

## **CHAPTER 22: CIVIL ENGINEERING PROJECT MANAGEMENT**

### **22.1 Introduction of the Unit of Learning**

This unit describes the competencies required to manage civil engineering projects. It involves managing project time, managing construction project quality, managing project site safety, health and security, managing construction project cost, managing project labour, managing project contracts and managing construction materials, plant, tools and equipment.

### **22.2 Performance Standard**

Manage project time, construction project quality, project site, safety, health and security, construction project cost, project labour, project contracts, and construction materials, plant and tools and equipment based on project specifications.


### **22.3 Learning Outcomes**

#### **22.3.1 List of Learning Outcomes**

- a) Manage project time
- b) Manage construction project quality
- c) Manage project site, safety, health and security
- d) Manage construction project cost
- e) Manage project labour
- f) Manage project contracts
- g) Manage construction materials, plant, tools and equipment

## 22.3.2 Learning No 1: Manage Project Time

### 22.3.2.1 Learning Activities

Learning Outcome No 1: Manage Project Time	
 Learning Activities	Special Instructions
1.1 Prepare work schedules and time programs 1.2 Monitor and evaluate project timelines 1.3 Control project time schedules 1.4 Prepare and disseminate project timeline reports	<ul style="list-style-type: none"><li>• Group discussions</li><li>• Demonstration by trainer</li><li>• Online videos</li><li>• Power point presentation</li><li>• Exercises by trainee</li></ul>

### 22.3.2.2 Information Sheet No22/LO1: Manage Project Time



#### Introduction to learning outcome

This learning outcome deals with project time management and this can be achieved through the knowledge of various aspects such as; preparation of work schedules and time programs, monitoring, evaluation and control of project timelines and schedules. All this is based on the project specifications.

#### Definition of key terms

**Work schedule:** Ronald (2015) defines schedules in project management as a process of identifying deliverables, milestones, and activities in chronological order with a start and end date and time. Therefore, work schedules can be defined as an organization of activities, deliverables, and project milestones to ensure that inputs are transformed into outputs in a project at a stipulated time.

**Project timeline:** The project timeline can be defined as the process of showing the chronological order of events in a project.

#### Content/Procedures/Methods/Illustrations

##### 1.1 Prepare work schedules and time programs based on the project specifications

The process of preparing work schedules and time programs can be complex since different projects have varied approaches and challenges. However, there are six steps simplified steps that can be applied in all projects regardless of the project nature.

**a. Identify and Write down the project tasks**

The most crucial step in project management allows the project manager to understand the project nature. Moreover, it determines how activities will be well-coordinated within the project stipulated time.

**b. Define the various relationships between the tasks.**

Once the project tasks have been written down, it is crucial to identify the existing relationship between the various events.

**c. Develop various Milestones**

Project milestones indicate the event that allows the end of a particular project activity and allows the beginning of another activity. The steps involve allocating the relevant tasks that will facilitate the achievement of the set milestones.

**d. Allocate time for the identified milestone**

After the milestone development, the next step now becomes identifying the available time and allocating accordingly. The time allocation should be balanced and clearly stated. Moreover, it should have an allowance to avoid inconveniences.

**e. Allocate resources**

After the project's milestones have been identified, it is crucial to understand the various roles and resources allocation basis. The project success depends on this step since the progress and results will be dependent on the product mix on this stage.

**f. Review and Revise the schedule regular**

The first attempt might not provide the most feasible option; therefore, it is necessary to adjust the program. However, the revision should be aligned with the project's goals, objectives, and allocated time and resources.

**1.2 Monitor and evaluate project timelines based on the project specifications**

Project monitoring and evaluation (M&E) is the process of gathering and interpreting data to check if the project is moving towards the stipulated direction. Monitoring is carried to measure progress and performance for decision-making purposes at the different stages of the projects. On the contrary, evaluation is carried out for general data assessment purposes of understanding the extent at which the specified goal is achieved. It is crucial to understand the direction and the impact that a particular project, therefore the need to carry out monitoring and evaluation activities. Furthermore most projects are time bound, and evaluation and monitoring help in maintaining the specified timing.

**1.3 Control project time schedules based on the project specifications**

For easier control project time schedules, data collection plays a crucial role. The data collection varies with the project nature; thus, the project managers need to identify the sustainable data collection method. From the data collected, the resource and responsibility allocation is identified with the time being a factor of consideration. The information helps in operational and strategic management, and controlling the project becomes an easy and straight leader.

#### 1.4 Prepare and disseminate project timeline reports based on the project specifications.

After the data is collected, the need for compiling and analysis arises. Therefore, the project manager collaborates with the research team members and selects the various tools required to analyse the data collected logically and acceptably. After analysis, the data organized and prepared in an official document that will be used for reporting purposes. The data collected should be organized in such a way that it allows objective and strategic adjustments.

