqiuvip@126.com

Abstract. *Innovation and development paradigm has dominated the world since the 19th century. In the era of industry 4.0, innovation ecosystem has been advocated globally. There are different innovation paradigms in history. Before 1960s, the competitive and monopolized paradigm was dominative, while between the 1970s and 1990s, the cluster and innovation valley paradigm had played a key role. In the 21st century, with the advent of industry 4.0, the innovation ecosystem paradigm is advocated globally. Accordingly, there exist different innovation strategies, in reality, considering different economic and social context. However, no matter if having in mind developed or developing countries, the ecosystem paradigm has high rewards for different companies and society. There is also evidence showing that research and development by top universities and research institutes have high productivity and benefits for enterprises and society nowadays, no matter the development state of the areas considered. The author analyzes by literature review and case study the necessity, feasibility, strategy and approaches of innovation ecosystem from a knowledge supplying side. The strategy and approaches include collaboration between university, industry, agriculture and government, talents education, knowledge diffusion, patent purchasing, technology tailoring, consulting, human resource training and platform construction. Science community also takes the role of standards development and maintaining, high technology forecasting and innovation monitoring. The patent office, start-ups, spin-offs and innovation labs act as the links between science, technology, and application.*

Keywords: *innovation ecosystem, knowledge supplying, knowledge diffusion, technology forecasting, knowledge platform.*

Introduction

The concept of innovation ecosystem comes from the idea of natural ecosystem. Different species adapt to each other and to environment for survival. They co-exist and co-evolve in the course of ages. In innovation activities, the collaborative and coevolving mechanisms are the effective and optimal choices for multiple actors.

The innovation and development paradigm co-evolves with global, national and regional economic, politic and technological context. In the era of industry 4.0, the innovation ecosystem paradigm has been universally

advocated. In 2004, the US Council of Competitiveness put forward the concept of "innovation ecosystem" which emphasized on the interaction between enterprises, governments, educators and workers to establish a new relationship and form an innovation ecosystem. Nevertheless, what are the effective strategy and approaches to choose in a different context? How to deal with the conflicts between efficiency and effectiveness, between competition and collaboration? What is the dynamics of sustainable innovation and development? Moreover, how to decrease the risk and cost of innovation activities? In this paper, the author puts forward the hypothesis of promoting innovation ecosystem from a knowledge supplying side considering the characteristics of the knowledge economy. The author tests the hypothesis through literature review and a case study from both historical and reality perspectives. Finally, a conclusion is drawn and some suggestions are put forward (see Figure 1).

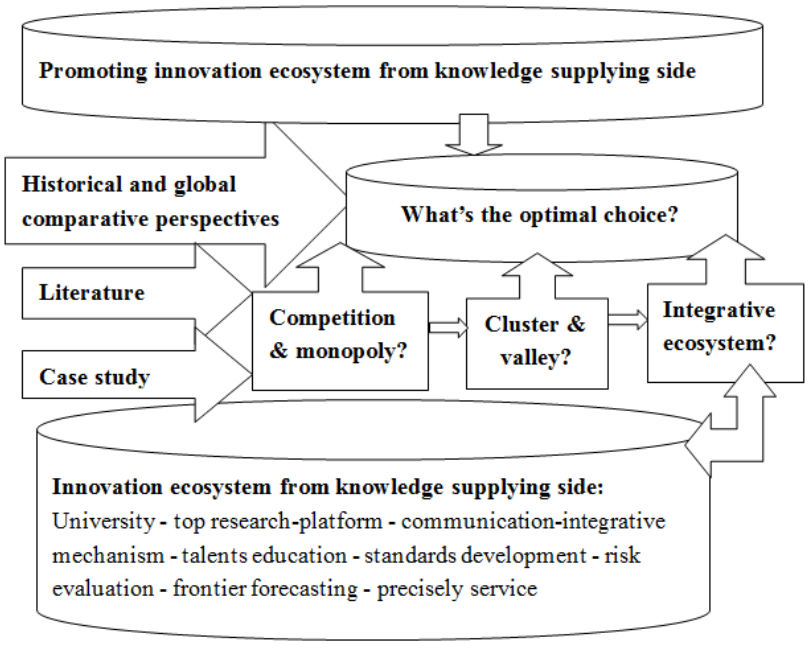

Figure 1. Outline of the study

Literature review

Alfred Marshall (1899) first put forward the term "agglomeration", which means that when firms that are more relevant cluster together, their costs of production may decline significantly. In addition, they can gain more profit, for the agglomeration may attract more suppliers and customers than a single firm could achieve alone. However, evidence shows that such

kind of development model may create problems of crowding and traffic congestion.

