Intelligent Automation And Soft Computing, 2020
Vol.26,no.4,765–771
DOI: 10.32604/iasc.2020.010111

The Construction and Path Analysis of the School-Enterprise Cooperative Innovation Model under the Background of the Open Independent Innovation

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ABSTRACT

The organic combination of the independent innovation and open innovation opens a new pattern of innovation. Under the background of the open independent innovation, the cooperative innovation model of the school and enterprise is established, and an optimal development path model of the cooperative innovation of the school and enterprise based on the fuzzy decision control algorithm is proposed. Based on the rough set theory, a path search model of the cooperative innovation between a school and enterprise is established under the background of the open independent innovation. Under the background of the open independent innovation, the fuzzy decision-making method is used to design the fuzzy decision control algorithm for optimizing the development path of the cooperative innovation between a school and enterprise. The information feature extraction and adaptive scheduling of the cooperative innovation development path between a school and enterprise are carried out by using the adaptive weighting method. The optimal path optimization method is used to optimize the development path of the cooperative innovation in the context of the open independent innovation, so to reduce the cost of the cooperative innovation development under the background of the open independent innovation. The development efficiency of the cooperative innovation in the background of the open independent innovation is improved. The simulation results show that this method improves the development efficiency of the cooperative innovation and reduces the cost of time and economic benefits by constructing the development path model of the cooperative innovation of the school and enterprise under the background of the open independent innovation, so as to promote the development of open independent innovation and cooperation between a school and enterprise innovation development.

KEY WORDS: Cooperative innovation model; development path planning; fuzzy decision control algorithm; open independent innovation.

1 INTRODUCTION

OPEN independent innovation is the core of the national development strategy in the new century and is the key to improve the comprehensive national strength. Scientific research is the source of independent innovation but also the engine and power source of industrial innovation. With scientific and technological breakthroughs, and scientific and technological inventions, along with discovery, its connotation extends to all scientific research results used in production. The important way to realize the independent innovation strategy is to advocate the cooperation between the industry, university and research, and to provide a guarantee for the innovation strategy in academics, talent and practice (LI Ani, Zhang Xiao, Zhang Boyang, et al. 2017). When China emphasizes "independent innovation", multinational corporations have begun to "open innovation" strategies, which has become the trend of international industrial innovation, which we must have a full understanding and response. The development of innovation must clarify the relationship between the independent and open innovation, establish the corresponding integration of industry, look at education and research and the dual core innovation of

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industry so as to implement the open independent innovation and meet the challenge of global open innovation, and provide a solid support system (Lin J M, Ban W J, Wang J Y, et al. 2016).

Open innovation not only makes the innovation development move to a higher stage but also promotes the innovation, adjustment and improvement of higher education, academic, scientific research quality, knowledge structure and innovative talent structure, thus creating a new era of innovation (Ulukus S, Yener A, Erkip E ,2015). The result is a stronger sense of social innovation, faster mobility of human resources, fiercer competition for innovation in enterprises, faster market orientation of new technologies and new products, and better service for the country and society as a result of innovative achievements. The achievements of the innovation will benefit the people better (Chitra K, Jeevarani B. 2013). The newest innovation model not only drives innovation and development but also drives the enterprise innovation, business innovation, economic innovation, scientific and technological innovation, educational innovation, cultural innovation, social management innovation and even political agenda innovation. More vigorously promote the rapid development of the economy and society. In this paper, the cooperative innovation model of a school and enterprise under the background of the open independent innovation is studied, and an optimal development path model of the cooperative innovation in the open independent innovation is proposed based on the fuzzy decision control algorithm. Based on the rough set theory, a path search model of the cooperative innovation between a school and enterprise is established under the background of the open independent innovation. Under the background of the open independent innovation, the fuzzy decision-making method is used to design the fuzzy decision control algorithm for optimizing the development path of the cooperative innovation between a school and enterprise. Under the background of the open independent innovation, the information feature extraction and adaptive scheduling of the cooperative innovation development path between a school and enterprise are carried out by using the adaptive weighting method. Under the background of the open independent innovation, the optimal path optimization method is used to optimize the development path planning of the cooperative innovation between schools and enterprises, and the optimization design and the path planning design of the cooperative innovation model of a school and enterprise under the background of the open independent innovation are realized (Mohan B, Govardhan A, 2013). Finally, the performance test is carried out through the simulation experiment, which shows the superior performance of this method in improving the cooperative innovation ability of a school and enterprise under the background of the open independent innovation.

