
The Construction of the Drilling Waste Treatment Technology Innovation System Dynamics Model

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Abstract

According to the analysis of the drilling waste disposal technology in the internal and the overseas area, combining with our own creative features, the thesis chooses factor analysis method. On the foundation of attaining the significant factor of the technology innovation, the thesis constructs technology innovation motive model, and proceeds the simulation; finally provides the basis of improving the drilling waste disposal technology, by establishing the creative motion mechanism.

Keywords

Drilling Waste Technical Innovation Dynamic; Factor Analysis; System Dynamics Model.

1. Introduction

At present, the domestic and foreign industrial production and Research on drilling waste treatment methods include: direct discharge [1], recycling use of [2], recycling and reuse of [3], curing method [4], microbial treatment method [5], MTC [6] etc. However, at this stage, the treatment of waste have not completely harmless, resources based, and in the process of processing and treatment will produce two pollution. So drilling waste treatment technology to a great extent need for innovation. And it is one of the urgent problems for oil and gas drilling to be solved that how to under the background of building an innovation oriented country and society, and under the premise of meet the reduction, harmless, resources based requirements, sustainable innovation of drilling waste treatment technology in Enterprises, so as to create a good economic and social benefits for the enterprise and the society.

2. Comments on the innovation of drilling waste treatment technology

The earliest and most accurate classical conclusions about the dynamics of innovation came from Pete's Theory of Economic Development. He believes that the driving force of innovation from the pursuit of excess profits and entrepreneurial spirit. Research on the dynamic model of technological /innovation, Zhang Guangyu (2010) comes to the conclusion that the process of green technology innovation through analyzing the characteristics of green technology innovation. And established a dynamic mechanism of green technology innovation model combined with the CAS theory, the use of Repast software system simulation[7].An Yana (2013) analysis of the technology innovation model of China's large enterprises, and use of SEM theory to build a new model of large-scale enterprise technology innovation, demonstrates the size of the enterprise, technological capabilities of enterprise technology innovation has a significant role in promoting [8].From the search to the literature can be seen on the dynamic model of technological innovation research object is mainly a broad sense of the enterprise, but rarely for a certain industry of a technical innovation. Therefore, this paper will combine drilling waste treatment technology innovation features to build a dynamic model of drilling waste treatment technology innovation.

3. Analysis on dynamic factors of drilling waste treatment technology innovation

3.1 External power factor analysis

(1)The gradual improvement of environmental protection laws and regulations

With the development of society, people's environmental awareness has been strengthened, and the requirements of the environment are becoming more and higher. It prompted the government to gradually improve the environmental protection laws and regulations to make it conform to the expectations of mankind. And with the improvement of environmental protection laws and regulations, petroleum enterprises had to improve the drilling waste treatment technology in order to meet the requirements [9].

(2)Government policy support

In order to achieve sustainable development, from the overall interests of the community and the interests of the next generation, the government must encourage enterprises to carry out technological innovation and reduce the external non economic phenomenon. So in order to promote the oil drilling company drilling waste treatment technology innovation and need to government policy support to enable enterprises to marginal external cost (MEC) reduced ,so as to achieve the purpose of reducing the cost of production, and ultimately to promote enterprise technological innovation.

(3)Combination of production, study and research

Universities and related research institutes have a large number of scientific research personnel reserves, and plenty of scientific research experience, but lack of drilling waste treatment technology innovation needs and requirements. However if enterprises establishment of common technology platform with them to achieve drilling waste to share the resource of technology innovation and intellectual property processing, in order to obtain these institutions of technical support, can effectively improve the drilling waste treatment technology innovation efficiency [10]

(4)Improvement of science and technology management system

Science and technology management system to the enterprise's technological innovation to exert a full range of influence, such as the development of national science and technology development strategy planning and major decisions, create an environment conducive to innovation and so on. Reasonably scientific and technological management system can effectively guide enterprises in accordance with the needs of the government to carry out technological innovation, and encourage enterprises to use national resources independent innovation and regulation [10].

(5)Strengthen international cooperation

Under the situation of China's modern petroleum industry started late and drilling waste treatment technology is also relatively backward, strengthening international cooperation can make the drilling exploration enterprises in our country utilize the external technology resources effectively. And the introduction of foreign advanced technology and the way of re-innovation can effectively improve the technological innovation level of drilling waste treatment [12].

3.2 Internal dynamic factors analysis

(1)the number of R&D talents

According to the world's top 500 enterprises analysis report (2012) statistics, the world's top 500 enterprises, high-tech R&D practitioners have reached 5 times of the traditional industries.it suggested that R&D personnel plays a more and more important role in the development of enterprises as well as technological innovation, and gradually become one of the decisive factors of the competitiveness of enterprises. Whether it is to increase the intensity of the introduction of R&D talent or strengthen the R&D personnel training are in order to increase the R&D talent pool, to provide adequate personnel resources for enterprise technological innovation.