#### Conclusion

This learning outcome covered project time management

#### Further Reading



Read more on project timelines and project time control

#### 22.3.2.3 Self-Assessment



#### Written Assessment

1. Work schedule can be defined as
  - a) the various expectations that show the project's success
  - b) process of identifying deliverables, milestones, and activities in chronological order with a start and end date and time
  - c) A document that shows a chronological order of events in a project.
  - d) Organization of activities, deliverables, and project milestones to ensure inputs are transformed into outputs in a project at a stipulated time.
2. Which one of the following does not explain the purpose of carrying out monitoring and evaluation in a project?
  - a) Capacity building
  - b) Clarification
  - c) Accountability
  - d) Strategic management

3. Which one of the following explains the meaning of monitoring a project?
- The document prepared during the process can be used for explanation purposes to the project donors and stakeholders about the utilization of the various resources in the program.
  - Information acquired at the different project levels can be used to change the project approach due to the objective and strategies adjustment.
  - Process of measuring progress and performance for decision-making purposes at the different stages of the projects
  - Provides information that is required for the coordination and management of the various resources for project improvement purposes.

### **Short answer question**

Identify the tools required to analyse and report the collected data?

### **Essay question**

Describe the process of monitoring and evaluate project timelines based on the project specifications

### **Case Study Assessment**

The county board of directors has selected you in the short-list on their project manager in a county development project. Prepare a document that you will present on the interview day to demonstrate your ability to organize, manage, and report the project at the various project stages.

### **Project Assessment**

Write a report on the management of the post-modern library being constructed in your school

#### **22.3.2.4 Tools, Equipment, Supplies and Materials**

- Scientific Calculators
- Relevant reference materials
- Stationeries
- Design Software
- Computer lab
- Relevant practical materials
- Laboratories (chemical, biological & soils)
- Internet
- Manuals and guidelines
- Project management software
- Measuring and drawing tool
- Printer/plotting device
- Codes of practice

### 22.3.2.5 References



- Eng. Ssempebwa Kibuuka Ronald. (2015). Project Schedule Management. Hawaii. Research Gate.
- Hu, X., Cui, N., Demeulemeester, E., & Bie, L. (2016). Incorporation of activity sensitivity measures into buffer management to manage project schedule risk. *European Journal of Operational Research*, 249(2), 717-727.
- Susser, B. S. (2012). How to Effectively Manage IT Project Risks. *Journal of Management & Business Research*, 2(2).

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### 22.3.3 Learning No 2: Manage Construction Project Quality

#### 22.3.3.1 Learning Activities

Learning Outcome No 2: Manage Construction Project Quality	
 <b>Learning Activities</b>	<b>Special Instructions</b>
2.1 Develop construction project quality plans 2.2 Develop construction project methodology 2.3 Acquire construction project resources 2.4 Undertake construction project quality control 2.5 Prepare construction project quality reports	<ul style="list-style-type: none"> <li>• Group discussions</li> <li>• Demonstration by trainer</li> <li>• Online videos</li> <li>• Power point presentation</li> <li>• Exercises by trainee</li> </ul>

#### 22.3.3.2 Information Sheet No22/LO2: Manage Construction Project Quality



##### Introduction to learning outcome

This learning outcome deals with development of construction project quality plans, methodology, and undertaking of project quality control together with preparation of project quality reports.

##### Definition of key terms

**Contract:** This is an agreement creating and defining obligations between parties. It is an agreement enforceable at law made between two or more persons by which rights are acquired by one or more to act on the part of the other or others.

**Contract specifications:** These are the rules of the contract. They are the agreed upon set of requirements that provide the necessary details about specific requirements.

##### Content/Procedures/Methods/Illustrations

#### 2.1 Develop construction project quality plans according to the contract specifications

Construction project quality plan is a written plan detailing how one will manage quality on a construction project. Project quality plans vary depending on the type of construction project one undertakes; however, they are limited in scope. Quality plans are written to make the clients know how you going to control the quality of your projects, so it is necessary that when developing a quality plan, one should make clear how and when you would control quality in your project. A construction quality plan should be prepared in such a way that your headings match up with your client's specifications.

### **Essential elements of a construction project quality plan include**

- i. Project personnel in charge of the project quality. Has the overall responsibility
- ii. Quality communications to ensure quality work is done.
- iii. Quality assurance surveillance-Monitoring overall project quality.
- iv. Project quality specifications-Where one makes sure compliance with the projects contract specifications.
- v. Inspections and tests-To inspect phases of works to ensure they are up to the required quality.
- vi. Control of nonconformance-The quality control plan should outline how to handle situations that go wrong.

