

# Study on the application of Supply Chain Management (SCM) for Jiaojia Gold Mine

L. GUOQING, H. NAILIAN, and H. XUCHUN

*Department of Resource Engineering, University of Science and Technology Beijing (USTB), China*

With the accession to WTO and the establishment of Shanghai Gold Exchange, gold mines in China are facing more severe competition from both home and abroad. Supply Chain Management (SCM), a new management idea gradually accepted all over the world, provides the gold mines in China with a new management mode. In this thesis, under the guidance of SCM theory, based on the analyzing to the actualities of Jiaojia Gold Mine, the Jiaojia supply chain framework is constructed, the function system for Jiaojia SCM is configured, and function modules are described in detail.

Keywords: Supply Chain Management, Gold mine, Informatization

## Introduction

China gold mines have been running under the planned economy system for a long time. Accordingly, they have taken the management mode of 'Vertical Integration' featured in 'complete whatever scale', such as overstaffed organization, low productivity, faint market sense, shortage in technique innovation and slow accession to informatization. All of these disadvantages have restricted the development of the enterprise and weakened the capability in competition.

Supply Chain Management (SCM), a typical mode of 'Horizontal Integration', is a new management idea and pattern gradually accepted all over the world. SCM emphasizes the establishment of a strategic cooperative relationship between the nuclei enterprises and other members. By consigning part of operations to the supporters, the nucleus enterprise can pay more attention and put more resources on its main business so that its capability in competition can be improved.

During the process of management mode reforming and information engineering, Jiaojia Gold Mine, a typical representative in China's gold industry, has introduced the idea of SCM into its practical operation to integrate and optimize the resources according to the facts. Then the SCM framework is constructed, and the management system under that framework is designed.

## Summary of SCM

### Conception of SCM

SCM is a kind of management idea by integrating the supply chain and the value-increasing chain to function the plan and control of the material-flow from the supplier to the end customer and furtherly to realize the combination of the cooperation inside and outside enterprise.

Four main fields are involved in the SCM: Supply, Schedule Plan, Logistics, and Demand. So SCM can be executed as this following way: instructed by synchronized and integrated producing schedule, supported by technique based on Internet/Intranet and working with supply, operation, logistics management and demand satisfaction. The main tasks are planning, communicating and controlling the material and information from the suppliers to the customers.

### Several 'flows' in the supply chain

There are five basic 'flows' flowing on the supply chain.

- *Information flow*—Demanding information and supplying information are flowing on the supply chain in different way. The flowing of information is overlapped and complicated. The flowing of demanding information from the demander to the supplier causes material flow, at the same time the supplying information, along with the material, is flowing toward the demander.
- *Material flow*—The material flow is the most obvious change on the supply chain. It begins from the supplier, through every link, and ends in the demander.
- *Fund flow*—The flowing of materials causes the flowing of funds initiated by the materials' value. Any operation in an enterprise will consume certain resources and result in funds flowing out. Fund flowing-in as well as profit gaining will not happen unless the products which have consumed certain resources are sold out. Therefore, each operation activity of the supply chain is to be monitored and adjusted under the financial cost system. The economy benefit is evaluated by the rate of return and funds circulation.
- *Value flow*—The flowing process of material in the

supply chain is a value-increasing process due to its constant increase in technology and added value.

- *Work flow*—Information, material and fund cannot begin their flowing if there is no workflow caused by the operations. The workflow determines the velocity and quantity of other flows.

The interrelation and interaction of these five kinds of flow make an integrated system. The virtue of SCM is to manage and optimize these flows constantly in order to enhance the enterprise's competitive advantages.

### Actualities of Jiaojia Gold Mine

The actualities of Jiaojia Gold Mine should be analysed before starting the design work, especially on the present chain and business process, in order to summary the existing problems and obstacles which influence the planning of supply chain.

- *'Vertical Integration' management mode*—As a typical representative of gold mines in China, Jiaojia adopts "Vertical Integration" management mode, featured in "complete whatever scale", such as overstaffed organization and complicated operations. Not only has it mining, processing and melting process, but also has corresponding auxiliary work and some related serving work.
- *Unready market response and 'selling upon producing' strategy*—The imperfectness on gold market and the speciality of gold mine in China can not enable the gold enterprises to produce entirely according to the changing gold market, instead they produce more to the geological resources and the acknowledged productivity. The management purpose is to finish the mining and processing work under the minimized cost.
- *Traditional exploitation industry, indistinct supply chain*—As a traditional exploitation enterprise, Jiaojia is much different from the manufacturing enterprise. For instance, the ore, its raw material in manufacturing, comes from the nature by a series of mining operations rather than purchasing from the market. But, parts of auxiliary materials have to be consumed during the mining process which makes the supply chain more complicated.
- *Certain foundation on informatization, 'Information*

*Isolation' still exists*—Jiaojia Gold Mine has attached more importance to information engineering and gotten many experiences. However, the mine's integration under informatization has not truly realized for the reasons of quality difference in the staffs, imperfect management, lack of united schedule, etc. As a result, the 'information isolation' is still common.

