

# Design and Implementation of Lightweight Workflow Management System Based on XML -A Case Study of Central Geological Exploration Fund Project Capital Process Management System

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**Abstract**—According to central geological exploration fund project capital management methods, the whole process of central geological exploration fund project capital management includes four interlinked stages, such as project estimate, design budget, fund allocation and fund settlement, etc. Different management stages are completed by different units and users. The process management features are obvious, but the diversity of process settings in the management process and the instability of the management period place higher demands on the processing of workflows in the subsequent information process, and traditional heavyweight workflows or workflows that need to be cured in the system are clearly not suitable for the requirements of this project. In order to achieve flexible, lightweight and easy-to-operate business process management in the system construction, the XML-based lightweight business workflow model is designed and implemented. Based on this model, a workflow based on the four stages of project estimation, design budget, fund disbursement management and settlement management is further realised. The workflow is built into the central geological exploration fund capital management system, supporting the customisation and operational control of business processes and seamlessly connecting the business work of each node, which can meet the needs of the whole process of central geological exploration fund project capital management and effectively improve the level of fund project capital management.

**Keywords**- XML; lightweight workflow; central geological exploration fund projects; full process management

## 1 INTRODUCTION

The central geological exploration fund is different from general investment funds, special funds or financial allocations, and it has its own characteristics in terms of capital management, budget preparation and review, and adjustment of fund budget criteria[1].In accordance with the requirements of the standardized management of the funds of the central geological exploration fund projects (hereinafter referred to as the Fund projects), and in accordance with the Fund budget standards and the Fund capital management methods, combined with the characteristics of the Fund project operation and capital management [2], the capital management system of the central geological exploration fund (hereinafter referred to as the

Fund) was developed to realize the informationization of the whole process of capital management of the Fund projects, including the preparation and review of project estimates, the preparation and review of design budgets, the management of fund disbursement and the management of fund settlement. In the previous project management system, most of the system research and development adopted the way of binding business processing and business flow rules. In this case, business functions are often cured in the system, and changes in business processes require system maintenance research and development, thus bringing system maintenance overheads and poor system flexibility and scalability [3]. As workflows are increasingly used in project management systems, the workflow management system is unable to determine all processes in advance, and often the process is not constant in the execution process, leading to the phenomenon of "deadlock" in the workflow system [4]. This paper designs a lightweight workflow based on XML and builds a central geological exploration fund project capital management system, which supports the customisation of business processes and operational control to effectively meet the needs of fund project capital management and ultimately achieve standardised, scientific and convenient fund project capital management.

## **2 CENTRAL GEOLOGICAL EXPLORATION FUND PROJECT CAPITAL MANAGEMENT PROCESS**

According to the capital management method, the whole process of capital management of the central geological exploration fund projects mainly includes four stages, see Figure 1. The first stage is the project estimate stage, involving the undertaking unit, the Fund Centre and the evaluation experts; the second stage is the design budget stage, involving the undertaking unit, the Fund Centre, the evaluation experts and the higher authorities; the third stage is the fund allocation stage, involving the undertaking unit, the supervision department, the Fund Centre and the evaluation experts; the fourth stage is the settlement stage, involving the undertaking unit, the supervision department, the Fund Centre and the evaluation experts. The fourth stage is the settlement stage, involving the contractor, the Supervision Department, the Fund Centre and the evaluation experts.