### **2.2 Develop construction project methodology according to the contract specifications**

Construction Project methodologies are processes that assist project managers with guidance and the steps to take to bring a project to completion.

Depending on contract specifications, there are a number of methodologies that are crucial to getting the job right. The choice of methodology will depend entirely on the project with their set of rules, principles, processes and practices.

- **Agile**

This is one of the most recognizable methodologies where demands and solutions evolve through the cross functional teams and their customers.

- **Lean**

This type of construction methodology promotes maximizing customer value while minimizing waste.

- **Waterfall**

In this methodology, processes flow downwards in one direction like a waterfall. One is able to move onto the next phase of development once the current phase has been completed as illustrated by Winston W George in an article written in 1970.

- **PMI/PMBOK**

PMI stands for project Management Institute which is a non-profit membership association, project management certification and standard organization.

PMI produces the PMBOK which is a guide detailing the set standards that characterize project management.



### **2.3 Acquire construction project resources according to the contract specifications**

Construction resources in a construction project might include:

- i. Products and material
- ii. Human resources
- iii. Space and facilities
- iv. Finances
- v. Construction plant, tools and equipment.
- vi. Subcontractors.

Construction Project resources vary depending on cost, duration, quality and safety as the construction project industries are diverse and contains subcontractors, contractors, consultants, architects, owners and others. Acquiring resources needs an understanding of what resources are needed, what resources are available, where the resources are located and the ability to reschedule those resources accordingly.

### **2.4 Undertake construction project quality control according to the contract specifications**

Construction quality control is or are measures to ensure that a project conforms to the quality as indicated in the specifications.

To ensure quality, a number of steps are employed in a construction project.

- i. Organizing for Quality-Have a group that will have an overall responsibility of ensuring that the project quality is adhered to.
- ii. Inspectors and quality assurance personnel will be involved in day to day quality check of the project.
- iii. Work and material specification. -This documentation includes special provisions of the design project facility as well as references to generally accepted specifications to be used in construction.
- iv. Quality control by statistical methods-This involves testing all the material on a particular project. Such as non-destructive techniques or an onsite inspector can witness the appropriateness and adequacy of construction methods.

### **2.5 Prepare construction project quality reports according to the contract specifications**

Construction quality report is an account generated that is given to the customer of the materials used in the project together with a description of its technical characteristics.

The reports details how the quality plans were followed to ensure quality is attained.

## **Conclusion**

This learning outcome covered management of construction project quality

## Further Reading



Read more on construction project methodologies on Kolarić, S., Pavlović, D., & Vukomanović, M. (2015). Developing a methodology for preparation and execution phase of construction project. *Organization, technology & management in construction: an international journal*, 7(1), 1197-1208.

### 22.3.3.3 Self-Assessment



#### Written Assessment

1. Quality control is...
  - a) The graphic display of data that illustrates results of a process
  - b) Measures to ensure that a project conforms to the quality as indicated in the specifications.
  - c) Processes that assist project managers with guidance and the steps to take to bring a project to completion.
2. Which of the following is not an essential element of a construction project quality plan?
  - a) Quality communications
  - b) Control of nonconformances
  - c) Project submission
3. Quality control plan must address
  - a) Quality control of the project
  - b) Quality assurance of the Project
  - c) All of the above
4. Which statement is true?
  - a) The choice of methodology will depend entirely on the project with their set of rules, principles, processes and practices.
  - b) Construction Project methodologies are processes that assist project managers with guidance and the steps to take to bring a project to completion
  - c) All of the above
5. Summarize the different methodologies in a construction project.
6. With reference to quality control, outline three quality standards in a construction project.
7. Summarize quality control plans.

### **Essay question**

With reference to construction project plan outline and explain in details what one would consider then planning for a construction project.

### **Oral Assessment**

1. Outline the factors to include in a construction resource
2. Evaluate the elements of a construction project

### **Case study assessment**

A road is to be constructed in your area and your firm has been contracted to do it. As the project manager present your project plan for approval by the relevant authorities.

#### **4.3.2.4 Tools, Equipment, Supplies and Materials**

- Scientific Calculators
- Relevant reference materials
- Stationeries
- GPS
- Design Software
- Computer lab
- Relevant practical materials
- Laboratories (chemical, biological & soils)
- Internet
- Manuals and guidelines
- Project management software
- Measuring and drawing tool
- Printer/plotting device
- Codes of practice

#### **22.3.3.5 References**




Flood, I., Issa, R. R., & Liu, W. (2006, June). A new modeling paradigm for computer-based construction project planning. In Proceedings of the Joint International Conference on Computing and Decision-Making in Civil and Building Engineering (pp. 1-11).