### The framework of supply chain for Jiaojia Gold Mine

Based on the discussion on the SCM theory above, we would like to plan and design SCM for Jiaojia Gold Mine.

#### The framework of Jiaojia supply chain

The difference between the exploitation industry and the manufacturing industry is the way to obtain raw materials. But compared under the SCM, some common points can be found. The cost of exploring and mining in exploitation industry can be regarded as the purchase cost in manufacturing industry. Similarly, the value of ore flow will increase continuously because of the input of manpower, capital and materials during the process to the finished products.

Therefore, in the framework of Jiaojia's supply chain, the ore flowing through the links of processing, storage and transportation can be regarded as the material flow. So SCM will stress on the integration and optimization on the flows of information, ore, capital, value and work. The framework is shown in Figure 1.

#### The characteristics of Jiaojia supply chain

Jiaojia Gold Mine is a kind of natural resource enterprise. Its supply chain has the professional specialities summarized as follows.

- *Drove by the resource*—The apparent problem faced by a resource enterprise is the non-reproduction of geological resource. So its key competition ability is its mining and controlling measures to various geological resources. Accordingly, the constraints to the supply chain exist in the resources limitation and the gold mine restricted productivity. So that Jiaojia supply chain takes geological resources as its primary driver performance rather than the market. Enterprise

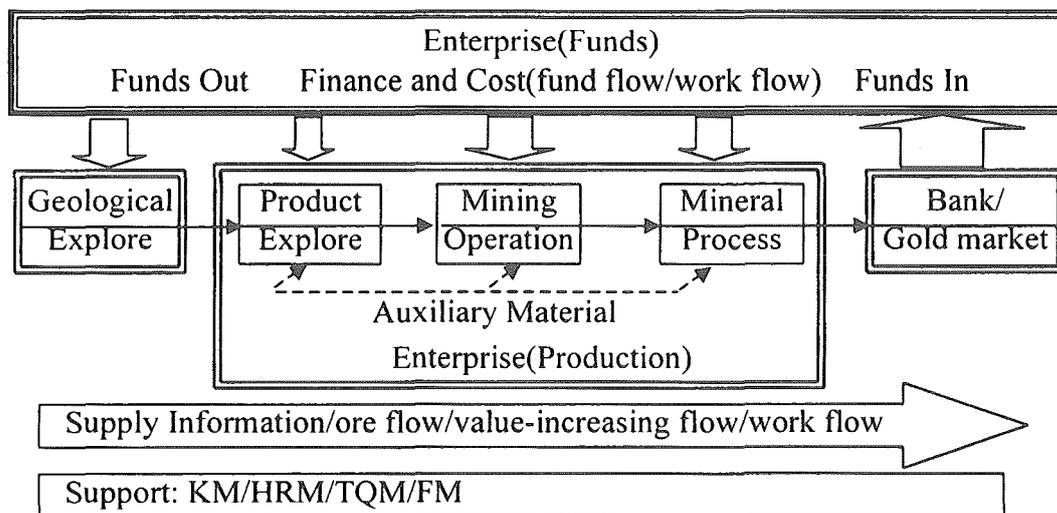


Figure 1. Supply chain framework for Jiaojia Gold Mine

sustainable development strategy and the geological resource condition should be considered at the same time combining with the outside circumstance during the supply chain decision.

- *Concentrate on physical function*—Jiaojia supply chain runs under the mode of pushing process because of its single products structure and relatively stable market, which means to take the operation as the main task and the resource as the restriction for the concentration on the physical function of the supply chain. It means the conversion of the resource to the final products with minimized cost and the realization of the ore's flowing in the chain.
- *Dynamic performance*—Different from the chain of manufacturing enterprise, Jiaojia supply chain is dynamic due to the variability of geological resources. As a resource enterprise, its main processing object, geological resource, will change with the production. Therefore, more and more accurate geological information should be obtained from the production which will renew the supply chain constantly and makes Jiaojia's SCM more dynamic.

## The function systems of Jiaojia SCM

### The function system configuration

According to its supply chain framework, the function system of Jiaojia SCM is made up of the five function modules: enterprise strategic management, planning and controlling, material flow management, finance management, Human Resources Management (HRM) and Knowledge Management (KM). The configuration is shown in Figure 2.