Eric Dahmén (1950) launched the term "development blocks" for economic development supported by high technology and special policy. He was inspired by Joseph A. Schumpeter's theory of entrepreneurship, capital and value creating, disruptive innovation (Schumpeter, 1943, pp.81-84).

Christopher Freeman (1988) and Bengt Åke Lundvall (1988) introduced the idea of "national innovation system" which embraced not only the primary actors of entrepreneurs, companies, and capital, but also national regulation of labor markets, factor markets, education and other policies into the framework for economic development.

Michael Porter (1980) published his book "The Competitive Advantage of Nations" in which he introduced the concept of "clusters" as a strategic advantage for economic development of industries, regions, and nations.

James Moore (1993) first introduced the term "business ecosystem" in his study. Since then the term "innovation ecosystem" becomes more and more popular in government white papers for economic development and academic papers on global innovation and competition. Most breakthrough innovations do not succeed in isolation. They need complementary innovations to attract customers. Clearly, operating in an innovation ecosystem - the synthesis of your new offerings and other firms' that creates a coherent customer solution-carries risk.

Andrew and Sirkin (2006) highlight the importance of deciding what role to play in an innovation ecosystem. Select your role depending on the nature of the innovation, the capability requirements, and the investment requirements. Compared to development blocks or clusters, innovation ecosystem introduced little new in concept until now. In the industry 4.0 era, innovation ecosystem means more than the former concepts. It emphasizes on the interaction between innovation units such as university, industry and other innovative organisms, communities across regions and nations to global dimensions. The main novelties for today's innovation ecosystems can be realized from flexible platform and networks. Any entrepreneur with a good idea can, irrespective of geographical location, launch business application platforms and construct an innovation ecosystem to avoid risks and improve efficiency and effectiveness.

In 2010, Stanford University launched the international innovation ecosystems network in cooperation with selected partners in Finland,

China, and Japan. At the same time, innovation ecosystems denote Information and Communication Technology Platforms like Apple's iPhone, Google's Android, cloud computing and software platforms dominated by companies like Microsoft, Amazon, etc.

In knowledge economy and industry 4.0 context, promoting innovation ecosystem from a knowledge supplying side is embraced by multiple stakeholders as science community, company and government. Universities are the main stream of knowledge discovery and production. In America, 56% of the basic research is being conducted in universities. Many frontier topics, such as astrophysics, condensed matter physics, particle physics, and plasma spectroscopy, neuro science, bio-fuel, cancer genetics, hybrid corn, water processing, microbiology, molecular genetics, geology, traditional medicine ,nuclear magnetic resonance, terrestrial and planetary atmospheres, visualization, simulation, the renewable energy materials, energy and matter, accelerator physics, nuclear physics, aging, bio-engineering, computer modeling, ultra-light, hi-strength aluminum composite conductors, digital computer, tornado simulator for wind energy, high resolution virtual reality, etc., are studied coherently at universities and form a value-creating cycle as talents education- citation and open access-application and innovation.

Diana Crane (1972) reveals that the invisible college, science community and high-yielding scientists play important roles in promoting knowledge diffusion and form academic circles, which can decide knowledge distribution and knowledge life cycle. B. Latour (1987) regards culture as a network of associations and focuses especially on the relationship between science, technology, and society. He highlights the function of citation, argument, and rhetoric.

George Por (2001) has launched the term of knowledge ecology and regards it as a perfect system of knowledge exchange network. Communication is the central link between knowledge innovation, evolution, and sharing. The mutual influence and mutual promotion of individual mental models provide a basic structure in knowledge ecosystem. A virtual learning community is a system in which people exchange thoughts and knowledge and integrate individual knowledge into systematic knowledge.