Haswell, C. K., & De Silva, D. S. (2013). Civil engineering contracts: practice and procedure. Butterworth-Heinemann.

Murray, M., & Langford, D. (Eds.). (2008). Construction Reports 1944-98. John Wiley & Sons.

## 22.3.4 Learning No 3: Manage Project Site, Safety, Health and Security

### 22.3.4.1 Learning Activities

Learning Outcome No 3: Manage Project Site, Safety, Health and Security	
 Learning Activities	Special Instructions
3.1 Develop project health, safety and security guidelines 3.2 Conduct site health, safety and security inspections 3.3 Coordinate and monitor project site security	<ul style="list-style-type: none"><li>• Group discussions</li><li>• Demonstration by trainer</li><li>• Online videos</li><li>• Power point presentation</li><li>• Exercises by trainee</li></ul>

### 22.3.4.2 Information Sheet No22/LO3: Manage Project Site, Safety, Health and Security



#### Introduction to learning outcome

This learning outcome deals with development, coordination and monitoring of project health, safety and security guidelines. The health and safety of people places of work deals with development, coordination and monitoring of project health, safety and security guidelines. These provisions are enhanced by legal regulations which introduce measures to improve the health and safety of workers through minimizing the risks they go through at their places of work.

#### Definition of key terms

**Occupational safety and health:** is an essential sector that deals and ensures the safety, health and welfare of the workers.

#### Content/Procedures/Methods/Illustrations

##### 3.1 Develop project health, safety and security guidelines in line with the OSH Act

Health and Safety Project is planned to assist in the monitoring of operations and promote a risk-based approach to the prevention of dangerous actions that may lead to accidents or illnesses or severe workplace incidents. The following are guidelines in line with the OSH Act (2007):

- i. There should be registration of work places applied before any persons occupy or uses any premises as a work place
- ii. There should be training and supervision of inexperienced works
- iii. There should be supervision, employment of persons below eighteen years, apprentices and indentured learners
- iv. Protective clothing and appliances
- v. There should be cleanliness in the workplace
- vi. Proper ventilation should be provided

- vii. Proper lighting should be provided
- There should be evacuation procedures

### **3.2 Conduct site health, safety and security inspections in line with the OSH Act**

- i. Initial environmental audit- OSHA identifies and understands all legal and other requirements for workers within the site or work places according to environmental aspects
- ii. Environmental policy – whether the employees and employers are observing their responsibilities on observing safety and health measures
- iii. Planning – OSHA formulates their policies to be put in day to day practice
- iv. Implementation – by allocating functions and responsibilities, motivating employees and training them to be accountable in the delivery of their duties diligently.
- v. Training – OSHA clarifies the impact, beware of the task and responsibility within work places and consequences of the non-compliance workers
- vi. Communication – OSHA do their best to communicate using various ways such as visits, open door events, the legislation, conferences to ensure safety and security of workers and employees
- vii. Auditing – by assessing performance (monitoring operations and track frame) identify problems and correct them, keeping records performances and documented files

### **3.3 Coordinate and monitor project site security in line with the OSH Act**

There should be proper coordination and monitoring among the employer and the workers in the project site. The employer and the workers should be aware of:

- i. Types of hazards that may occur from work being performed on-site by employees hired by contractors, subcontractors or staffing agencies.
- ii. Procedures or measures necessary to prevent or control exposure to such hazards.
- iii. How to contact the manufacturer, subcontractor or personnel department if they have a health issue.
- iv. Past work undertaken and the types of risks that might still be present at the job site.

### **Conclusion**

This learning outcome has prepared the student to be able to apply the general and particular legislation and regulations of Health and Safety at work, understand management of project site, safety, health and security

## Further Reading



Read further on safety, health and security as illustrated on the Occupational Safety and Health Act, 2007.

### 22.3.4.3 Self-Assessment



#### Written Assessment

1. Which of the following is not a provision of health and safety?
  - a) Permit to work
  - b) Fire prevention
  - c) Project site
2. Can you interpret the following as used in OSHA?
  - a) Act
  - b) Prevention
3. Summarize the application of OSHA guidelines
4. Are you able to interpret OSHA guidelines?
5. Summarize the health and safety general provisions.
6. State health and safety general provisions
7. Summarize importance of project management

#### Essay question

1. Discuss the basic aspects of targeted by OSHA.

#### Oral Assessment

1. Evaluate the importance of OSHA in a project
2. Summarize on skills necessary for project management on site.

## **Project Assessment**

An elevated road is being constructed at Maji ya Chumvi along Nairobi-Mombasa Highway to fly over the railway line. Prepare the project report.