In Figure 2, the information centre as the foundation of the SCM configuration is located at the bottom level of the system. The data warehouse on it provides the model, method and algorithms for SCM's plan, design and analysis. These two form the support system of Jiaojia SCM.

### Function modules

- *Enterprise strategic management module*—The

enterprise strategic management module helps the enterprise in analysing and strategizing. This module introduces advanced mathematical models, which is supported primarily by the enterprise data warehouse, and adopts the On-Line Analytical Processing (OLAP). In the enterprise sustainable development planning module, long-term and medium-term plans are made under the guidance of mine sustainable development theories. The function of business process management module is to analyse, diagnose and improve the enterprise business flows. The gold market analysing and forecasting module can make a quick response for the enterprise on the variable gold market and supply the necessary information to the producing and planning control modules. The management effect evaluation is a feedback link in the SCM system. It comprehensively reflects the management effect and provides the management information to the enterprise.

- *Planning and controlling module*—This module is the key to Jiaojia SCM. It also introduces suitable mathematical models and is supported by data warehouse and open database. Guided by the mid- and long-term plan made from the strategic management module and constrained by the geological resource, producing planning module can make the exploring schedule and producing schedule out, as well as the auxiliary plan in ore processing. Meanwhile, it can make the material demand schedule upon the productivity and the equipment service and maintenance schedule upon the equipment management. But due to the dynamic performance of Jiaojia SCM, the planning and controlling module will be adjusted according to the geological resource, gold market and the management effect.

Producing control is the execution of producing schedule and the supervisor of all processing links. It introduces the On-Line Transaction Processing (OLTP) for data collecting and saves in the open database for other function modules.

This demonstrates the planning and controlling module has close relationship with the others. It maximizes the resources utilization. This is also the key competition

Enterprise strategic management	Enterprise sustainable development planning		Business process analyzing and optimizing	Gold market analyzing and forecasting	Management achievement evaluating
Planning and controlling	Product exploring schedule	Master Production Schedule	Auxiliary Production Schedule	Material/Capacity Requirements planning	Equipment maintenance planning
	Production (Mining, Mineral Processing, melting, transportation)				Outsourcing
Material flow management	Geological resources management		Ore flow management	Total quality control	Auxiliary material management
Finance management	Accounting			Finance control	
HRM&KM	Human resources management		Document Management	Technical innovation management	
Model base / Method base / Data warehouse					
Enterprise information center / Open database / Information integration					

Figure 2. The function system configuration of Jiaojia SCM

advantage of Jiaojia Gold Mine as stated above. So making a scientific schedule and ensuring its execution are the primary tasks of Jiaojia. While, other unimportant business can be finished in the mode of outsourcing.

- *Material flow management module*—The material flow management of Jiaojia Gold Mine is on the basis of planning and controlling. Because the ore flow can be regarded as the material flow of the supply chain, the logistic management aims at the storage, transportation and the value-increasing of the ore during the processing. Since the main technique and economic index of mine are the grade of ore and the composite recovery, the key of total quality control strategy for Jiaojia is the recovery control. The function of auxiliary material's purchase and preparation aims at the need of auxiliary materials in the processing.
- *Finance management*—Two modules are involved in the finance management. They are accounting and financial control module. Accounting is carrying out simultaneously with planning, purchasing, producing, storing, transporting and selling. Its main tasks are data recording and calculating, as well as cost accounting. The original data come from the open database, which presents the simultaneousness of the funds flow and the material flow. Based on the accounting data, the finance management functions in analysis, forecasting, management and controlling. The datas from this module will be stored into the data warehouse for the

strategic management module.

- *Human resources management and knowledge management*—This module functions in staffs' qualification evaluation and management. It is also an important approach to get the outside information, for instance, government policies, laws and regulations, the trends of industries, etc. It is a process of knowledge accumulation and study. The information of human resources and knowledge will be arranged and stored into the open database and shared in the enterprise for improving the whole knowledge level.

### **Application and Conclusions**

SCM is the core idea of 'digital mine' for Jiaojia Gold Mine and has gotten initiate effect during the application. The enterprise mode has been improving under the requirements of SCM, and the information system has been building up according to the designed SCM framework.

As one of the traditional gold mine, Jiaojia Gold Mine has attempted and boldly innovated on the management mode and information system establishment. It will function on utilizing the resource effectively, improving the management level, enhancing the market competition and realizing the sustainable development. But what should be attached importance to is the speciality of the Chinese gold mine. Therefore, the combination of SCM theory and enterprise management will still be a continuously improving and developing procedure.