CHEMICAL ENGINEERING TRANSACTIONS
VOL. 71, 2018
A publication of AIDIC
The Italian Association of Chemical Engineering
Online at www.aidic.it/cet
Guest Editors: Xiantang Zhang, Songrong Qian, Jianmin Xu

ISBN 978-88-95608-68-6; **ISSN** 2283-9216
DOI: 10.3303/CET1871218

Collaborative Mechanism of Petroleum Key Material Management Data Ecosystem Based on Big Data

Yang Xia, Dawei Gao

Department of computer and Information Engineering, Inner Mongolia Vocational College of Chemical Engineering, Inner Mongolia 010070, China
yangxia5567@21cn.com

Under the guidance of the 13th Five-Year Plan for Petroleum Industry Development, Petroleum enterprises are confronted with the problem of capacity clearing and improving industry concentration and mechanization. In this paper, the SEM model is used to study the factors affecting the accepting will of the key material management e-commerce platform, and based on this to design the function structure of the platform; combining with the ecological theory, it proposes the concept of “Petroleum mine key material management key ecosystem”. Under this concept, function design of the Petroleum mine key material management e-commerce platform is carried out, the paper clarifies latent variables affecting the potential users' willingness to accept the Petroleum mine key material management e-commerce platform, by suing the AMOS and SPSS software, it analyzes the structural model consisted of latent variables, according to the structural path relationship between latent variables, it also establishes the design and operation principles of the e-commerce platform for Petroleum mine key material management.

1. Introduction

Petroleum mine resource is an important energy source for the development and operation of our country. The demand for Petroleum mines in various fields is very large. Under the condition of social development, Petroleum mine resource has begun to present a state of demand exceeds supply, and the total amount of the resource is quite scarce. Therefore, in order to avoid further development of this situation, it requires us to pay attention to the management of Petroleum mine resource. In order to realize the management of Petroleum mine resource, many modern Petroleum mining enterprises have begun to adopt big data technology to achieve their goals. Therefore, this paper will study the synergetic mechanism of Petroleum mine key material management data ecosystem based on big data, and analyze the structural model consisted of latent variables through AMOS and SPSS software.

Before, with the progress of society and economic development, the production and operation mode that suppliers and customers only fight each other and only focus on their own interests has been gradually abandoned. The idea of win-win cooperation, complementary advantages, joint strength and long-term cooperation between enterprises in supply chain management and management has been advocated by more and more enterprises. At present, under the background of the trend of global economic integration, the guidance of "One Belt and One Road" strategy, "big data", "Internet +" and other times, enterprises are facing wider development space, unprecedented development opportunities and more fierce competition and challenges. Therefore, how to seize the current opportunities and win in the competition is particularly urgent and important. As an important link in the whole logistics of enterprises, the scientific and standardized level of material supply management directly affects the development and decision-making of enterprises. Timely and effective acquisition and sharing of information in the supply of goods and materials, adjusting and optimizing the management strategy of the supply of goods and materials, to improve the scientific and standardized level of the supply of goods and materials management has important significance and far-reaching impact.

Please cite this article as: Xia Y., Gao D., 2018, Collaborative mechanism of petroleum key material management data ecosystem based on big data, Chemical Engineering Transactions, 71, 1303-1308 DOI:10.3303/CET1871218