(2)Capital investment

According to the theory of input and output, adequate funding support can effectively improve the output of technology innovation and technology innovation output more and more generous economic benefits for the enterprises. So they formed a virtuous cycle that companies are more willing to increase capital investment to promote the technological innovation of the enterprise continuous development.

(3)Staff treatment

Staff treatment is reflected in the two aspects of salary and talent evaluation system. It is effectively promote the whole enterprise from making decisions to implement and then to the implementation of the technical innovation activities to improve pay or improve the evaluation system can fully mobilize the enthusiasm of each employee to participate in technological innovation [13].So the staff treatment directly affects the attitude of the technology innovation, and the attitude of the staff to the technological innovation is related to the effectiveness of enterprise technology innovation.

(4)Cultivation of innovative talents

National scientific and technological achievements network data released in 2012 showed that China's 2012 scientific and technological achievements in the completion of personnel, 62676 doctoral students, accounting for 15.05% of all personnel; master's degree 110263, accounting for 26.47 of all personnel. There is still a big gap compared with the developed countries. It shows that our country technology innovation high quality talent base is relatively small, and it is urgent for colleges and universities to output more outstanding scientific research and innovation personnel. Moreover the high quality innovative talents are the main body of the key problem to solve the technical innovation, and directly affect the effectiveness of the technology innovation.

(5) Management system

The role of management system on technological innovation is mainly reflected in the aspects of the enterprise innovation incentive mechanism, the enterprise innovation culture, the willingness of the decision-making level, and the management of enterprise technological innovation. Fair incentive mechanism to mobilize the enthusiasm of staff innovation. Excellent enterprise innovation culture can effectively create the passion of enterprise technology innovation. Decision making is to encourage enterprises to persist in technological innovation and to maintain the direction of technological innovation. Enterprise technology can ensure the proper management of the enterprise technology innovation process smoothly [14].

3.3 Determine the dynamic factors

This paper lists the 29 dynamic factors in the system through the analysis of the impact factors of drilling waste treatment technology innovation and combined with the characteristics of drilling waste treatment technology innovation.

Table 1. Influencing factors of drilling waste treatment technology innovation

	influence factor
External	Environmental pollution of drilling wastes ; Government support ; Restraint intensity of media supervision Restraint strength of environmental protection laws and regulations ; Improvement of science and technology management system ; Bank advance ; Stock financing ; Technical support level in Institutions of higher learning ; Technical differences between domestic and foreign
Internal	R&D talent introduction ; Technology introduction strength ; Drilling waste disposal capacity ; Innovation initiative of R&D talent technology ; Enterprise's own R&D funds investment ; Internal employee fund raising ; R&D talent treatment ; Entrepreneur's willingness to innovate ; Enterprise R&D talent quantity ; Enterprise scientific research development strategy ; Enterprise technology innovation management ; Introduction of technology to digest ; Technology introduction funds ; Enterprise technology stock ; Intellectual property rights protection system ; The level of technical knowledge ; Enterprise internal incentive mechanism ; Enterprise innovation culture ; Talent evaluation system

4. Drilling waste treatment technology innovation dynamic factor analysis

Using the method of questionnaire survey and factor analysis, after the reliability test, correlation test, extraction of common factor, the drilling waste treatment technology innovation dynamic comprehensive variable table is as follows:

Table 2. Dynamic comprehensive variable table of drilling waste treatment technology

	Comprehensive variable	Influencing factors
External power factor analysis	F4 Technology import	M11 Technical differences between domestic and foreign, M23 Technology introduction funds, M22 Digestion of imported technology, M12 Technology introduction strength
	F5 Government support	M5 Improvement of science and technology management system, M2 Degree of government policy support
	F6 Business finance	M16 Enterprise internal financing, M8 Stock financing, M7 Bank advance
	F7 Waste pollution prevention and control	M13 Drilling waste disposal capacity, M1 Environmental pollution of drilling wastes
	F8 External constraints of enterprises	M4 Environmental protection laws and regulations restraint strength, M3 Media supervision and restraint intensity
Internal dynamic factors analysis	F1 R&D talent introduction	M20 Enterprise scientific research development strategy
		M17 R&D talent treatment, M29 Talent evaluation system, M10 R&D talent introduction
	F2 Enterprise internal innovation environment	M27 Enterprise internal incentive mechanism, M28 Enterprise innovation culture, M18 Entrepreneur's willingness to innovate, M21 Enterprise technology innovation management
	F3 Processing technology innovation ability	M24 Enterprise technology stock, M25 Intellectual property rights protection system, M26 Technical knowledge level
	F9 R&D talent training	M19 Enterprise R&D talent quantity, M14 The enthusiasm of talent technology innovation, M9 Support level of colleges and Universities
F10 Enterprise's own R&D funding and innovation gains	M15 Enterprise's own R&D funds investment, M6 Enterprise innovation efficiency	

By using the factor load factor of the measured variables, the weighted average of the measured variables inside the comprehensive variables is obtained, and the weighted average value of the 10 comprehensive variables is obtained [15], which is shown in the following table:

Table 3 Dynamic normalization of drilling waste treatment technology

Comprehensive variable	Not standardized ranking	ranking
F1 R&D talent introduction	2.4463	6
F2 Enterprise internal innovation environment	2.6164	4
F3 Processing technology innovation ability	2.3507	7
F4 Technology import	2.3448	8
F5 Government support	2.8441	3

F6 Business finance	2.2244	10
F7 Waste pollution prevention and control	2.2726	9
F8 External constraints of enterprises	3.0774	2
F9 R&D talent training	2.5734	5
F10 Enterprise's own R&D funding and innovation gains	3.3462	1

5. Construction of innovative dynamic model of drilling waste disposal technology

5.1 Cause and effect analysis

According to the theory and method of system dynamics [16], the main cause and effect relationship of drilling waste comprehensive variable is as follows:

A. Enterprise's own R & D funds investment is the driving force of enterprise technology innovation. Innovation benefit is the driving force of enterprise technological innovation. The more the enterprise R&D funds investment or more innovative revenue, and enterprise technology innovation power is more enough, the more it can promote drilling waste technology innovation output. B. The stronger external constraints, such as environmental laws and regulations more perfect and the greater degree of media exposure, the more able to restrict the behavior of corporate environmental pollution. It can prompt to increase R & D funding, accelerate the training of R & D personnel, so as to enhance the ability of enterprise technology innovation. C. The government's support is the thrust of enterprise technology innovation, which can promote enterprises to accelerate the introduction of new technologies, increase the intensity of R & D personnel training and training, in order to increase the effectiveness of technological innovation. D. The innovation environment of enterprise is the guarantee of enterprise technology innovation. Generous staff treatment can effectively stimulate the enthusiasm of staff innovation. And the importance of the decision-making layer and a good enterprise innovation management system can ensure the sustainable development of enterprise technology innovation behavior.

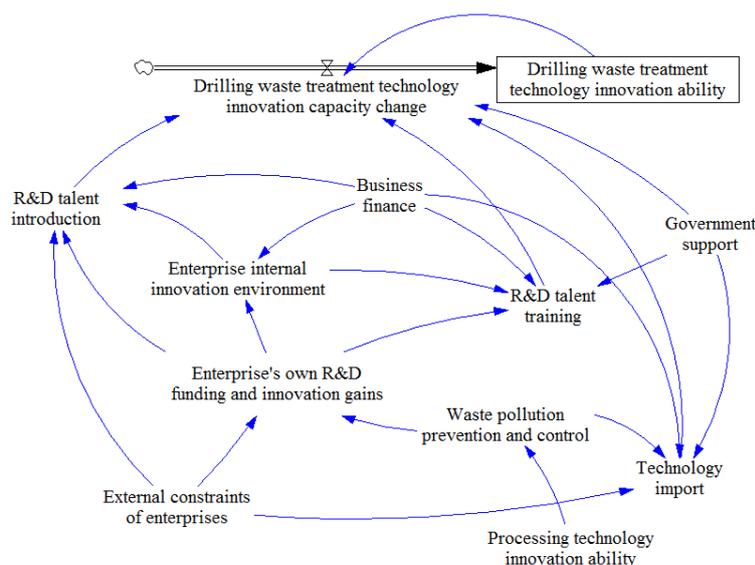


Fig. 1 Dynamic model of drilling waste treatment technology innovation

According to the above analysis, the main cause and effect relationship is as follows:

Processing technology innovation ability → + Waste pollution prevention and control → - Enterprise's own R & D funding and innovation gains → + Enterprise internal innovation environment → + R&D talent training → + processing technology innovation ability.

(1) Processing technology innovation ability→+Waste pollution prevention and control→ -External constraints of enterprises→ + Enterprise's own R&D funding and innovation gains→ +Enterprise internal innovation environment→ + R&D talent introduction→ +Processing technology innovation ability.

(2) Government support→ +Technology import→+ processing technology innovation ability.

(3) Business finance→ + Enterprise internal innovation environment→ + processing technology innovation ability.

5.2 Draw causal loop diagram

According to the cause and effect analysis of the impact factors of drilling waste technology innovation, the dynamic model of drilling waste treatment technology innovation system is as follows:

6. Conclusion

Take out the 10 comprehensive variables that affect the dynamic of technological innovation by analyzing the internal and external factors that affect the technological innovation of drilling waste and the factor analysis method is adopted. On the basis of this, the system dynamics model is established. Analysis results show that strengthen the intensity of external constraints, such as improving environmental protection regulations and the intensity of media supervision, etc; providing a good internal innovation environment for the enterprise, such as the establishment of internal incentive mechanism, create a cultural atmosphere of innovation, and encourage entrepreneurs to innovate and improve the management of enterprise technology innovation; enhancing the support of the government, such as supporting the establishment of scientific research institutions, improving the national science and technology innovation system and the government to formulate policies on drilling waste treatment technology innovation support; increasing the enterprise's own R&D funds, etc could improve the technological innovation of drilling waste. This study can provide the basis for the drilling waste treatment technology innovation, and reducing the drilling waste pollution to the environment and enhance the competitiveness of enterprises.

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