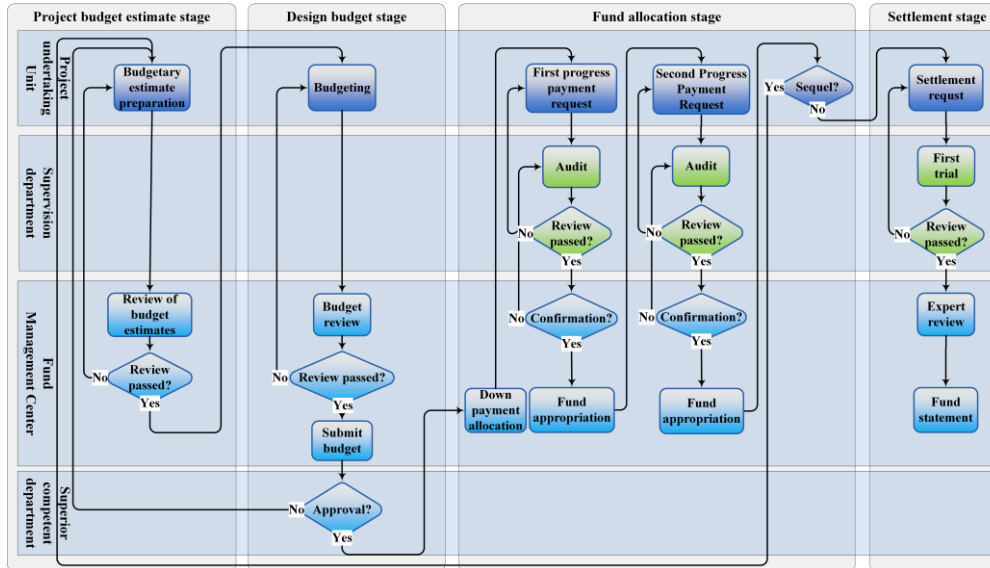


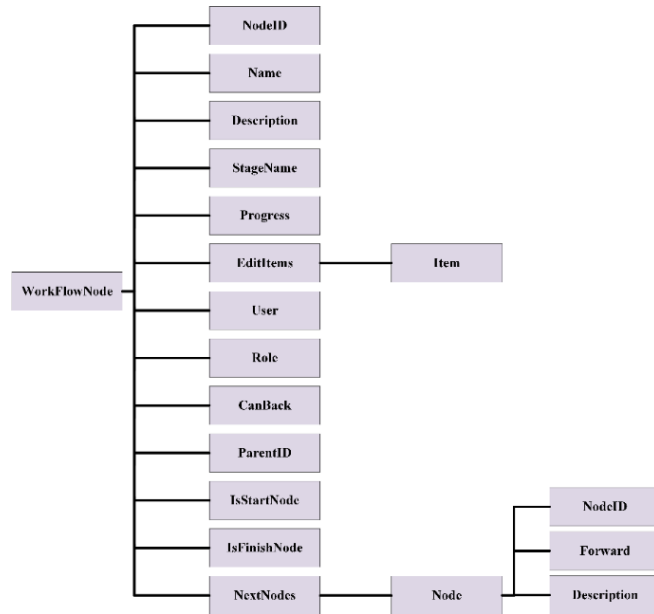
Figure 1. Business flow diagram

### 3 XML WORKFLOW-BASED PROCESS DESIGN FOR THE FULL MANAGEMENT OF GEOLOGICAL EXPLORATION FUND PROJECT FUNDS

#### 3.1 Designing a lightweight XML-based business workflow model

In this paper, we design a lightweight XML-based business workflow model that is more in line with the needs of "lightweight" systems, as there are several XML-based business process description languages in the workflow domain, but they are too cumbersome for lightweight workflow systems[5]. The structure of this model is shown in Figure 2, where the <WorkflowNode> element defines the root process node, the <NodeID> element defines the process node ID, the <Name> element defines the process node name, the <Description> element defines the description of the work content of the node, and the <StageName> element defines the name of the work stage of the process node, <Progress> element defines the progress bar value of the current node, <EditItems> element defines the work items that can be carried out under the current node, and there can be multiple work items, <User> element defines the element defines the operator of the current node, the <Role> element defines the operator role requirements, the <CanBack> element defines whether the current node can be backed out, the <ParentID> element defines the parent node ID of the current node, the <IsStartNode> element defines whether it is the start node, the < element defines whether it is the start node, <IsFinishNode > element defines whether it is the end node, and <NextNodes> element defines the next set of nodes contained in the current node, each of which must define the node ID, whether it is forward or not, and a description of the work content. In a workflow

system, managers develop business processes based on specific business requirements and use the workflow designer to complete the specific definition of the workflow, generating a process description XML format template file.