2. Literature review

Regarding the concept of the Petroleum mine material management data ecosystem, research on data ecosystems at home and abroad is not yet mature. For the data-based ecosystem, the overall conceptual system was proposed. However, the overall developmental changes are described. Data collection, analysis and mining are applied throughout the entire industry chain. The whole is defined as an ecosystem of big data. SWOT analysis method is used to analyze the advantages and disadvantages, opportunities and threats of Weibo's ecological environment. From the information itself, information users, information environment and technology, the establishment of the overall environment of the information ecosystem is discussed (Bian, 2016). In the research of synergy theory, the model of synergy degree is used to measure and rank the cooperation degree of foreign-invested banking systems. The core competitiveness of these foreign banks that invest in China is analyzed (Gang, 2016). The measure of synergy is substituted into the realities of manufacturers, suppliers and distributors. A realistic measurement indicator system was constructed. Finally, the behavior of several participants was evaluated based on the measurement of synergy (Henghu, 2015). Research on material management at home and abroad has been carried out in many aspects and perspectives. At the macro level, the process of deepening the management of abandoned materials was analyzed. Several typical projects, such as the San Francisco Zero Waste Program, were selected to explore the management, governance, and utility recovery of abandoned materials. The main conclusion is that the current society is a transitional period of disposal management, and these wastes must be turned into available resources through the concept of circular economy (Jian, 2018). The RFID system was analyzed. Especially for industries engaged in order management, RFID technology can maximize the benefits of management. Restructuring, process reorganization, and ERP are used to upgrade the material management process of the enterprise (Li, 2018). A network information system was built. This system covers economic information, material accounting, input and output analysis, etc., which can be used to analyze resource consumption and waste utilization. The method of material management can be analyzed from the theory of the product life cycle (Michael, 2015). In addition to this, a web tool was developed. This tool generates a Sankey chart that can be used to track the flow of resources (Nenad, 2017). There are relatively few research literatures on Petroleum mine management at home and abroad. Researchers in this field in China also focus on the perspective of informatization, especially the realization of information systems. First, the computer code is implemented for the material management of the Petroleum mine. Next, in the material management, procurement process and reserve management, the material management system is constructed. Material ordering and demand planning are compared to optimize material procurement and reserve management processes. From the perspective of demand and process management, the specific design of the business function of the material management of Petroleum mines is implemented. In the perspective of management optimization, synergistic analysis with related companies has been added (Mishra, 2015). The reasons for the high cost of material management in Petroleum mines are: On the one hand, Petroleum mines in production lack government supervision, which increases production costs. On the other hand, the material procurement business is not reasonable, which leads to the purchase of more material than the demand and causes a backlog of goods. Inventory costs are increased. However, the on-time rate of arrival of goods is very low, and the cost of out-of-stock is formed. Some information management platforms for material management were built. Enterprises can clearly resolve the status of materials and make timely planning arrangements. The division of labor between business units is optimized. It has the effect of reducing the cost of corporate goods (Radha and Manish, 2016). The process business involved in the construction of the Petroleum mine management system lacks the overall standards and technically inadequate issues. Therefore, the planned management, supply business, business process and warehouse management functions of the Petroleum mine are optimized. The material management system of the Petroleum mine was further improved (Stephen and Pordyumna, 2016).

In summary, the above research work mainly focuses on the structure and framework of Petroleum mine management, the analysis and prediction of data ecosystem research, and the mechanism of collaborative systems. However, there are few studies on the application of synergies. Therefore, in response to the above problems, the function of the electronic platform of the key materials of the Petroleum mine is designed. The characteristics of the platform's data ecosystem under the e-commerce model were studied. The key influencing factors of the synergy of the key material management data ecosystem of the Petroleum mine are identified, and the structural element model is constructed. The dynamic coordination mechanism of variables in the structural element model is studied and the Lotka-Voterra model is improved. The key material management data ecosystem of the Petroleum mine was constructed.

3. Method

3.1 Structural equation

The structural equation model, also called the causal model, is a theoretical model used to establish and test causal relationships between variables. Because the model establishes an association between latent variables and observed variables through measurement models, by measuring observed variables we can indirectly reflect latent variables that are difficult to be measured directly. However, many of the researches in the social science field are difficult to be measured directly or accurately, so the theoretical model is especially suitable for the research work in the social science field.

