

# *Quality Management of Offshore Engineering Project Based on Clustering Algorithm*

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**Keywords:** Clustering Algorithm, Offshore Engineering, Project Quality, Quality Management

**Abstract:** With the rapid development of social economy, environmental problems have become increasingly prominent. Quality management is an important link in offshore engineering projects. This paper first introduces the research status at home and abroad in recent years, summarizes the construction background and main problems of China's shipbuilding industry and water conservancy projects, and then analyzes in detail the common methods and applications in the field of marine engineering technology and construction engineering. Finally, it is proposed to establish a perfect and effective quality management mechanism for construction projects using clustering method and verify that this mode plays a good role in actual engineering projects through specific cases. The performance test of the management system is carried out. The test results show that the quality management system for offshore engineering projects based on Clustering algorithm has a short data processing time, low delay time and low memory consumption

## **1. Introduction**

Marine engineering projects are large-scale comprehensive infrastructure integrating environmental protection, ecological construction and scientific and technological innovation. With the rapid development of China's economy and society, the demand for energy is increasing day by day. At the same time, the problem of resources and environment is becoming increasingly prominent. In this case, how to effectively manage the limited natural resources of sea, land and air has become one of the urgent problems to be solved by the country and coastal cities, that is, to ensure the quality of construction safety production[1-2].

Many scholars have done relevant research on marine project management. In terms of project management, experts and scholars from developed countries such as the United States and Japan have conducted a lot of detailed and in-depth discussions and analyses on the quality management of engineering projects. China only began to introduce construction projects from the international

community in the 1980s. With the continuous improvement of economic level and the wide application and progress of science and technology since the implementation of the reform and opening-up policy, great changes have taken place in the international construction engineering field[3-4]. The state has issued a series of relevant normative documents to ensure the quality of construction projects, shorten the construction period, and promote the survival of the fittest of construction enterprises to achieve faster and better benefits. Some scholars attribute the direct reasons affecting the construction quality of construction projects to three elements: materials, machinery and equipment and environment. Some scholars have proposed the "Three-stage" control method[5-6]. Some scholars have established a multi-index evaluation system to study the interaction between different participants in the project and the decisive role of the characteristics of each sub item in the quality management process. Therefore, this paper studies the quality management of offshore engineering projects based on clustering algorithm.

With the rapid development of social economy, the scale of marine engineering construction is expanding, but it also brings many problems. This paper mainly studies the quality management of marine water conservancy projects in China. This paper first introduces the current theories and methods of project quality management and guarantee system at home and abroad, secondly analyzes some key defect factors and their causes in domestic marine engineering construction, and finally puts forward measures, suggestions and Countermeasures to improve China's marine construction projects, strictly control raw material procurement, strengthen personnel training and improve the quality of operation teams, so as to fundamentally solve these problems, Ensure that the construction of water conservancy projects can meet the needs of social and economic development.

## **2. Discussion on Quality Management of Offshore Engineering Project Based on Clustering Algorithm**

### **2.1. Offshore Engineering Project**

Offshore engineering project refers to a series of activities such as design, construction and management carried out by various means under the existing resources in order to achieve certain economic and social benefits [7-8]. It mainly includes the development of marine resources, the construction and management of sea areas, the protection of marine living resources, the utilization of coastlines, and the comprehensive renovation of coastal zones. It also includes some basic conditions in a region, such as environmental conditions (climate conditions) and hydrological characteristics (distribution density and quality change trend of water resources). Offshore engineering projects are characterized by large scale, high technical requirements and complex construction technology. Carry out design and construction according to relevant national laws and regulations and industrial standards, control the quality objectives of the whole offshore project through on-site construction technology management, and make preparations for damp proof and fire prevention measures in combination with local climate and environmental characteristics to ensure safe production and normal operation of the project. With the deepening of the marketization of China's construction industry and the gradual acceleration of the growth rate of the national economy, the construction scale is also getting larger and larger. At the same time, with the increasing requirements of people for environmental quality and the increasingly serious ecological and environmental problems, these factors make the construction project face greater challenges. Foreign engineering construction should not only consider whether it can meet people's living needs, but also not at the cost of destroying the ecological environment. Reasonable and effective water conservation on the basis of ensuring construction safety and surrounding buildings is one of the major environmental protection issues that need to be solved urgently. At the same time, it is also

necessary to take the protection of water recycling as an important content and basic policy of environmental protection, and combine it with the sustainable development strategy to establish a complete sewage treatment facility construction system[9-10].

