A New Approach for Constructing Self-Evolution Three-Dimensional Innovation Ecosystem of a Regional Digital Economy

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Abstract. Innovation has some new changes today. Competition evolves into the competition of the ecosystem between companies, which is very obvious in the digital economic activities. However, many innovation systems have been only analyzed from the perspective of statistics and industrial chain with a single dimension, linear and static structure, which were not suitable for the development of the digital economy. This paper proposes a new approach to construct a three-dimensional innovation ecosystem of regional digital economy, which can self-evolution and includes six sub-ecosystems of innovation firms, human resources, financial capital, technological innovation, intermediary services organizations and policy environment. Disruptive innovation is the most important action. It is useful by approved of a case study. Using the ecosystem, the new business growth points and industrial formation are cultivated automatically.

1 Introduction

In the paper [1], innovation ecosystem has become an emerging research method because the innovation system fails to distinguish innovation events from innovation structure. We should not only pay attention to the organizational structure of innovation, but also pay attention to the events of innovation process. Research and technology development organizations are regarded as the important part of an innovation system [2]. Scientific and strategic planning is engaged to foster the innovation [3]. In the innovation system, technology is the crucial factor accepted by many enterprises. So the technology-driven business model and strategic planning stimulate the enterprises’ growth [4]. Strategic orientation plays a key role in the sustainable growth of organizations [5] [6]. In many papers [7] [8] [9] [10], the impact of strategic orientation on the competitive advantage of a company has been extensively discussed. The interaction orientation is also important to improvement of a new product [11] [12]. The higher corporate performance is the target of company [13] [14] [15]. These arguments, like technology, strategic planning, etc. have been discussed to improve the competition of the company, while co-evolution between enterprises and other innovation factors [16] [17] [18] [19] [20] [21].

With the development of Big Data and Artificial Intelligence technology, digital economy is the inevitable trend of the future industrial economic development and the new driving force of the social development. In this paper, we propose an approach to construct three-dimensional innovation ecosystem and the self-evolution model, which makes the ecosystem from plane to three-dimensional.

2 The Plane Innovation Ecosystem

Many researchers have discussed innovation ecosystems which we regard as the plane innovation ecosystem in this paper. The plane innovation ecosystem of a regional digital economy, consist of six factors, such as the innovation firms, financial capital, innovation technologies, human resources, policy environment and intermediary service organizations, which are related with the digital economy or relational digital economy. It is shown in the figure 1.
Figure 1. The plane innovation ecosystem.

In the figure 1, two-way arrows mean they interact with each other. We can strengthen the affection through the activities of forum, production exhibition, technology salon, IPO road show, etc. Digital economy policy environment includes tax incentives, preferential reemployment, rent subsidy, training, promotion, post-graduate, incubators and accelerators, industrial parks etc. Digital economy innovation firms include the sustaining innovation companies [22][23], half-disruptive innovation companies and disruptive innovation companies in those software and hardware fields, which include the produce data, collecting data, data analysis and so on. In this paper, we emphasis on the companies because the firms are the main body of the innovation and can create the immediate value to the social development. Digital economy financial capital includes venture capital investments to support projects. Digital economy innovation technology includes the intellectual property, scientific and technological achievements, basic research results and theories and so on. Digital economy human resources include the teachers, professors, engineers and researchers who are engaged in the technology or application or theory research in the field of big data or artificial intelligence. Digital economy intermediary services organizations include intellectual property agency, intermediary service agency for transformation of scientific and technological achievements, etc.

3 Three-Dimensional Innovation Ecosystem

There are six innovation sub-ecosystems in the three-dimensional innovation ecosystem, shown in the figure 2. They are mutual connection and enhancement each other. In each sub-ecosystem, there are three parts of resources to respectively encourage disruptive innovation, half-disruptive innovation and sustaining innovation to create new fields or new business formats. The six innovation sub-ecosystems are working together to encourage some new start-ups in new fields.

There are three types of venture capital investments to support the disruptive innovation, half-disruptive innovation and sustaining innovation in the capital innovation ecosystem. Policy environment ecosystem includes different policies to support the disruptive innovation, half-disruptive innovation and the sustaining innovation like the plane innovation ecosystem. There are three types firms, which are engage in disruptive innovation, half-disruptive innovation and sustaining innovation respectively in the innovation firm ecosystem. In the intermediary service organizations ecosystem, there are different institutes to serve different technology innovation and intelligence property. Human resources ecosystem includes researchers, professors and studies who are engaged in different fields of the digital economy. Technology innovation means the achievements of scientific research, just like the internet of things, artificial intelligence, block chain, etc.

There are two value network systems in three-dimensional innovation ecosystem, which is shown in the figure 3. The $O$ and $O'$ points mean the marginal market and main market respectively. $XOY, XOY'$ represent an old value network system and a new value network system respectively. $Y$ and $Y'$ axis mean the performance of the product. $X$ and $X'$ axis mean the time. The $Z$ axis means different customer wants in the market. In the old value network system,
the enterprises, as the main body of the market, constantly meet the needs of the high-end and low-end market through the sustaining innovation methods, such as reducing costs, improving management efficiency, improving performance of the product. The $ef$ and $e'f'$ lines mean the high-end market demand and the low-end market demand respectively. The $A$ and $B$ (red) rays show that different enterprises continuously improve product performance through sustaining innovation, and gradually meet the demand of different market. Half-disruptive innovation happens from the $A$ ray to the $B$ (red) ray.