**Figure 2.** XML-based lightweight business workflow model structure

### 3.2 Geological exploration Fund Full Process Design

Combined with the whole process management process of the central geological exploration fund project funds, this paper designs a workflow process based on the four stages of project estimate, design budget, funds allocation management and settlement management, with 29 nodes and 56 routes, see Figure 3 (where the solid line is the forward route and the dotted line is the backward route), and also describes the work content of each node and the work content of the forward and backward routes, see Table 1.

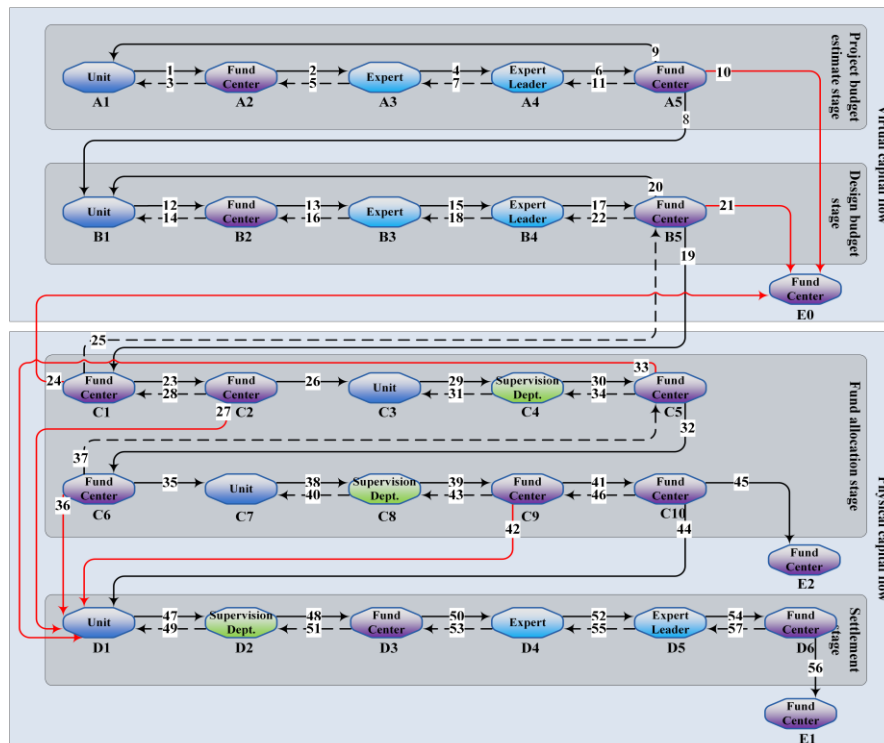


Figure 3. System workflow flow diagram

Table 1 Description of system workflow process nodes and lines

| NO. | Node name   | Job Description   | Line description  |
|-----|---|---|---|
| A1  | Preparation of budget proposals                         | Create new projects and fill in basic project information, prepare project estimates  | 1:Submission of project budget estimates for preparation, pending review of project budget estimates  |
| A2  | Management of the organisation's budget proposal review | Organise the review of budget estimates, appoint economic experts to projects and prepare for the review of standing budget estimates | 2:Designation of the economic reviewer and expert team leader for the project's budget estimate in preparation for the budget estimate review<br>3:Return to the undertaking unit |
| A3  | Review of budget proposals                              | Review of the project estimates by the lead economist of the proposed budget  | 4:Complete the review of the project's budget proposal and submit it to the head of the expert group for review of the results<br>5:Return to the Foundation Centre               |