## 2.2. Project Quality Management

Project quality management refers to the results of using scientific and reasonable methods to control the whole construction project in the process of construction, design and control with the whole life cycle of the construction project as the center and on the premise of meeting the specified requirements and standards[11-12]. With the continuous improvement of the level of social and economic development and the increasingly fierce competition in the construction field, China's construction engineering industry is facing unprecedented opportunities and challenges. In order to cope with this situation, we must strengthen the quality management awareness of the construction unit and establish a complete, efficient and complete system to enhance the overall competitiveness of the enterprise, so as to adapt to various problems in the market competition in the new era. The project is a complete system, which includes all aspects of the whole project, such as product quality, environmental management and human resources. The characteristics of the project itself also determine that it belongs to a high-risk industry to a certain extent. Therefore, for any enterprise, it should not pursue too high or too low investment to lead to failure. On the contrary, I also think that only by ensuring good construction results can the company obtain better profits and more profit margins. On the premise of meeting the functional requirements, the overall performance of the project is improved through reasonable organization and coordination. Project quality management is the general term of all work contents and processes carried out in the whole construction project from raw materials to finished products to achieve the expected objectives. It is a management function or responsibility of the construction unit and the project supervision organization[13-14]. Figure 1 is the composition diagram of project quality management.

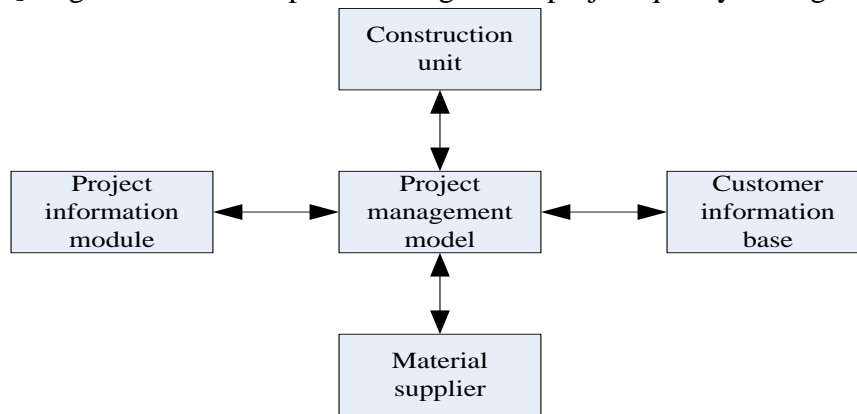


Figure 1. Project quality management

## 2.3. Clustering Algorithm

In a clustering algorithm, each sample has the same attributes, and these features are called "classifiers". The data is divided into different categories according to the selection rules[15-16]. According to the degree of similarity, it can be divided into several different types of subgroups, and according to the combination mode, it can be divided into three or four types, such as intra group similarity, extraversion relevance and extra seat groups. The most commonly used single sample clustering method is the single sample clustering rule, which is a global optimization method. Each sample in the sample is classified into the same cluster (sub cluster). In clustering

algorithm, the most basic principle is that all samples belong to the same cluster. If a point in a sample linear distribution data set is divided together, it means that the group has a certain degree of similarity. Traditional classification methods usually divide each class into several small categories (i.e. "1-7") as a whole to study statistical laws or mathematical operations, while clustering algorithms consider that sample sets with the same attributes or types in a certain group and great differences between different categories are called candidate group sets. In statistical analysis, clustering refers to dividing multiple data into several groups according to certain rules, and classifying each sample according to the characteristics of these groups[17-18]. Fig.2 is the calculation flow of the clustering algorithm.

