Optimization of oil depot operation process

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Abstract. Oil depot is an important department for loading, unloading, transhipment and storage of petroleum products. The operation process of oil depot is directly related to the company's efficiency and affect the quality. This thesis sorted out the operation of oil depots, analysed the common problems in the operation process of China’s oil depots, and gave an optimization plan for the operation process by taking a secondary oil depot of PetroChina as an example.

1. Introduction

Petroleum is called "industrial blood" and it is an important energy resource in China. Due to its flammability, explosiveness and volatility, it needs special attention in the process of storage and transportation. Oil depot is an important department for loading, unloading, transshipment and storage of petroleum products. Storage is an important link in the circulation of petroleum products. In addition, in the production and operation of oil companies, once an accident occurs in the oil depot, it may cause serious casualties and property losses. Therefore, the scientific and rational operation of oil depot is directly related to company's efficiency and the products’ quality and safety. process optimization is an important means to improve the efficiency of oil depots’ operations. Through process optimization and process improvement, it will effectively compress business operation time, reduce costs, and make the depot run safely and smoothly.

In the previous research, Du Zhigao et al. designed an oil storage safety management system based on the Internet of Things\textsuperscript{[1]} for the operation management of the oil depot; Yang Yi et al. used the fuzzy neural network to conduct a safety evaluation of an oil depot’s operation\textsuperscript{[2]}; Jan Karasek et al. used genetic programming algorithms to optimize the process of logistics depots\textsuperscript{[3]}; Hu, Yuqin et al. analyzed the cases of electrostatic accidents in oil and gas storage and transportation\textsuperscript{[4]}.

This thesis will start from the operation process of the oil depot, analyze the common problems in the operation of China’s oil depots. Then it will be taken a secondary oil depot in PetroChina as an example to explore the optimization of the operation process in oil depots.

2. Operation process of oil depot

2.1. Operation Links of Oil depot

The general oil depot operation process mainly includes oil receiving, oil storage, oil delivery and safety management of oil depots.

Oil receiving. The oil depot receives oil receipt orders and prepares to receive. After the arrival of the tanker, the samples are examined. Finally measure into storage.
Oil storage. Classified storage for different types and specifications of oils. Inventory monthly and check the quality regularly.

Oil delivery. Check the type and quantity of oil products and sent out according to the order. Cars and ships will be ready for shipment when they arrive. Shipment in time after meeting the requirements. After the loading is completed, the dispatching and Ex-warehouse procedures shall be handled, and complete the registration and statistics.

Safety management. Control the combustibles and isolate fire sources. Prevent static electricity and oil vapor accumulation.

The general process is shown in Figure 1.

2.2. Oil depot operation process design and optimization
In terms of process design, the 5W1H analysis method is often used as a method of process design. Every process in the operation process should be considered from six aspects: cause (why), object (what), place (where), time (when), person (who) and method (how). The process designer needs to clarify the purpose of the process design, the object of the process service, the time and place of each process, to arrange personnel and equipment, and to coordinate the series of elements.

In the process of process optimization, the ECRS analysis principle is often used to optimize the operation process, that is, the process is to eliminate, combine, rearrange and simplify.

1 Eliminate
For totally redundant work that will not cause any loss to the result after removal, it can be eliminate.

2 Combine
Combine repetitive and closely related processes into one process.

3 Rearrange
It includes changing the sequence of processes, adjusting the location of field equipment. Processes that can be carried out simultaneously are processed in parallel.

4 Simplify
After the elimination, combining, and rearrangement, a further analysis of the operation process is conduct to see if there is room for further optimization, to simplify the existing methods, and improve the efficiency of process operation.

The ECRS analysis principle is based on the 5W1H analysis, seeking improvement directions in the process flow and conceiving new working methods to replace the current working methods. Using the four principles of ECRS can help managers find better performance and better process methods.

3. General problems in the operation of China’s oil depots

3.1. Congestion of transceiver channel
The oil depots are crowded with tankers and vehicles. The main reasons for congestion are as follows:

1 The procedures are complicated. Take the oil terminal as an example. Before the unloading operation, it is necessary to carry out operation approval at the Port Authority and the Port Supervisory Bureau. The approval time is within 24 hours, and the unloading work can’t be conduct without the agreement of Port Authority.

2 Limited service capabilities. With the development of the economy and the industry, the demand for petroleum products and refined oil products in China has increased year by year. In the case of
business growth is faster than service capacity growth, the problem of oil depot congestion has also followed.

3 Lack of effective evacuation. After the loading and unloading operation, due to the lack of evacuation work, the tankers and the vehicles will stay in the passage for a long time.