Richard Whiteley (2000) analyzes the intellectual and social organization of science, the changing nature of knowledge production, the professionalization of scientific work, the scientific discipline and organizational specificity, the social and cognitive configuration of laboratory activities, the role of cooperated research, the standardized

symbol systems and the increasing mutual dependence, control over standards, formal publications as control systems in modern science.

F. Murray (2002) uses a case study of an emerging area of bio-medicine-tissue engineering to trace the citation network of patents, papers, inventors, and authors, and found that there exist distinctive scientific and technological networks. Co-mingling exists through funding, licensing, consulting and advising.

D.N. Resende and M. Bravo (2016) introduced a project to build a National Innovation Network based on the University Technology Transfer Offices (TTOs), incubators and science parks. The University Technology Enterprise Network (UTEN) was created to synergize the growth and stimulate new competencies in international technology transfer and commercialization to facilitate industry access to leading markets worldwide.

Case study

The following cases show the role of knowledge supplying side from the university in promoting innovation valleys or districts. For example, the Silicon Valley is supported by Stanford University, Santa Clara University, San Jose State University, Carnegie Mellon University, West Coast Campus, which offer academic frontiers and consulting support for start-ups and spin-offs. While University of California - Berkeley, University of California - Davis, University of California - Santa Cruz, California State University - East Bay, and California State University - Hayward offer them high-quality graduates and research resources for innovation.

Another case is GE who has been quickly adapting to the digital industrial business and has created an extraordinary performance. GE adopts the Predix based applications which are connecting industrial assets, collecting, and analyzing data and delivering real-time insights for optimizing industrial infrastructure and operations, including GE and non-GE assets. Global knowledge exchange system, "GE store" for all business sharing technology, market, structure, and intelligence and promote cross-border innovation and application.

Universities play a key role in innovation through top research and knowledge transfer. For example, at Texas A&M University, the Texas A&M AgriLife Research is the source for relevant research and critical issues: from plant diseases, animal parasites, grass and forage production, and the

economical feeding of dairy and beef cattle. Researchers keep a connection to farming and ranching while developing crops with enhanced nutrition, discovering innovative renewable energy resources, and implementing new methods to improve air and water quality. They serve all 254 counties in Texas and have 15 facilities around the state.

Colorado State University`s professor Jennifer Dimas (2014) studies the emergence of innovation cluster in the agricultural value chain along Colorado's Front Range and identifies trends in innovation as well as factors that position Colorado's Front Range for the emergence and growth of an innovation-led industry cluster in the agriculture and food system. The study looks at who is innovating in agriculture and food-related industries within Colorado by examining where scientific publications and the US patents originate within the state. This provides a cross-sectional view of Colorado's evolving science base as well as its output of technological innovations.

In 2014, the EU launched the largest scientific research and innovation project in history: "Horizon 2020". The holistic idea is to engage in responsible research and push innovation. It considers excellent science as the foundation of tomorrow's technologies, jobs, and well-being. Europe needs to develop, attract and retain research talent and access to the best infrastructures, integrate part of the activities, working beyond "silos" and widening participation.

Findings

Innovation ecosystem is a dynamic term in history

Innovation paradigm evolves from regional development clusters and glomeration to global innovation ecosystem. In different developing stages and contexts, different strategies are adopted. In global and knowledge economy time, aided by information technology and big data science, innovation ecosystem is advocated globally by multiple stakeholders such as government, university, and companies.

The fundamental science has powerful potential for innovation

The new discovery such as nano and computer science has been integrated into many fields and brought about a revolution in the industry, business and daily life. The quantum information science (QIS) has been widely spread in other areas of science. There is great potential in QIS when considering institutional boundaries, education and workforce training,

technology and knowledge transfer, materials and fabrication, etc. When more and more industries and service departments integrate QIS into products, process, and business, innovation scenario will emerge and form a self-adaptive innovation ecosystem.

Universities and research institutes play key roles in innovation ecosystems

Evidence shows that the R&D intensity investment in industries is grossly ineffective investment nowadays. The technology life cycle is shrinking and companies need to preserve its traditional advantages and consider quality improvement with high-technology adopting in time. It is more efficient for enterprises to cooperate with universities and research institutes for technology frontiers forecasting and strategy designing, as well as human resource training than to invest on R&D by themselves.