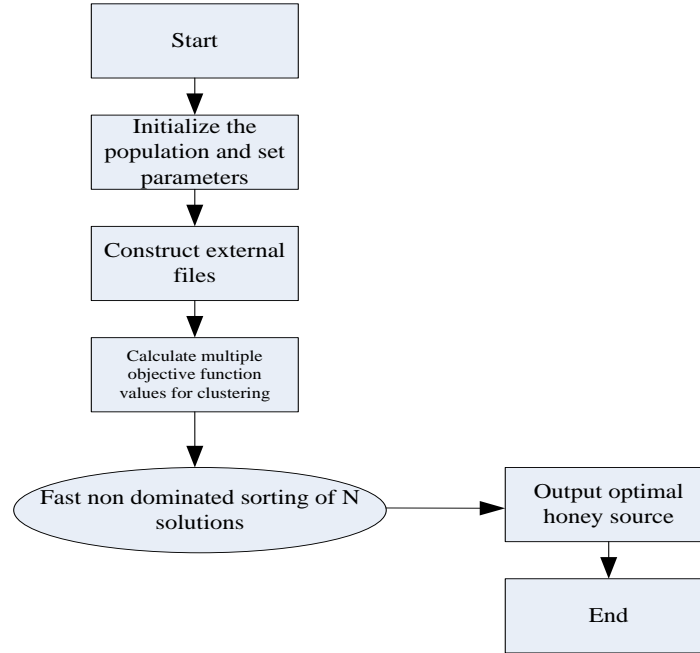


Figure 2. Computational flow of the clustering algorithm

In the clustering algorithm, there are many types of calculation functions for the distance between data objects, which are mainly divided into absolute distance, Minkowski distance (including absolute distance, Euclidean distance and Chebyshev distance), Mahalanobis distance and Canberra distance. Among them, in most clustering algorithm applications, Euclidean distance method is a more common method to calculate the distance between numerical objects. Specific contents include:

$$d_{ij}(q) = \left( \sum_{k=1}^q x_{ik} - x_{jk} \right)^q, q > 0 \quad (1)$$

$$d_{ij}(1) = \left( \sum_{k=1}^q x_{ik} - x_{jk} \right)^q, q = 1 \quad (2)$$

$$d_{ij}(2) = \left( \sum_{k=1}^q x_{ik} - x_{jk} \right)^q, q = 2 \quad (3)$$

There are two kinds of traditional methods: one is to establish a new category based on statistical principles. The other part studies the sample set from the basic theory. The former usually only

considers the uncertainty of information such as eigenvalue and probability density, the principle of minimizing statistical error, and whether the classification model is reasonable. The latter makes use of the concept of similarity measurement attribute to a certain extent, so that it has better discrimination ability.

### 3. Experimental Process of Quality Management of Offshore Engineering Projects Based on Clustering Algorithm

#### 3.1. Composition of Offshore Engineering Project Quality Management System Based on Clustering Algorithm

The project management information system is composed of relevant information management systems for project quality, safety and progress control, including two functions of personnel configuration entry and review. Among them, the staffing mainly includes the number of construction personnel entering the site and their certificates. Determine whether the staff have corresponding qualifications through qualification examination. Before entering the formal work, it is necessary to do a good job in technical disclosure and data preparation for all posts, and clearly divide and implement the responsibilities and authorities of all departments. In the process of project construction, quality management is a system engineering, not a part or a sub item problem. Therefore, it is necessary to control and supervise the whole project comprehensively, scientifically and effectively. Fig. 3 is a composition diagram of the quality system of offshore engineering projects based on the clustering algorithm.

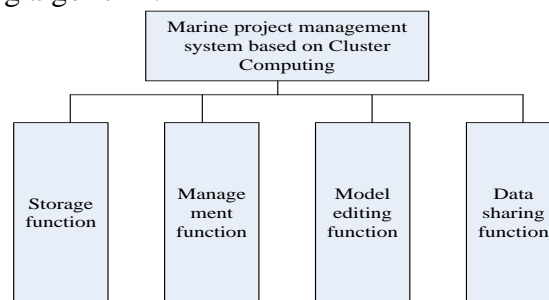


Figure 3. Composition of the quality system for Marine engineering projects

(1) Clustering technology uses the data processing ability of computers to realize information sharing, obtains attribute information such as the internal characteristics and external environment of the research object by simulating human-computer interaction, and classifies and analyzes them to form a classification scheme library. At the same time, it can also set the similarity between different categories according to needs, so as to provide a common rule system for different types. The quality management system of offshore engineering projects based on clustering algorithm is composed of the following parts:

(2) Management information system. Including system requirements analysis, overall design and database development. The system is the most core link in the whole process, which determines whether the final product can be successfully delivered and used, and also supports the follow-up work;

(3) The functional modules of the prefabrication process control subsystem, the corresponding software operating platform and the hardware equipment maintenance system constitute a complete clustering algorithm application environment;

(4) Operator management information system, safety information management system and user authority setting.