2 THE DEVELOPMENT MODEL OF AN OPEN AND INDEPENDENT INNOVATION

THE open independent innovation is an advanced stage to include a combination of scientific research and industry. Compared with the traditional transformation mode of scientific research, it needs a more mature and effective technology transformation market environment. Accordingly, it is not only necessary to consolidate and perfect the traditional single core mode of production, education and research, but also to adopt the dual-core model of the scientific research industry, which is beneficial to the transformation of scientific and technological achievements into real productive forces (Okandeji A A , Khandaker M R A , Wong K K, et al.2016).

2.1 Combination of Production, Education and Research with the Single Core Model

The cooperative innovation of industry, university and research is an important means of innovation and development. It is a combination of enterprises, universities, scientific research units and government departments to pursue the goal of innovation and development. Since the 1990s, China has been promoting the integration of industry, education and research on the basis of the experience of developed countries in the world, and it has become an important part of the economic and social development of our country (Zhang R, Ho C K, 2013). At present, the main forms of our country's industry, and university research cooperation are technology transfer, commissioned research, joint research and development, scientific research and research-based construction, scientific research strategic alliance, and co-construction of research and development entities, etc. The above forms are neither comparable nor superior and which way to adopt mainly depends on the cooperator's system relation, interest relation and oneself condition. The combination of production and learning and research has played an important role in integrating innovative resources, improving scientific research ability, solving technical obstacles, promoting the transformation of achievements and promoting the development of industrialization. In particular, the guidance and support for emerging industries, is particularly important. However, at present, the combination of industry, education and research in our country depends more on the government and the department as the leading factor, without the strong conscious consciousness of the main body of cooperation, and the common interest pursuit and incentive mechanism, which makes this combination have the advantages of the mechanism (Wang Y, Sun R, Wang X, 2016). It is difficult to form an effective innovation system and high-end

innovation achievement, because of the congenital defects and constraints on mechanisms. The organic combination of the independent innovation and open innovation opens a new pattern of innovation.

2.2 The Dual Core Model of the Scientific Research and Industry

With the increasing competition between countries and enterprises under the background of globalization, the increasing cost of innovation and the uncertainty and risk of innovation itself, the integration of industry, education and research does not make the scientific research an effective transformation. The ineffectiveness and waste of scientific research and management, the lack of communication and cooperation, and the disconnection between R&D and demand, etc. are to name a few. When the industry-university-research cooperation develops into a dual-core model of scientific research and industrial integration, the scientific research and industrial innovations are "dual", "pluralistic", and no longer "monistic". Recognizing that the scientific research and industry are not only consortia in the innovation systems but also separate the systems and operate in accordance with their respective laws, based on which effective open innovation cooperation can be formed. In the common pursuit of innovation, each does its best, and each doing its part. The integration of the industry, university and research will link the scientific and technological achievements with the industrial economy at a certain stage. The integration of production, education, and research improves the scientific and technological support and the R&D capability (Zhao Qingqing, Huang Tianmin, 2018). The integration of industry, education and research accelerates the transformation of achievements and sets the direction for scientific research. The combination of production, learning and research is the link and bridge, and has obvious advantages in the upstream and middle reaches of the process of technological innovation, in many industries, while many areas still need to continue to strengthen.

3 SCHOOL-ENTERPRISE COOPERATION INNOVATION MODEL

AT present, there are insufficient innovation and uneven innovation abilities in our country. To solve this problem, we must carry out the innovation strategy of the independent innovation and open innovation and must have a macro-innovation strategy layout at the national level. Advocating innovation and encouraging the existence and development of multiple innovation subjects. By following the laws of scientific research, market law, and forward-looking, leading to include an exploratory innovation strategic vision. We should not only focus on guiding and supporting applied research but also continue to support basic research. We should not only attach importance to the core position of universities and scientific research institutions in innovation but also recognize the irreplaceable role of the industry in innovation. In order to get out of the dilemma of innovation, accelerate the development of innovation, improve the ability of innovation, realize the scientific research and production, innovation and industry of the "seamless" docking, and close combination so that the source of innovation cannot roll (Wen Z, Liu X, Beaulieu N C, et al. 2016).