Universities take the responsibility to educate qualified graduates to spread science and put results into practice. The discipline and curriculum are arranged systematically and rationally for the students to learn. If the students are well educated they can master the knowledge body for a profession and learn to learn, learn to think, learn to innovate. Their brain structure and function are trained for more rigor, more logic, are smarter and more sensible. They can interact and inspire each other at the workplace. Knowledge is embodied in individuals and embedded in the environment. Human being and things around interact with each other, which can inspire new ideas, concurrent thinking, and collaborative innovation. So where the intellectuals assemble, where there will be the center of new ideas and systematic thoughts, which are the original and assurance of innovation.

Suggestions

Encourage top research and enhance collaboration between university and company

The scientific rigor, originality, frontiers, research ethics and social responsibility should be advocated and practiced by scientists, scholars, and students. Funds from government and companies should support top research and bring together the best research teams that are working at the frontiers of cross-disciplinary and form an innovation ecosystem. Innovation platform, the patent office, and knowledge base should be the bridge to link research, innovation, production and marketing.

Enhance high-quality graduates supplying with rigor science and research training

This quality and literacy of graduates should be further emphasized: integrity, resilience, creativity, initiative, confidence, humanity, value making, autonomy and independent thinking. Evidence shows that students who engage in research have careers that are more successful after graduation. These students go on to become the next generation of scientists, engineers, teachers, and leaders in government and industry and will act as media to link science community with industry sectors and promote innovation. Students can participate in project and conferences and can publish a paper, apply for patent or launch start-up companies based on their research projects and experience.

Encourage interdisciplinary projects and integrate high-tech in education

University curriculum should integrate new science discovery in time, encourage interdisciplinary projects, and combine core courses to help students develop a deeper understanding of the world of science-technology and society. For example, the nanoscience and technology, energy, and life sciences can be integrated into medical, engineering, science and arts, and form a curriculum cluster. Students can participate in collaborative projects of interdisciplinary and cultivate cooperative and initiative spirit and multiple perspectives.

Enhance innovation potential assessment and technology forecasting

Science community takes the responsibility for innovation potential assessment and technology forecasting. Knowledge has certain life-cycle from emergence to wide recognition and application. Science community can stimulate and regulate innovation from the upper stream by frontier technology forecasting , quality controlling, risk monitoring, and preference analysis, etc. Science seeks for truth and good. Scientists are well educated for the mission of science and produce systematic knowledge under rigor criteria and norms. They also decide what is to study on and on what scale science can be open to the public (see Figure 2).

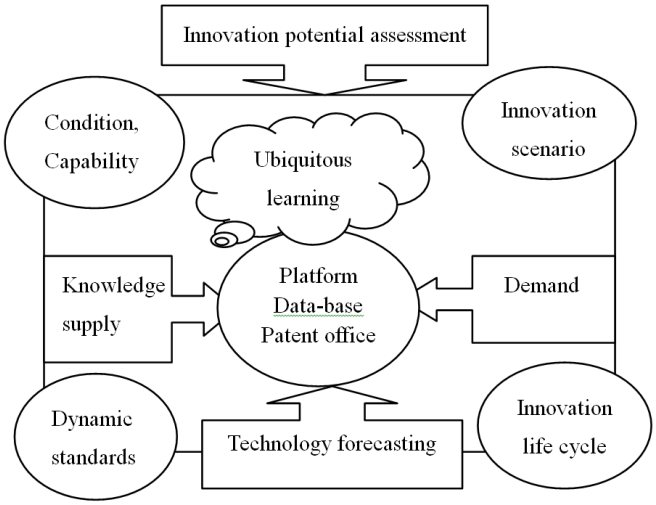

Figure 2. Innovation potential assessment and technology forecasting

Assessing the need for complementary innovations is one key part of a successful innovation game plan. 1) pick your playing field-markets where the best opportunities are hiding and where you can play to your strengths; 2) analyze major innovations in those markets to identify criteria your opportunity must meet to succeed; 3) develop a strategy for ensuring that your project meets those criteria; and 4) fund the project conservatively at first to force your innovation team to learn and adapt as it moves forward.