|    |  |   |   |
|----|--|---|---|
| A4 | Team Leader Review                           | The head of the economics expert team reviews the economics lead expert's review of the project budget proposal | 6<br>: Agree with the opinion of the lead economist on the project's budget proposal and submit the results of the budget proposal review<br>7: Return to the lead economist  |
| A5 | Management of budget proposal review results | Process the results of the review of project estimates and decide on the next steps                             | 8: Initiation of the design budgeting process for the project<br>9: Re-proposal of the project<br>10: Termination of the project<br>11: Return of the expert team leader for the review of the budget proposal  |
| B1 | Budgeting                                    | Project design budgeting by the undertaking   | 12: Submission of project budgeting, pending project budget review  |
| B2 | Organizational budget review management      | Organise budget reviews, appoint economic experts to projects and prepare design budget reviews                 | 13: Designation of the lead expert and expert team leader for the economic review of the project's budget in preparation for the budget review<br>14: Return to the undertaking   |
| B3 | Budget Review                                | Review of the project design budget by the lead budget economist  | 15: Complete the budget review for the project and submit to the Head of Expert to review the results<br>16: Return to the Foundation Centre  |
| B4 | Team Leader Review                           | The head of the budget economics expert team reviews the economics lead expert's review of the project budget   | 17<br>: Agree with the opinion of the lead economist on the budget review of the project and submit the results of the budget review<br>18: Return to the lead economist  |
| B5 | Budget review results management             | Process the results of the project design budget review and decide on the next steps                            | 19: Design budget approved and project moves to allocation stage<br>20: Project re-budgeted for design<br>21: Project terminated<br>22: Returned to Budget Review Specialist Leader   |
| C1 | Down payment allocation management           | Selection of supervisory department, allocation of down payment   | 23: Disbursement of the down payment and initiation of management of the preparation of the first disbursement request<br>24: No disbursement of the down payment, the project is terminated<br>25: Return to the previous budget stage of budget review results management |

|    |   |  |   |
|----|---|--|---|
| C2 | First allocation request preparation work initiation management | Down payment has been made and a decision has been made whether to initiate the preparation of the application for the first progress payment of the project | 26: Initiate the preparation of the first progress payment application for the project<br>27: The project is terminated and enters the settlement phase<br>28: Return to the previous step of managing the down payment allocation  |
| C3 | First progress payment request preparation                      | Preparation of the first progress payment application by the contractor  | 29: Submission of the first allocation request for the project, pending initial review by the Supervision Department  |
| C4 | Preliminary examination   | Initial review of the first progress payment application   | 30: Grant the project's first disbursement application, pending final review by the Fund Centre<br>31: Return the project to the undertaking and the project will be re-applied for the first disbursement  |
| C5 | Final hearing   | Final review of the first progress payment application to determine whether progress payments will be made   | 32: Disbursement of the first progress payment and initiation of management of the preparation of the second disbursement application<br>33: Failure to disburse the first progress payment, the project is terminated and enters the settlement phase<br>34: Return to the Supervision Department for a new initial review of the first disbursement application |
| C6 | Second Allocation Request Preparation Initiation Management     | First progress payment has been made, decide whether to initiate the preparation of a second progress payment request for the project                        | 35: Initiate the preparation of the second progress payment application for the project<br>36: Terminate the project and proceed to the closing stage<br>37: Return the first final review session  |
| C7 | Second progress payment request preparation                     | Second progress payment application preparation by the undertaking   | 38: Submission of the second allocation request for the project, pending initial review by the Supervision Department   |
| C8 | Initial review  | Initial review of second progress payment application  | 39: Grant the project's second disbursement application, pending final review by the Fund Centre<br>40: Return the project to the undertaking and the project will be re-applied for a second disbursement  |