![Figure 2. Three-dimensional innovation ecosystem.](image)

In the ecosystem, by the government’s policy guidance to promote the financial, human resources, enterprises, intermediary service institutions, other subsystems and constantly enforce the existing industries. When the company wants to survive by avoiding to compete with the big company, they will take the half-disruptive innovation to develop. Because, these big companies pursue sustaining innovations at the higher demand of their markets, do not open the door at the bottom or low demand of the market. Because by charging the highest prices to their most demanding and sophisticated customers at the top of the market, they will achieve the greatest profitability. The half-disruptive innovation allows a whole new non-population of consumers at the bottom of a market by lower gross margins, smaller target markets, and simpler products and services that may not appear as attractive as existing solutions when compared against the big company.

![Figure 3. Three-dimensional value network system.](image)
The $C$ (blue) ray means the disruptive innovation. The $e^{-f}$ line means the unformed market demand. In $XOY$ value network system, there is not a very good market with a low profit, unreliable environment and high risk. We can take disruptive innovation to provide customers with simple, cheap and convenient solutions, and strive for the customers, whom the competitors have not contacted. This is the most core action of the ecosystem.

4 The Self-Evolution Model

With the development of new digital technology, local government can make new policy to eliminate the backward and encourage the advanced technology by disruptive innovations. The three-dimensional innovation ecosystem does can self-evolution through the circle-function of the policy, project and industry in the figure 4. Policy includes the tax incentives, industrial development planning, science and technology plan, etc. The project includes the scientific research projects, government subsidy projects, projects of technological transformation, etc, which are in the digital economy. Industry is the new start-up, new business format. Policy, project and industry interact to form a virtuous circle system.

5 A Case Study

In China, we all know that the Guiyang is famous of BIGDATA now. This is a city in the southwest corner in China, which was jokingly called the provincial capital without a sense of existence. However, from 2013 to 2018, through disruptive and sustaining innovation, the big data industry has successfully been developed. It was from nothing to rooting and then to succeed today. A magnificent counter attack was happened in the city. It has led the city to develop with a rare double-digit growth rate in China's digital economy. It drives the transformation and upgrading of traditional industries with innovation, and becomes the benchmark for the less developed regions.

In November 2012, the opinions on accelerating the leaping development of information industry was issued by the government of Guizhou province, which clearly stated that "building a big data industrial pattern of one area, two poles and seven bases ", and striving to seize the opportunity of the new generation of information technology development.

In July 2013, the development strategic plan of cloud computing industry in Guizhou Province made it clear that by setting up cloud computing Industrial Park, formulating supporting policies and implementing six key projects to build a complete cloud computing industry chain.

In September 2013, a strategic cooperation framework agreement was officially signed, between Guiyang government and Zhongguancun Science and Technology Park Management Committee, to build Zhongguancun and Guiyang science and technology park.

By end of the 2013, the Guizhou information park project of the china telecom cloud computing with a total investment of 7 billion yuan, the cloud computing center project of the china unicom (Gui'an) with an investment of about 5 billion yuan and the data center project of the china mobile (Guizhou) with a total investment of 2 billion yuan were built in Guizhou.
In 2014, the government of Guizhou Province has issued that the opinions on accelerating the development and application of big data industry and the outline of the development and application plan of big data industry in Guizhou province (2014-2020). The digital economy development plan of the Guizhou province (2017-2020) was issued in 2017.

The Big Data Expo has seen five successful runs, since its launch in 2015. In 2017, it was officially upgraded to a national expo. It is the world’s first big data-themed expo, which has become a trendsetter of global big data industries and the most authoritative and “international” industry sharing platform.

According to the official statistics, by 2018, there are more than 8900 big data enterprises in Guizhou province, contributing 33 percent to the economic growth of the province. The big data has injected a new momentum into the striding development of the Guizhou's digital economy.

By analyzing the process of big data development in Guiyang, we can see that the three-dimension innovation ecosystem with the characters of disruptive and sustaining innovation, and the self-evolution model have made the development of the Guizhou's digital economy. The Guiyang leads the city from the edge to the world stage by developing the big data industry. This is also the disruptive innovation of a region’s development strategy. This is the first time for Guiyang to stand at the international forefront in a real sense. In addition to the promotion of its discourse power, the weight of its economy in the China national territory has also changed significantly.

6 Conclusion

In this paper, the approach of constructing three-dimensional innovation ecosystem is first mentioned and very useful to develop digital economy of a region. There are six sub-ecosystems of innovation firms, human resources, financial capital, technological innovation, intermediary services organizations and policy environment in the three-dimensional innovation ecosystem. Disruptive innovation, half-disruptive, sustaining innovation and self-evolution model are the core portions and the special properties of the innovation ecosystem. Disruptive innovation is the key and important action to make the plane innovation ecosystem become three-dimensional innovation ecosystem.

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