The structural equation contains two basic models: the measurement model and the structural model, wherein the equation corresponding to the measurement model is: $\begin{cases} X = \Lambda_x \mathfrak{H} + \partial \\ Y = \Lambda_y \eta + \varepsilon \end{cases}$

where X represents an exogenous observable variable, and Y represents endogenous observable variable, Λ_x represents the factor load of the exogenous indicator on the exogenous latent variable, Λ_y represents the factor load of the endogenous indicator on the endogenous latent variable, ∂ represents the error term of the exogenous observable variable X, ε represents the error term of the endogenous observable variable Y, $\mathfrak{H}$ represents the exogenous latent variable, and η represents the endogenous latent variable.

The equation corresponding to the structural model is: $\eta = \mathrm{B}\eta + \Gamma\mathfrak{H} + \iota$. Where B represents the relationship of endogenous latent variables, Γ represents the influence of exogenous latent variables on endogenous latent variables, η represents endogenous latent variables, $\mathfrak{H}$ represents exogenous latent variables, ι represents residual error, it indicates unexplained part of the endogenous latent variables.

The relationship between the measurement model and the structural model can be represented by Figure 1.

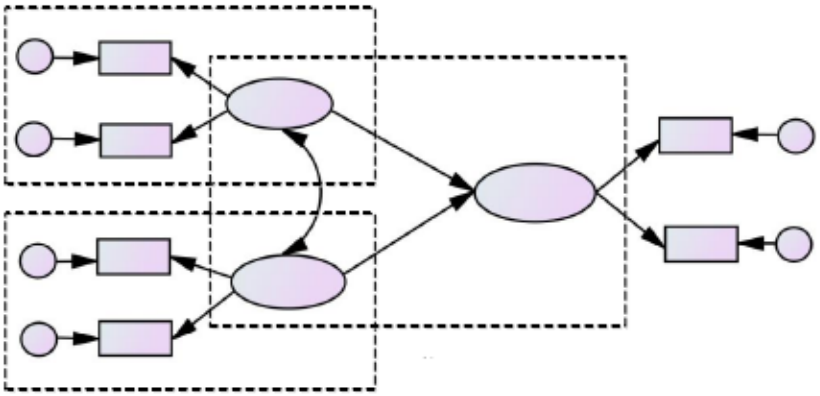

Figure 1: Relationship between structural model and measurement model

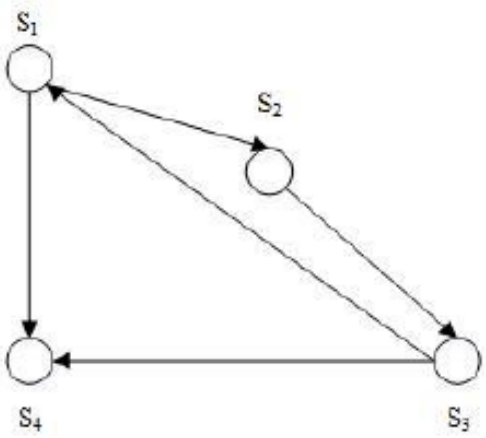

Figure 2: Directed connection

3.2 Key structural element identification method

ISM is an effective method for interpreting structural models, it is mainly used for the analysis of static relationship structure of complex element systems. By analyzing the one-to-one logical relationship between elements, the disordered and discrete complex systems are sorted into multi-layer hierarchical structure models. Interpreting structural models is generally based on qualitative analysis, and the theoretical basis is the same as complex networks, all based on the Graph Theory, which combines the matrix with the graph, and transforms unclear concepts and ideas into intuitive and hierarchical structural models by decomposing the reachability matrices. It is suitable for the analysis of system with multi-variables, complex relationships and unclear structures. Its basic concept is the directed connection. Figure 2 is a diagram of directed connection.

3.3 Lotka-Volterra ecological theory

The Lotka-Volterra ecological theory was developed on the basis of the Malthusian population growth index model. The British sociologist Malthus concluded that the increase in unit population is proportional to the total population at the time by studying demographic data, by calculus, he proposed the population growth index model, which was also called the J population development curve at the time, as shown in Figure 3.