|    |   |  |  |
|----|---|--|--|
| C9 | Final hearing                                       | Final review of the second progress payment application and decision on whether to make progress payments                          | 41: Second progress payment made and second payment completed<br>42: Second progress payment not made, the project terminated and entered the settlement phase<br>43: Returned to the ACA for initial review of the second payment application |
| C1 | Second allocation to complete management            | Post-processing of projects after funds have been disbursed  | 44:Funds disbursement complete, moving to closing<br>45:Current year project complete, renewal exists for this project<br>46:Returned to second progress payment finalisation session in previous step   |
| D1 | Settlement request preparation                      | Undertaking the preparation of the application for project funding closure   | 47: Submission of settlement application pending preliminary approval of settlement by the ACA   |
| D2 | Preliminary Settlement                              | Initial review of settlement reports   | 48:Agree to the project's settlement application pending processing by the Fund Centre<br>49:Return to the undertaking unit for a new settlement application preparation   |
| D3 | Organisation of settlement expert review management | Organise settlement reviews, appoint economic experts to projects and prepare expert reviews of project funding settlements        | 50 :Designate the lead economic reviewer and expert team leader for the project's settlement in preparation for the settlement review<br>51:Return to the Supervision Department   |
| D4 | Settlement review                                   | Review of project financial closure report by lead closing economist   | 52:Complete the review of the project's settlement and submit it to the Head of Panel for review of the results<br>53:Return to the Fund Centre  |
| D5 | Team Leader Review                                  | The head of the settlement economics team reviews the review of the project finance settlement report by the lead economics expert | 54:Agree with the economic lead expert's review of the project's settlement and submit the results of the settlement review<br>55:Return to lead expert  |
| D6 | Settlement management                               | Processing of project settlement review results for settlement processing  | 56:Settlement processing completed, project completed<br>57:Returned to Group Leader   |
| E1 | Project completion                                  | Project completion   |  |
| E2 | Project annual work completed                       | The disbursement of funds for the current year is complete, but this project needs to be renewed and will be                       |  |



|    |             |  |  |
|----|-------------|--|--|
|    |             | consolidated when the project is fully completed |  |
| E0 | Termination | The project has been terminated                  |  |

### 3.3 Example of an XML workflow model

- First, the nodes for the preparation of the estimates are as follows.

```

<WorkflowNode ID="11">
  <Name> Estimated budget preparation</Name>
  <Description> Create a new project and fill in basic project information, prepare a project estimate</Description>
  <StageName> Estimation stage</StageName>
  <Progress>6</Progress>
  <EditItems>Project , Basic information|Estimate, Estimate preparation</EditItems>
  <User>? </User>.
  <Role>WorkUnitRole</Role>
  <CanBack>>false</CanBack>
  <ParentID></ParentID>
  <IsStartNode>>true</IsStartNode>
  <IsFinishNode>>false</IsFinishNode>
  <NextNodes>
    <Node>
      <NodeID>12</NodeID>
      <Forward>>true</Forward>
      <Description> Submission of project estimates for preparation pending review of project estimates</Description>
    </Node>
  </NextNodes>
</WorkflowNode>

```

- Second, the nodes for the preparation of the estimates are as follows.

```

<WorkflowNode ID="24">
  <NodeID > 11< / NodeID >
  <Name>Budget Review Results Management</Name>

```

<Description>Processing the results of the project design budget review and deciding on the next steps</Description>

<StageName>Budget Phase</StageName>

<Progress>49</Progress>

<EditItems></EditItems>

<User></User>

<Role>FundsManagerRole</Role>

<CanBack>>true</CanBack>

<ParentID>23\_2</ParentID>

<IsStartNode>>false</IsStartNode>

<IsFinishNode>>false</IsFinishNode>

<NextNodes>

<Node>

<NodeID>30</NodeID>

<Forward>True</Forward>

<Description>Design budget approved, project moves to allocation stage</Description>

</Node>

<Node>

<NodeID>21</NodeID>

<Forward>>false</Forward>

<Description>The project was re-designed for budgeting</Description>

</Node>

<Node>

<NodeID>0</NodeID>

<Forward>>false</Forward>

<Description>This item is terminated</Description>

</Node>

<Node>

<NodeID>23\_2</NodeID>

<Forward>>false</Forward>

<Description>Return of Budget Review Expert Team Leader</Description>

```

</Node>
</NextNodes>
</WorkFlowNode>