### **22.3.4.4 Tools, Equipment, Supplies and Materials**

- Scientific Calculators
- Relevant reference materials
- Stationeries
- GPS
- Design Software
- Computer lab
- Relevant practical materials
- Laboratories (chemical, biological & soils)
- Internet
- Manuals and guidelines
- Project management software
- Measuring and drawing tool
- Printer/plotting device
- Codes of practice

### **22.3.4.5 References**




Kenya government, (2007). Occupational Safety and Health Act.

Jones, A. M. (2014) Fire Protection Systems, Jones & Bartlett Learning, ISBN-10: 1284035379,  
ISBN-13: 978-1284035377

www.osha.gov, (2016), Occupational Safety and Health Administration

## 22.3.5 Learning No 4: Manage Construction Project Cost

### 22.3.5.1 Learning Activities

Learning Outcome No 4: Manage Construction Project Cost	
 <b>Learning Activities</b>	<b>Special Instructions</b>
4.1 Prepare project budget 4.2 Procure, allocate and monitor site resource utilization 4.3 Control project cost variation 4.4 Prepare project financial report	<ul style="list-style-type: none"> <li>• Group discussions</li> <li>• Demonstration by trainer</li> <li>• Online videos</li> <li>• Power point presentation</li> <li>• Exercises by trainee</li> </ul>

### 22.3.5.2 Information Sheet No22/LO4: Manage Construction Project Cost



#### Introduction to learning outcome

This learning outcome deals with project budget preparation, procurement, allocation and monitoring of site resource utilization and the control of project cost variation.

#### Definition of key terms

**Project scope:** Project scope is the part of project planning that deals with determining project goals, the project methods such as labour and materials, project timeline, functions and project fixed costs. These are parts which are needed to deliver and achieve a project to its completion.

**Cost variation:** Cost variation is the difference between the earned value of a project and its actual cost (McMullen, 2010)

#### Content/Procedures/Methods/Illustrations

##### 4.1 Prepare project budget according to the scope of the project

The project budget is the total cost that has been projected to complete the project within a specified period of time for instance payments, operating costs, starting capital among others.



Table 60: Project budget according to the scope of the project

<b>Sample Project Budget</b>			
<b>Activity</b>	<b>Direct cost</b>	<b>Budget Overhead</b>	<b>Total cost</b>
Survey	1,500	500	2,000
Planning	6,000	500	6,500
Foundation	4,000	1,000	5,000
Materials	8,000	1,500	9,500
Building	10,000	2,000	12,000
Plumbing and electrical	4,000	500	4,500
<b>Cumulative</b>			<b>39,500</b>

#### 4.2 Procure, allocate and monitor site resource utilization according to the project scope

Procurement of construction materials and resources is vital to ensuring the success of the project. It involves the following important steps:

- i. Particularization. This is the first step as it involves the coordination of the project manager and the purchasing department in order to buy the required materials and items required to complete the project.
- ii. Choosing. This is where the client or the purchasing firm selects the potential suppliers of materials before and during the construction period.
- iii. Contracting. The purchasing department coordinates with the suppliers on when and how the materials will be delivered to the site and they must lie within the budget of the project.
- iv. Management control. How these materials will be utilized and controlled will determine the successful completion of the project. This will be done by the management team of the project.
- v. Measurement. This is the last step of procurement as it represents the accountability of the team that ensured the accomplishment of the project. There are several measurement indicators in project management that have to be adhered to and their criteria met after the project has been handed over to the client.

Allocation of resources involves scheduling the available resources appropriately required to complete the project.

The following steps will ensure a good resource-allocation to ensure that the project is completed within the estimated duration and does not exceed the budgeted cost.

- i. The project is divided into different steps
- ii. The available resources are assigned
- iii. The different aspects of the resources are actuated.
- iv. Resources are resolved and allocated as required
- v. Ways of resource utilization are utilized.

Table 61: Procure, allocate and monitor site resource utilization according to the project scope

Month	From	To
June	Survey	Planning
July	planning	Foundation
August	Foundation	Materials & Building
Sep	Building	Other Finishes

### 4.3 Control project cost variation as per SOPs

The cost variation of the project is the numerical difference between the value of the project earned and the actual cost of the project.