It solves the macroscopic cognition and the microcosmic operation problem, and one is to realize the upgrade from the univariate mode of production, learning and research in the planned economy era to the marketization and globalization of the dual mode of the scientific research industry. It is necessary to solve the problems of the division of labor, cooperation, allocation, evaluation, motivation, goal and reality, achievement and transformation in the process of innovation. To solve the institutional and mechanism obstacles in the process of innovation, to abandon short-sighted behavior in innovation and to make quick and immediate gains. More importantly, it is necessary to fully understand, attach great importance to the enterprises, industries and markets in innovation, show the main position and important role so that the healthy development innovation and, orderly, truly forms a team cooperation. In the context of globalization, in China's leading industries, some large enterprises already have the R & D capability, and gradually become the talent highland but this kind of innovation ability is often ignored. At present, the integration of production, education and research cannot meet the innovation needs of enterprises, resulting in an innovation dilemma, which is neither conducive to the scientific research nor to the enterprises, so that the innovation of the industry-study-research cooperation stays at a shallow level and cannot be further explored. Driven by the newest innovation model, we can provide a better division of labor, allocation, and better responsibility for each other. Since universities and colleges focus on basic research and long-term application research, they are at the high end and the frontier of scientific research, and they are the explorers and pioneers of innovation. Enterprises are also in an open innovation system, doing a good job in the transformation of achievements and marketization of products, promoting enterprise development with innovation and new technology, serving society with the latest innovative achievements, and providing endless power for innovation and to make innovation and development to a new stage.

4 SCHOOL-ENTERPRISE COOPERATION MODELING ANALYSIS

4.1 Open and independent innovation modeling analysis

IN order to improve the development path scheduling model of the cooperative innovation between a school and enterprise under the background of the open independent innovation(Park J J, Moon J H, Kim D I, 2016), first the network structure model of the cooperative innovation development path of a school and enterprise under the background of the intelligent open independent innovation is constructed, and the network partition matrix of the cooperative innovation development path of a school and enterprise under the background of the open independent innovation is assumed as follows:

$$J(x)=\begin{pmatrix} \frac{\partial v_1(x)}{\partial x_1} & \frac{\partial v_1(x)}{\partial x_2} & \cdots & \frac{\partial v_1(x)}{\partial x_n} \\ \frac{\partial v_2(x)}{\partial x_1} & \frac{\partial v_2(x)}{\partial x_2} & \cdots & \frac{\partial v_2(x)}{\partial x_n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{\partial v_N(x)}{\partial x_1} & \frac{\partial v_N(x)}{\partial x_2} & \cdots & \frac{\partial v_N(x)}{\partial x_n} \end{pmatrix} \tag{1}$$

where, $\frac{\partial v_N(x)}{\partial x_n}$ represents the load of the cooperative innovation development path, solves the differential equation, plus obtains the second order gradient of $\nabla^2 F(x)$, and obtains the dynamic model of the innovation development (Moon J H, Park J J, Kim D I, 2016). The dynamic model of the innovation development can be described as follows:

$$\begin{cases} \frac{ds(t)}{dt}=-\beta i(t)s(t)+\alpha r(t) \\ \frac{di(t)}{dt}=\beta i(t)s(t)-\mu i(t) \\ \frac{dr(t)}{dt}=\mu i(t)-\alpha r(t) \end{cases} \tag{2}$$

Assuming that a set of aggregate data sets is composed of l different paths of the cooperative innovation development, the context of the open independent innovation, and the β probability propagates to the adjacent nodes of the development path of the cooperative innovation in the context of the open independent innovation, and is recovered with probability α. There are:

$$\begin{aligned} \varphi(i,t) &= \prod_{j=1,\cdots,n}\{P(j,t-1)(1-\beta)+[1-P(j,t-1)]\} \\ &= \prod_{j=1,\cdots,n}[1-\beta P(j,t-1)] \end{aligned} \tag{3}$$

The formal description of the optimal path optimization model under the background of the open independent innovation is shown as follows:

$$m_{aggr}=MSG\_REP_{BS}\,\|\,SN_{head}\,\|\,data_{aggr}\,\|\,Pos_{aggr}\,\| \tag{4}$$

Therefore, the network structure model of the cooperative innovation development path between a school and enterprise is constructed under the background of the intelligent open independent innovation (BI S, HO C K, ZHANG R, 2015).Figure 1 shows a simulation data comparison diagram of the open structure model.