```

## 4 WORKFLOW FUNCTION IMPLEMENTATION AND APPLICATION IN THE SYSTEM

### 4.1 General system functionality

The central geological exploration fund capital management system is based on B/S (Browser/Server) structure, realising the business process-based project fund project estimate preparation and review function, design budget preparation and review function, fund allocation application preparation function, fund allocation review function, settlement preparation function, settlement review function, as well as process control function, system user and personnel management function, budget standard automation function, report output function, etc. The process management control module enables overall control of the system process, management of the business process stage of the project, display of process information and project declaration and review information, and the ability to initiate, accept, cancel and return business processes.

### 4.2 Implementation of workflow functions in the project estimate phase

Take the Fund Centre user to carry out the management of the organization's budget proposal review as an example, the work of the Fund Centre user is to designate economic experts for the project, ready to carry out the budget proposal review, click on the "Submit Work" function button, enter the business process selection interface, see Figure 4. Such as click on the "Select Lead Reviewer" When the selection of experts is completed, the user of the Fund Centre has two options, one is to transfer the project to the lead expert and expert leader for budget review, and the other is to return the project to the contractor.

Work submission confirmation

|                                  | The description of work  | Next work stage | Next Role   | Next user   |
|----------------------------------|--|-----------------|-------------|---|
| <input checked="" type="radio"/> | Designation of the economic reviewer and expert team leader for the project's budget estimate in preparation for the budget estimate review. | Estimate stage  | Expert user | <input type="button" value="Select expert"/><br><input type="button" value="Select expert leader"/> |
| <input type="radio"/>            | Return the project undertaking unit  | Estimate stage  | Unit user   | San Zhang   |

**Figure 4.** Management interface for the management workflow for the review of the organisation's budget proposal

| Work submission confirmation     |  |                           |                  |           |
|----------------------------------|--|---------------------------|------------------|-----------|
|                                  | The description of work                                      | Next work stage           | Next Role        | Next user |
| <input checked="" type="radio"/> | Design budget approved and project moves to allocation stage | Fund allocation stage     | Fund center user | Confirmed |
| <input type="radio"/>            | Project re-budgeted for design                               | Design budget stage       | Unit user        | San Zhang |
| <input type="radio"/>            | Project terminated   | Completion or termination | Fund center user | Confirmed |
| <input type="radio"/>            | Returned to Budget Review Specialist Leader                  | Design budget stage       | Expert user      | Si Li     |

**Figure 5.** Budget review results management workflow management interface

| Work submission confirmation     |   |                       |                             |           |
|----------------------------------|---|-----------------------|-----------------------------|-----------|
|                                  | The description of work   | Next work stage       | Next Role                   | Next user |
| <input checked="" type="radio"/> | Disbursement of the first progress payment and initiation of management of the preparation of the second disbursement application | Fund allocation stage | Fund center user            | Confirmed |
| <input type="radio"/>            | Failure to disburse the first progress payment, the project is terminated and enters the settlement phase                         | Settlement stage      | Unit user                   | San Zhang |
| <input type="radio"/>            | Return to the Supervision Department for a new initial review of the first disbursement application                               | Fund allocation stage | Supervision department user | Wu Wang   |

**Figure 6.** First Progress Payment Final Review Workflow Management Interface

| Work submission confirmation     |  |                           |                  |           |
|----------------------------------|--|---------------------------|------------------|-----------|
|                                  | The description of work                            | Next work stage           | Next Role        | Next user |
| <input checked="" type="radio"/> | Settlement processing completed, project completed | Completion or termination | Fund center user | Confirmed |
| <input type="radio"/>            | Returned to Group Leader                           | Settlement stage          | Expert user      | Si Li     |