3.2. Lengthy process
In the reception and delivery process, the operations need to be examined and approved, and almost all processes are carried out step by step. The process is long and the interval between some processes is too long. For example, after the arrival of the oil, the oil depot begins to check the order information, and then carries on the sampling test. After the test, the dispatch room will make the dispatch. After the dispatching order was issued, depot personnel began to prepare for unloading. The preparation time is too long. Regardless of the amount of oil, the number of people and equipment remains almost constant.

3.3. High oil loss rate
Natural loss will occur in the process of loading, unloading and storage of petroleum. The oil’s temperature and composition will be affected by high pressure and water vapor erosion, which will affect the quality of petroleum products. In the storage process, the storage loss rate of China’s oil companies averages around 4‰, and the rate in European countries is between 1.1‰ and 1.3‰, which is a big gap.

4. Operation process optimization of an oil depot
The author visited a large oil depot in China that is a secondary oil depot of PetroChina, which involves road transportation, railway transportation, water transportation and pipeline transportation of petroleum and petroleum products. The main business includes the products’ waterway reception and road delivery. Since 2019, in order to achieve cost reduction and efficiency increasing, and make the depot safety run, the depot has optimized the operation process from the aspects of process design, service capability optimization and information construction.

4.1. Process Design
The main business of the oil depot includes waterway oil reception, road oil delivery and oil storage. Among them, waterway oil reception is the most cumbersome, time-consuming, labour-intensive, and highest accident segment. In 2019, the oil depot carried out a new process design for the existing waterway oil reception business. They clarified the tasks of each department, and rationally divided the work. It carried out parallel operations, especially shortened the pre-discharge preparation time so that the handling efficiency of the orders was improved. Now, the waterway reception process of the oil depot has been reduced from the original 43 hours to the 35 hours. The flow chart of the waterway oil reception is as Figure 2.
4.2. Service capability optimization

The oil depot used existing resources to reduce the tankers queuing time and the compress oil unloading time.

The first is to increase the oil unloading passage. The oil depot will increase the service capacity and reduce the queuing time by adding oil handling ports and increasing the oil pipelines on each tanker to enable the terminal to serve two or more oil tankers at the same time.

The second is to arrange the number of people on duty. Unloading operations are the most cumbersome part of the oil depot. At present, the oil depot is implemented in three shifts. When there is a task of unloading oil, two shifts of staff are arranged to carry out unloading operations in the company. When there is no unloading task, one class of staff is assigned to carry out daily work.

4.3. Service capability optimization

The oil depot has built an intelligent information system that optimizes the following functions:

The first is to enhance the exchange of information with the upstream and downstream departments. An information system is established associated with the database of the lower and upper departments. Based on the system, the staff can respond promptly to the superior command to prepare in advance and grasp the inventory of the gas station in the lower level in real time to make a timely supply.

The second is to conduct a comprehensive collection of oil depot operation information. Through the information collection tools such as portable electronic tags and radio frequency identification, not only the collection and processing of all business information, operation information and result information in the oil depot are realized, but also manual input is reduced, and the timeliness and accuracy of information collection are improved.

The third is to improve the functional scope of the information system. Through the business system, it reflects the information of each oil collection and oil delivery, such as petroleum products, oil quantity, actual oil quantity, oil delivery company, etc. Through the management system, it manages the daily work of the oil depot, including financial analysis, statistical reports, organization management, performance appraisal, etc.
5. Conclusion
This thesis sorted out the operation of oil depots, analysed the common problems in the operation process of China’s oil depots, and gave an optimization plan for oil depots by taking a secondary oil depot of PetroChina as an example. Through the research in this thesis, we have summarized the following points in the optimization of oil depot operation process:

1. As a department for the transhipment and storage of petroleum products, the operation process design of oil depot is related to the business development and the production safety. Oil depots need to develop business processes based on tasks and goals to create value for the business.

2. The service level is directly related to the efficiency of the oil depot operation process. Oil depots need to rationally arrange existing resources to improve the service capabilities.

3. Informatization construction is an important means to improve the efficiency of oil depot operations. The oil depot needs to establish an intelligent information system that can collect the information in time to realize modern and efficient management.

4. Standardization construction will help improve efficiency, which requires oil depots to develop process specifications, establish standardized systems, and use standardized equipments to achieve scientific management and modern production.

In the future research, the evaluation of business process and operational efficiency of oil depots will be more applied to operational process optimization problems. The application of new technologies and new processes will also be the direction that scholars and business managers explore.

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