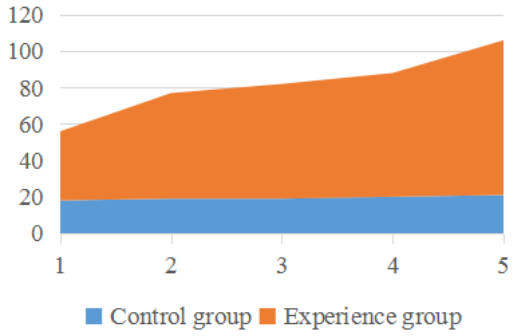

Figure 1. A Simulation Data Comparison Diagram of the Open Structure Model.

4.2 Analysis on the Path of School-enterprise Cooperation Innovation

Under the background of the open independent innovation, the cooperative innovation development scheduling is a linear programming problem, which has m nodes A_1, A_2 … A_n. Based on the artificial algorithm, it optimizes the development path node of the cooperative innovation under the background of the open independent innovation (Ulukus S, Yener A, Erkip E, et al., 2015). Under the background of the open independent innovation, the mathematical expression of the dispatching transportation problem in the cooperative innovation development of a school and enterprise is expressed as follows:

$$\min(f)=\sum_{i=1}^{m}\sum_{j=1}^{n}C_{ij}X_{ij} \tag{5}$$

$$\text{s.t}\begin{cases}\sum_{j=1}^{m} X_{ij} = a_i, i = 1,2\cdots m \\ \sum_{i=1}^{m} X_{ij} = b_i, j = 1,2\cdots n \\ X_{ij} \geq 0, i = 1,2\cdots m, j = 1,2\cdots n\end{cases} \tag{6}$$

In order to improve the ability of the global optimization in the path planning of the cooperative innovation development between schools and enterprises under the background of the open independent innovation (ZHAO N, ZHANG S, YU R, et al, 2017), the difference between the individuals is used as the adjustment factor, which is expressed as:

$$d_i = \sum\nolimits_j a_{ij} \tag{7}$$

Under the background of the open independent innovation, the diagonal elements of the development path of the cooperative innovation between a school and enterprise are described as follows:

$$D = diag(d_1, d_2, ..., d_n) \tag{8}$$

Based on the rough set theory, a path search model of the cooperative innovation development in schools and enterprises is established, and the optimized path search model is obtained as follows:

$$\begin{cases}\rho_t^I = \dfrac{\sum_{1}^{N_I} s(i,t)}{V} = \dfrac{N_I}{V} \\ \rho_t^R = \dfrac{\left|\sum_{1}^{N_R} s(i,t)\right|}{V} = \dfrac{N_R}{V} \\ \rho_t^S = \dfrac{N_S}{V}\end{cases} \tag{9}$$

Figure 2 shows the computer error accuracy of the open model.

Under the background of the open independent innovation, the information feature extraction and the adaptive scheduling of the cooperative innovation development path between a school and enterprise are carried out by using the adaptive weighting method.

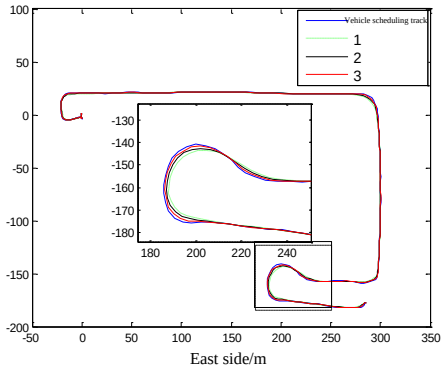

Figure 2. The Computer Error Accuracy of the Open Model.

Under the background of the open independent innovation, the development path planning of the cooperative innovation between schools and enterprises is mainly carried out by the optimal path optimization method to realize the optimal design of the development path planning (HU S, DING Z, NI Q, 2016). Figure 3 shows a comparison between multiple models and the open model.