**Figure 7.** Settlement processing workflow management interface

### 4.3 Implementation of workflow functionality in the design and budget phase

Take the example of a Fund Centre user conducting a budget review results management exercise, the Fund Centre user enters the business process selection screen for this item, as shown in Figure 5. At this point, the Fund Centre user has four options. Firstly, to move to the fund allocation stage, the Fund Centre user selects the "Approve Design Budget" radio button and clicks the "Submit" button on the interface, the budget stage is completed and the project moves to the fund allocation stage. Secondly, the user of the Fund Centre selects the "Budgeting" radio button and clicks the "Submit" button on the interface, the project is returned to the project unit for re-budgeting. Thirdly, the project is terminated, the user of the Fund Centre selects the "Click on the "Submit" button on the interface and the project will be terminated. Fourthly, the project will be returned to the expert team leader for re-examination, the Fund Centre user selects the "Return" radio button and Click on the "Submit" button on the interface and the project will be returned to the expert team leader for re-examination.

#### **4.4 Implementation of workflow functions in the funds disbursement phase**

As an example, if the Fund Centre carries out the first final review of progress payments, the Fund Centre user enters the business process selection screen for that process, as shown in Figure 6. At this point, the Fund Centre user has three choices. First, to disburse progress payments and enter the second disbursement application preparation initiation management, the Fund Centre user selects "Disburse progress payments and enter the second disbursement application preparation initiation management" radio button, click the interface "Submit" button, on behalf of the first progress disbursement, the central geological exploration fund of the undertaking unit has been disbursed funds for the sum of the first payment and the first progress payment. Second is to terminate the project unit, direct settlement, the Fund Centre users select the "terminate the project" radio button, click the interface Click on the "Submit" button, as the current down payment has been made but the first progress payment has not been made, the project will be terminated and go directly to settlement, and the central geological exploration fund allocated funds for the undertaking unit will be the down payment, and the undertaking unit can prepare the settlement application. Third, return to the previous step, the user of the Fund Centre selects "Return" radio button, return to the Supervision Department, re-examination.

#### **4.5 Workflow implementation for the settlement phase**

Take the Fund Centre user for settlement management as an example, after the Fund Centre user has completed the settlement work content, enter the business process selection interface, as shown in Figure 7. At this point, the Fund Centre user has two options. Firstly, the project is complete, the Fund Centre user selects the "Settlement completed, project complete" radio button and clicks the "Submit" button on the interface, which means the project is complete and enters the completion phase, while the final payment is disbursed. The second option is to return the project to the previous step, where the user selects the "Return" radio button and the project is returned to the team leader for a new review of the project.

### **5 CONCLUSION**

The capital management of the central geological exploration fund projects is divided into four stages, namely the project estimate preparation and review stage, the design budget preparation and review stage, the fund disbursement stage and the fund settlement stage. Each stage involves different user types such as the Fund Centre, the supervision department, the project undertaking unit and the economic experts, and the specific operations of different user types vary greatly in each stage. In this paper, a lightweight XML-based business workflow model is designed to support the customisation of business processes and operational control. Based on the fund budget standard fund capital management methods, combined with the fund project operation and capital management characteristics, the workflow model is used to design a workflow process based on four stages: project estimate, design budget, fund allocation management and settlement management, which can meet the needs of the whole process of central geological exploration fund project capital management. On this basis, the central geological exploration fund project capital management system is researched and built, which

ultimately realises the standardised, scientific and convenient management of fund project capital.

Lightweight business workflow has good adaptability for the central geological exploration fund project capital management system. If it is to achieve its wider generality and be integrated and used in more business systems in other industries, further research and enhancement is needed in the following two areas: firstly, support for complex process nodes, such as the support for parallel, serial or both cross-relationships when multiple users or roles are involved in a node; secondly, for business changes at process runtime, to achieve its runtime support for two or more sets of XML process templates, old and new.

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