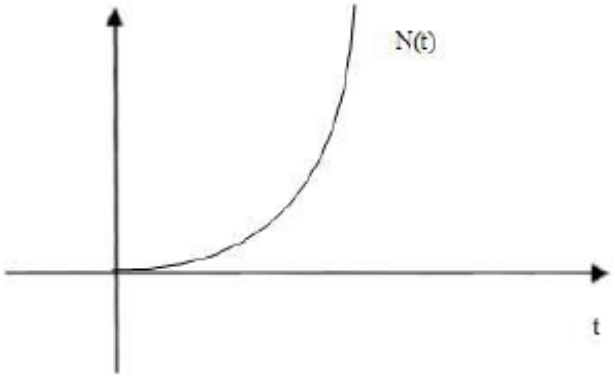

Figure 3: J population growth curve

It can be seen from Figure 3 that the lower limit of the Malthusian population development curve is 0, while the upper limit is not capped, which is obviously not in line with the real situation. Due to the constraint of limited resources, the population cannot grow without limit. Therefore, the Malthusian population equation is only applicable to a special stage where resources are sufficient to support population growth. When the population growth reaches a certain turning point, it will lead to insufficient resources and environmental degradation, which will result in a decline in the population. At this time, the Malthusian population model will no longer be applicable, but this phenomenon does not exist in this paper, so this model can be adopted.

4. Results

4.1 Design results

In this paper, the related design is carried out based on the above theory. In the design, a platform function framework is constructed first, the design steps are shown in the following figure. The platform function framework designed on the basis of platform user requirement analysis is as follows, the platform mainly includes three modules: transaction, decision and auxiliary. The vertical service of users is basically concentrated on the decision module, and the synergetic service requires the transaction module and the decision module to operate together. Figure 4 shows the function modules of the key material management e-commerce platform for Petroleum mine enterprises.

After that, the platform business logic is designed. This part includes two parts: registration login data stream and Petroleum mine key material management business logic. This will be analyzed below.

4.1.1 Registration login data stream. This platform requires that the user must be a company, not an individual. For the first time, the user needs to register and submit an application to join the platform. After passing the verification, the user can log in to the platform. Non-first-time users can log in to the platform to conduct e-commerce activities by verifying the account and password. The specific operation flow is shown in Figure 5.

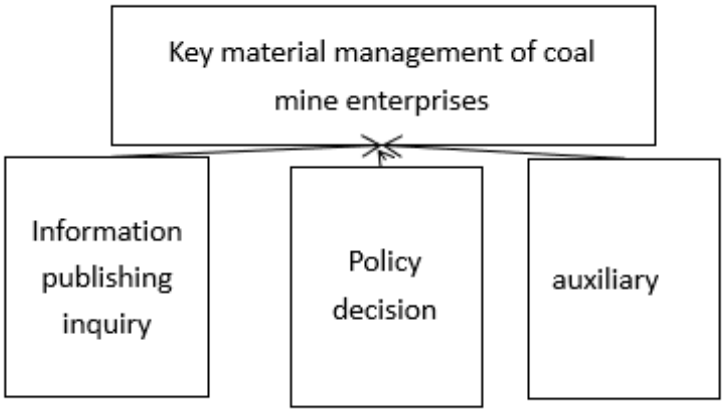

Figure 4: Function modules of e-commerce platform for key material management in Petroleum mine enterprises