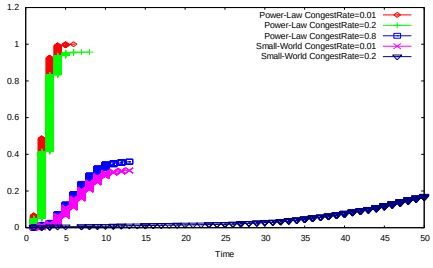

Figure 3. A Comparison between Multiple Models and the Open Model.

5 THE SIMULATION EXPERIMENT AND PERFORMANCE ANALYSIS

IN order to test the performance of this method in optimizing the development path of the cooperative innovation between a school and enterprise under the background of the open independent innovation, the simulation experiment is carried out, and the experiment is designed with Matlab 7 (Zhou Yuhao, Zhang Hongling, Li Fangfei, Qi Peng, 2018). We set the learning rate of the path distribution of the cooperative innovation and development of a school and enterprise. The number of individuals of the adaptive learning is 100, the number of test nodes is 150, $\eta = 0.7$. According to the above parameters, this paper uses the method to optimize the development path of the cooperative innovation between a school and enterprise under the background of the open independent innovation. The global convergence of the model is tested, and the convergence curve is obtained as shown in Figure 4.

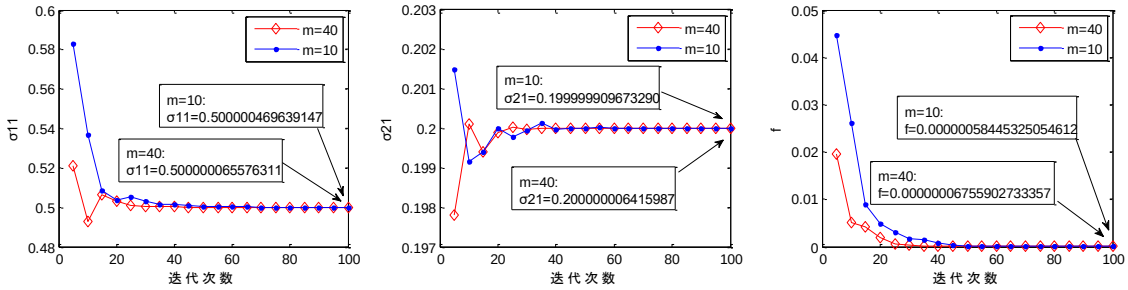

Figure 4. Convergence Test of the Model.

The simulation results in the analysis chart show that this method is used to construct the development path model of the cooperative innovation under the background of the open independent innovation, which improves the development efficiency of the cooperative innovation, and reduces the cost of time and economic benefits. The overall convergence of the entire development path is good, promoting the innovation and development of the cooperation between a school and enterprise.

6 CONCLUSIONS

IN this paper, the cooperative innovation model of a school and enterprise is established, and an optimal development path model of the cooperative innovation of a school and enterprise based on the fuzzy decision control algorithm is proposed. Based on the rough set theory, a path search model of the cooperative innovation between a school and enterprise is established under the background of the open independent innovation. The fuzzy decision-making method is used to design the fuzzy decision control algorithm for optimizing the development path of the cooperative innovation between a school and enterprise. Under the background of the open independent innovation, the information feature extraction and the adaptive scheduling of the cooperative innovation development path between a school and enterprise are carried out by using the adaptive weighting method. The development efficiency of the cooperative innovation in the background of the open independent innovation is improved. The simulation results show that this method can improve the development efficiency of the cooperative innovation and reduce the cost of time and economic benefits by constructing the development path model of the cooperative innovation of a school and enterprise under the background of the open independent innovation, so as to promote the development of the open independent innovation and cooperation between a school and enterprise innovation development. This model has an important guiding value in promoting the development and innovation of the cooperative innovation between schools and enterprises.

7 ACKNOWLEDGMENT

THE study is supported by “Science and Technology Project of the Shaanxi Province, China (Grant No. 2017KRM0802015KRM082)” “The Scientific Research Program was funded by the Shaanxi Provincial Education Department (Program No. 17JZ034)”.

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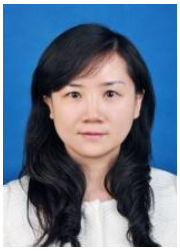
9 NOTES ON CONTRIBUTORS



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