### 3.2. Performance Test of Clustering Algorithm in Quality Management of Offshore Engineering Projects

Before clustering, it is necessary to divide each sample of the project into several categories according to the classification principle. First, these samples are divided into several groups according to the characteristics of each subset. And then grouped according to these groups. When applying clustering algorithm to project quality management, first of all, we should classify the input data set, arrange the samples of different categories according to the similarity level, and then generate a cluster according to the clustering diagram of different levels to represent the distance between each cluster. Due to the characteristics of long construction period, large tasks and bad working environment of offshore engineering projects, there are many complex and diverse influencing factors. Therefore, in order to improve efficiency and reduce costs and construction difficulties, the following measures can be taken: establish a multi-dimensional index system, select appropriate nodes for testing, divide multiple projects into several groups at the same time, and finally divide each member into two or more groups to complete the creation of the whole data set and word cluster. Then the test can be started. If there is no clustering operation, It is necessary to further check whether there is an error in the input information.

## 4. Experimental Analysis of Quality Management of Offshore Engineering Project Based on Clustering Algorithm

### 4.1. Performance Detection and Analysis of Quality Management of Offshore Engineering Projects Based on Clustering Algorithm

Table 1 shows the performance analysis of clustering algorithm for offshore engineering quality management.

Table 1. Performance detection for the clustering algorithm

Test times	Process data time(s)	System delay time(s)	Account for memory(k)
1	3	2	3432
2	4	2	3214
3	2	1	3456
4	3	2	3341
5	2	1	3213

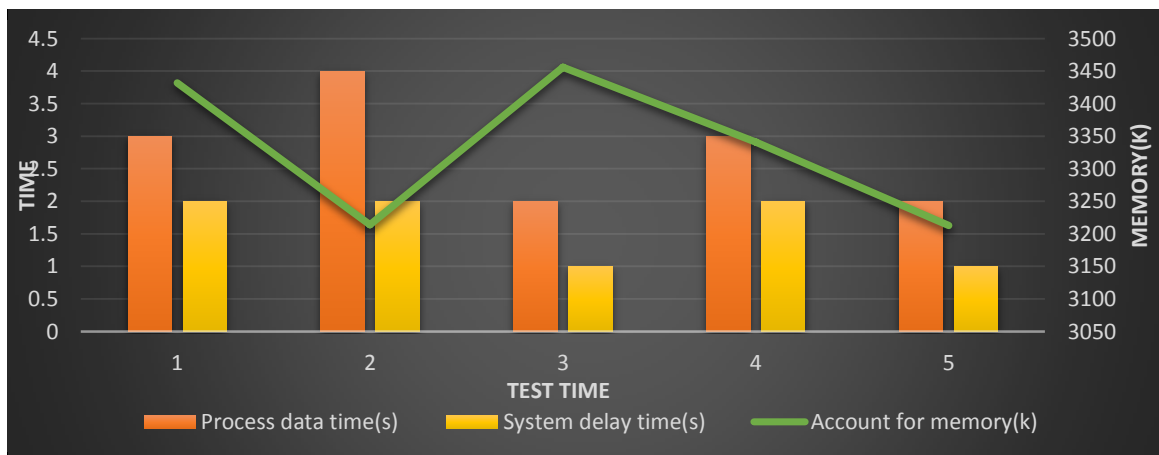


Figure 4. Performance testing

Clustering algorithm is a general method based on statistical classification. It performs data processing and pattern recognition in computer and has strong generalization ability. The basic idea is to divide the sample into several subsets (subsets or categories) according to certain rules. Each set can be used for similar feature point sets, label identification function sets and the number of corresponding relationships under different types of similarity function values to establish a clustering algorithm model and calculate the corresponding results to output to each cluster group. At the same time, the unlabeled attributes in the data can be deleted according to the obtained classification results. It can be seen from Fig. 4 that the data processing time of the quality management system of offshore engineering projects based on the clustering algorithm is very short, the delay time is low, and the memory consumption is relatively low.

## 5. Conclusion

With the rapid development of social economy, environmental problems have become increasingly prominent. Construction project management is the core and key link of engineering projects. This paper mainly studies the marine engineering project from two aspects: quality and schedule. Firstly, it introduces the research results and current situation of construction engineering quality at home and abroad. Secondly, it briefly analyzes the application background of clustering technology in China, its historical evolution and characteristics, and the influencing factors on different types of projects in water conservancy construction projects. Finally, it proposes to build a reasonable, scientific and perfect management system at the construction stage to ensure that high-quality construction can meet the requirements of social construction and environmental protection.

## Funding

This article is not supported by any foundation.

## Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

## Conflict of Interest

The author states that this article has no conflict of interest.

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