From the Sample Project budget

Value of the Project = 39,500

Actual cost of the Project = 42,000

Then, Cost variation  $42,000 - 39,500 = 2,500$

### 4.4 Prepare project financial report

The Project Financial Statements Report provides an Income Statement, Cash Flow and a Balance Sheet for individual projects as they provide credibility and accountability on the expenditure breakdown of the project's allocated finances. This provides you with useful data for tracking financial information related to individual projects according. The diagram below is an illustration of project financial report

## Program/Project Financial Report

Council on Library and Information Resources  
 Cataloging Hidden Special Collections and Archives Program  
 Financial Reporting Template

To be completed and signed by the financial officer responsible for project funds, then uploaded into the Hidden Collections Annual Report Form.

Organization: Lorem Ipsum University

Award period: 01/01/2013 -- 01/01/2015

Report period: 01/01/2014 -- 01/01/2015

**NOTE: Everything in this document must be explained within your narrative report in the section titled Financial Narrative. All numbers cited in the Financial Narrative must exactly match those in this document. All numbers in the Budget columns of the Expenditures table must match the numbers listed in your original application.**

**Income**  
 Grant amount: \$329,000.00  
 Interest credited to date: \$620.00  
**Total Income:** \$329,620.00

**This entire document refers to grant funds only. Cost sharing funds should not be included.**

**If no interest has been credited, send CLIR a letter explaining why interest is not being earned on the grant. You only need to submit this letter once. Interest earned should be included in the Expenditures table below.**

**Expenditures**

Categories	Current Period			Total Project		
	Budget	Actual Expenses	Variance (must be explained in the annual report form)	Budget	Cumulative Expenditures	Balance
Salaries and Wages	\$128,374	\$119,784	\$8,590	\$272,000	\$289,723	\$2,277
Fringe Benefits	\$23,894	\$29,123	-\$5,229	\$50,000	\$51,397	-\$1,397
Consultant and Training Fees	\$3,000	\$3,000	\$0	\$4,000	\$4,000	\$0
Supplies and Materials	\$1,620	\$1,620	\$0	\$2,620	\$2,500	\$0
Services	\$500	\$500	\$0	\$500	\$500	\$0
Other Costs	\$0	\$0	\$0	\$0	\$0	\$0
<b>Totals</b>	<b>\$155,388</b>	<b>\$154,027</b>	<b>\$1,361</b>	<b>\$329,620</b>	<b>\$328,120</b>	<b>\$1,500</b>

Budget and actual expenses for current Report Period only. (In this case, 01/01/2014-01/01/2015)

Figure 193: Project financial report

Source: www.blackbaud.com

### Conclusion

This learning outcome covered management of construction project cost, project budget, project cost variation and project financial report.

## Further Reading



Read further on project financial report

### 22.3.5.3 Self-Assessment



#### Written Assessment

1. What is not part of the earned value calculations?
  - a) Unknowns that are known
  - b) Unknowns that are not known
  - c) Amount of work completed
  - d) Budget of the project
2. Which one of the following does not contribute to the success of a project
  - a) Procurement
  - b) Resource allocation
  - c) Monitoring of the project
  - d) Resource vandalism
3. In project management, speed and dependability objectives are generally called?
  - a) Dependence
  - b) Vision
  - c) Time
  - d) Range
3. Summarize the various steps in ensuring a good resource allocation
4. Explain how uncertainties in project management are minimized.

#### Essay questions

Discuss the various ways of managing project costs

#### Case Study Assessment

Visit a nearby construction facility within your school and prepare a project management financial report

#### Practical Assessment

From the visited construction facility within your school determine the tasks and the estimated costs of each stage of construction

#### 22.3.5.4 Tools, Equipment, Supplies and Materials

- Scientific Calculators
- Relevant reference materials
- Stationeries
- GPS
- Design Software
- Computer lab
- Relevant practical materials
- Laboratories (chemical, biological & soils)
- Internet
- Manuals and guidelines
- Project management software
- Measuring and drawing tool
- Printer/plotting device
- Codes of practice

#### 22.3.5.5 References



Mullen, A. (2010). Chron small business.


Imbeah, W., & Guikema, S. (2009). Managing construction projects using the advanced programmatic risk analysis and management model. *Journal of Construction Engineering and Management*, 135(8), 772-781.

Iyer, K. C., & Jha, K. N. (2005). Factors affecting cost performance: evidence from Indian construction projects. *International journal of project management*, 23(4), 283-295.

Hwang, B. G., & Ng, W. J. (2013). Project management knowledge and skills for green construction: Overcoming challenges. *International journal of project management*, 31(2), 272-284.