Construct knowledge platform and promote communication

Firstly, scientists and engineers from cross-disciplinary fields can communicate with each other and exchange knowledge to promote knowledge diffusion and innovation. Secondly, enhance communication between specialists and the public. Asymmetric information and incomplete information between knowledge producers and applicants often hinder S&T innovation. Scientists have the responsibility to enlighten the public of the fact and risk to avoid kinds of man-made disaster and control the uncertainty of innovation. The science community should establish risk-sharing and forecasting mechanisms and construct knowledge sharing platform for open access. Science community can offer real time experts online service and interact with the public to enlighten their science awareness and to promote innovation.

Summative discussions

According to Say's law, supply creates its own demands (Jea Baptiste Say, 1803). We need to keep sensitive to high technology and create new demands for the market, to improve life standard and maintain a virtuous innovation ecosystem accordingly. We can also use big data to evaluate the preference of consumers and produce ahead of time to guide market and innovation. Science community takes the responsibility to supply enterprise, government and the public with top research, frontier technology, liberal knowledge, standards, as well as a high-quality human resources. With the aid of big data and the collaborative platform, the academic findings and insights can spread swiftly and be absorbed more conveniently by various members, which is likely to become the trigger for innovation emergence. Universities should take their responsibility to educate high-quality graduates. The academic journals and press should take their responsibility to public top research and liberal works, while knowledge platform should be constructed for open access and communication. Meanwhile, we highlight the precisely evaluating and forecasting of high technology and academic frontiers aided by big data and bibio metrics, simulating technology. Science community, intermediary, the patent office and trans-disciplinary projects, international academic exchange, learning society play key roles in the process. The dynamic standards, policy, and ethics are guarantees for innovation ecosystem.

Further study. Innovation from knowledge supplying sides should be carried out systematically and step-by-step. The present study could be extended on the global research frontier scenario and map the diffusion paths to find the effective mechanism from research to innovation.

Acknowledgment: *The paper was reported at the 14th Triple Helix Conference and funded by Philosophy & Social Science Project of Linyi University (No. 15LUZS08, 2015).*

References

Andrew, J.P., and Sirkin, H.L. (2006). *Payback: Reaping the Rewards of Innovation*. Boston, Massachusetts: Harvard Business School Publishing.

Crane, D. (1972). *Invisible Colleges: Diffusion of Knowledge in Scientific Communities*. Chicago. IL: University of Chicago Press.

Dahmén, E. (1950). *Svensk industriell foretagarverksamhet*. Stockholm: Industriens Utredningsinstitut.

Dimas, J. (2014). Is global warming being accelerated in the Arctic?. *Source*. Retrieved from http://source.colostate.edu/wallenstein-research/.

Freeman, C. (1988). Japan: A new national system of innovation? In G. Dosi, C. Freeman, R. Nelson, G. Silverberg, and L. Soete (Eds.), *Technical Change and Economic Theory* (pp.330-348). London: Pinter Publisher.

Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge, Massachusetts: Harvard University Press.

Lundvall, B.A. (1980). Innovation as an interactive process: From user-supplier interaction to the national system of innovation. In G. Dosi, C. Freeman, R. Nelson, G. Silverberg, and L. Soete (Eds.), *Technical Change and Economic Theory* (pp.349-369). London: Pinter Publisher.

Marshall, A. (1899). *Economics of Industry*. London: Macmillan.

Moore, J.F. (1993). Predators and Prey: A New Ecology of Competition. *Harvard Business Review*, 71(3), 75-86.

Murray, F. (2002). Innovation as co-evolution of scientific and technological networks: exploring tissue Engineering. *Research Policy*, 31(8–9), 1389-1403.

Por, G. (2001). The knowledge ecology. *Bized*, 6(11), 30-33.

Porter, M. (1980). *The Competitive Advantage of Nations*. New York: Free Press.

Resende, D.N., and Bravo, M. (2016). A Top-down and Bottom-up Approach to Improve Regional Innovation Ecosystems in Portugal. *Brazilian Journal of Operations & Production Management*, 1(1), 86-93.

Schumpeter, J.A. (1943). *Capitalism, Socialism, and Democracy* (6 ed.). London: Routledge.

Whiteley, R. (2000). *Himoff!*. London: Orion Media.

Received: October 29, 2016
Accepted: March 19, 2017