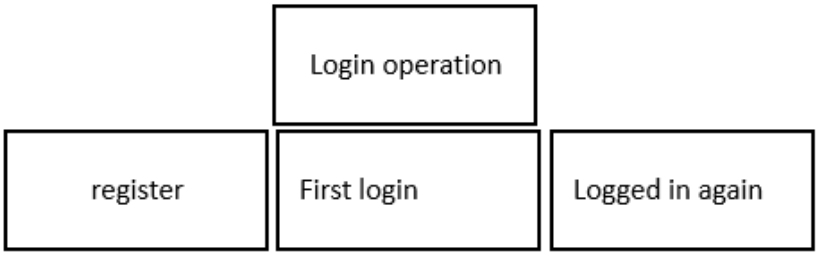

Figure 5: Registration login data stream

4.1.2 Petroleum mine key material management business logic. After logging in to the platform, the user must perform corresponding operations on the platform according to the type of service and the role of the user. We take the procurement of Petroleum mine key materials as an example, this business involves the buyer - the Petroleum mine enterprise, and the seller – the Petroleum mine key material supplier, the buyer and the seller have different business logics, the data stream is transferred with the business flow.

There are two ways to facilitate the procurement of materials. One way is to publish the purchase information or the sell information by the buyer or the seller themselves, and wait for the potential trading objects to respond; the other way is to filter the eligible trading objects according to the acceptable trading conditions. After a comprehensive analysis, this paper selects the second way as the main method, because the information release and screening module can select acceptable business transactions among the published transaction information by setting filter conditions, then it selects the best trading objects through the “partner selection” function of the decision module. The trading objects here not only involve the heterogeneous collaborative partners of the buyer and the seller, but also the homogeneous cooperative partners that jointly sell or synergistically purchase in the synergistic business. After the multiple parties have reached a willingness to cooperate, they can use the “contract management” function of the auxiliary module to sign the contract; payment can be conducted via the “online payment” function so as to improve the payment efficiency; the “order management” function can track the payment status, delivery information and the en route status; the "online insurance" function can insure this transaction to avoid trading risks; the “online reconciliation” function can regularly check the current account with the partners to facilitate the audit work; the “taxation planning” function can formulate reasonable tax avoidance plans to realize online payment of taxes; when there is a transaction dispute, users can apply for arbitration or seek legal solutions through the “dispute resolution” function. Finally, in the final part of the transaction, through the “partner management” function, the two parties can conduct mutual evaluation and get their respective credit scores.

4.1.3Combined with UTAUT2 model, initial trust, protection motivation and information construction and other theoretical studies, the conclusion is drawnThe constitutive equation introduces the research work and application of the potential users' use intention of the e-commerce platform of key materials management in Petroleum mineAMOS and SPSS analyze the software to find the causal path between the factors affecting the acceptance of the platformFactors influencing potential users' willingness to use the e-commerce platform

of key materials management in Petroleum mine depend on the influenceThe second is: performance expectation, price equilibrium desire, effort expectation of potential users and information construction of the platform.Price equilibrium and effort expectation have no effect on information construction, and performance expectation has no effect on effort expectation and priceEquilibrium has a positive correlation with information construction, and performance expectation and price equilibrium are both initially trusted by potential usersRegardless of the influence of the protective motivation, the effort is expected to be only affected by the initial trust and not affected by the protective motivation. According to theThis summarizes the design and operation principles of the platform to improve the acceptance rate of the platform among potential users.

5. Conclusion

By analyzing the types of Petroleum mine materials, this paper focused on the Petroleum mine key materials and realized the leap from the studies of one single business form or one single company, to the studies of the synergistic benefits of horizontal homogeneous synergy and vertical heterogeneous synergy achieved in the related industries of multiple Petroleum mine key material management under the multiple Petroleum mine key material management business. Looking forward, by combing the research progress on Petroleum mine material management at home and abroad, it is found that most scholars' research focused on Petroleum mine material classification, Petroleum mine material procurement management, Petroleum mine material inventory management, Petroleum mine material supply management and Petroleum mine material pricing mechanism, and most of these studies emphasized on the research of the above-mentioned business of a single company’s Petroleum mine materials. Under this premise, this paper has defects in a certain angle and needs to be perfected in later work.

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