## 22.3.6 Learning No 5: Manage Project Labour

### 22.3.6.1 Learning Activities

Learning Outcome No 5: Manage Project Labour	
 Learning Activities	Special Instructions
5.1 Develop project labour guidelines 5.2 Establish labour levelling plan 5.3 Allocate staff 5.4 Manage labour welfare 5.5 Prepare project labour report	<ul style="list-style-type: none"><li>• Group discussions</li><li>• Demonstration by trainer</li><li>• Online videos</li><li>• Power point presentation</li><li>• Exercises by trainee</li></ul>

### 22.3.6.2 Information Sheet No22/LO5: Manage Project Labour



#### Introduction to learning outcome

This learning outcome deals with management of project labour through the development of project labour guidelines, allocation of staff and management of labour welfare to ensure smooth implementation of work stages.

#### Definition of key terms

**Project labour.** This can be defined as the human resource that is employed in the project to implement the idea portrayed in the designs and drawings. They include technicians, masons, plumbers, electricians and drivers.

#### Content/Procedures/Methods/Illustrations

##### 5.1 Develop project labour guidelines in line with Labour laws and FIDIC regulations

Labour guidelines are rules or guides that are developed to ensure the labourers work in harmony, and towards one goal. Labour guidelines are crucial in a project as they affect how the employees feel about their jobs. The labour laws and Fidic are statutory bodies that have set and defined rules and regulations to ensure that any guidelines developed in a project protect the workers' rights. According to the Fidic Redbook, the contractor is the one that organizes, houses, and compensates any human resource employed in a project.

Developing labour guidelines is easy. You have to set rules that will favor the progress of the project but, at the same time, withhold the rights of the human resource. The best way to develop these guidelines is to involve all the workers to make sure you capture what would lead to maximum productivity.

Remember that you should pay the right wages and observe the conditions of labour every time. The rates of labour that are to be paid should not be lower than the industry's average rates.

The contractor should also comply with all the labour laws applicable to his personnel, including those that relate to the employees' health, safety, and environment. Movement and welfare. The employees are also required to adhere to all set laws concerning the project.

Work should only be carried out on the recognized days of work unless stated otherwise in the agreement. The extra hours worked should be recognized and overtime and compensated.

There are many rights of employees that are to be considered by the managers when developing a project labour guideline. Consult the Fidic Redbook for more.

### **5.2 Establish labour levelling plan**

A labour leveling plan can be defined as a plan according to which start and finishing dates are adjusted depending on labour limitation to create a balance between the demand of the labour and the available supply. Creating this plan calls for a proper understanding of progress monitoring. Since different people perform different tasks in a project, planning is key.

First, identify the number of activities that are supposed to be done in a specified time. Also, have in mind the amount of workforce you have. Also, identify how many people and how much time each task will need to complete. Once you have all that in mind, you can develop a histogram based on the earliest start time of any activity to balance the labour resource. This tends to spread the available workforce on the available tasks. It ends up rearranging the tasks according to the available labour which we call levelling.

The final result of this is a plan that will show all tasks assigned with an equal balance between available labour and demand for the same, arising from the tasks.

### **5.3 Allocate staff**

This is quite easy. However, there is a lot to consider. For you to do this effectively, you need to have in mind. Have the tasks to be done, preferably have a list. Also, on the same list indicate the skills demanded by that task and the number of staff it would require to implement. On the other hand, have a list of the available workers and the skills possessed by each. What should follow next is matching the tasks and the appropriate employees. In the process, you should remember to consider the staff's availability of the interests of the task. Also, remember to observe the labour guidelines stated by the statutory bodies fully.

### **5.4 Manage labour welfare**

Labour welfare means the services, benefits, and facilities that the employer avails to the human resource. They include accommodation and health services. They are provided to improve the productivity of the labourers. Therefore, labour welfare management entails the coordination of aspects carried out to ensure the comfort of the labour force is improved.

Managing the welfare of the employees is easy. All you need to do is have a clear understanding of their individual needs. Ensure that they have been provided with proper housing, proper medical services, and safety equipment at work.

The Fidic Redbook also dictates that the following should be done to the employees.  
Supply of quality foodstuffs and clean water. Also, the management should work to ensure the cultural and religious beliefs of all employees are upheld.  
Last but not least, the employer should not employ any forced or compulsory labour.

### 5.5 Prepare project labour report

A labour report is a detailed report prepared to show all the labour charges attached to the project. They include regular time, overtime, and also, the total number of work hours per employee. This report also captured the employee number, name, and the task performed.

To prepare this report, you need all the mentioned details. You can create a simple spreadsheet with a name column that corresponds to worked ours and total charges. Alternatively, you can use the vision planning software. This uses data from the project to generate a detailed report.

### Conclusion

This learning outcome covered project labour management. . From this outcome, the students should be able to properly coordinate the human resource involved in a given project. Also, the student should be able to prepare a number of reports concerning the human resource.

### Further Reading



Read further on labour resource management from the Fidic Redbook of 1999 and the labour laws of Kenya document. These two resources are available online for free.

### 22.3.6.3 Self-Assessment



### Written Assessment

1. Which one of the following is not a document that safeguards the rights of employees?
  - a) The Fidich Redbook
  - b) The labour laws of Kenya
  - c) Traffic regulations act
2. Which one of the following is a right of employees in accordance with the Fidic redbook.
  - a) Right to food and clean water
  - b) Right to practice religious and cultural beliefs
  - c) Right to drugs and alcohol



3. Briefly explain how a labour report is prepared
4. Explain, in details, any five clauses of the Fidic redbook, that are concerned with labour management

### **Oral Assessment**

Explain how inaccuracy of the labour report could affect project progress

### **Case Study Assessment**

Visit a nearby construction site, and consult on their labour guidelines. List down the rights that the management has considered.

### **Oral Assessment**

From your visit to the site, how would you advice the management to improve the welfare of the employees?

### **Practical Assessment**

Prepare a detailed labour report for the day you visited the named site

#### **22.3.6.4 Tools, Equipment, Supplies and Materials**

- Scientific Calculators
- Relevant reference materials
- Stationeries
- GPS
- Design Software
- Computer lab
- Relevant practical materials
- Laboratories (chemical, biological & soils)
- Internet
- Manuals and guidelines
- Project management software
- Measuring and drawing tool
- Printer/plotting device
- Codes of practice

### 22.3.6.5 References



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## 22.3.7 Learning No 6: Manage Project Contracts

### 22.3.7.1 Learning Activities

Learning Outcome No 6: Manage Project Contracts	
 Learning Activities	Special Instructions
6.1 Manage project documentation 6.2 Engage project stakeholders 6.3 Inspect construction project works 6.4 Manage project information 6.5 Prepare project implementation report	<ul style="list-style-type: none"><li>• Group discussions</li><li>• Demonstration by trainer</li><li>• Online videos</li><li>• Power point presentation</li><li>• Exercises by trainee</li></ul>

### 22.3.7.2 Information Sheet No22/LO6: Manage Project Contracts



#### Introduction to learning outcome

This learning outcome deals with management of project contracts through various aspects such as management of project documents, information, reports and inspection of project works. By completing this outcome, the students should be able to manage a civil engineering project to completion.

#### Definition of key terms

**Project implementation report:** The project implementation report is a written document, usually prepared by a project manager, whose purpose is to capture the progress of a given project. This report seeks to guide the implementation of design ideas into reality.

#### Content/Procedures/Methods/Illustrations

##### 6.1 Manage project documentation

Document management is very important for any project. Not just for its implementation but also for future reference for future projects. The success of a project also depends on how well the involved documentation is managed. Project document management is, therefore, defined as applying practices and procedures used to produce, store, and distribute various types of project documents. To manage project documents successfully, there are a few things that need to be done. Number one is that project documents should be treated with the utmost care and respect. A proper organizational structure for the document folders will be vital. Also, naming the documents using meaningful conventions will help keep the documents in order. There should also be a clear rule on how documents are shared. Access of documents should only be granted to necessary parties.

And once the time to return comes, there should be a clear protocol on how they are returned to prevent mix-ups. Lastly, you should ensure that the specified practices are adhered to in all aspects according to the capabilities and needs of the project.

## **6.2 Engage project stakeholders**

Project stakeholders are the people who have a direct interest towards the ongoing project. In short, these are the members of the project management team. They include, but not limited to, project sponsors, users, managers, and engineers. These are mainly the people who have a direct investment in the project, and their input can directly affect the outcome of the same project. There is a need to come up with a stakeholder engagement plan. This is a plan that helps the manager identify strategies and engagements required to bring active involvement of the stakeholders in the execution of the project. To engage the stakeholders, the plan should advise you to identify them as early as possible. It is not possible to engage stakeholders that you don't know of. Before you even initiate the project, make sure you identify the stakeholders first.

Find a way of bringing the stakeholders together and get them talking. Invite them to important project meetings. This will also help to solve any conflicts that may arise in the future. It would be best if you always tried to understand others before being understood. This simply means that you should always have the other people's perspective first before considering your own. For this to work, you have to be a very great team player. To manage them, you need to be a keen listener. It would be best if you learned to listen before talking. Lastly, learn how to communicate courteously. The best way of doing this is by developing a good communication plan that involves all the stakeholders.

## **6.3 Inspect construction project works**

Inspection of the works simply means monitoring and documenting the progress to ensure it aligns with the plan in terms of timely and quality completion. For a successful inspection, there are a few steps that need to be followed. Number one is to prepare fully for the inspection. Identify and write down the topics that need to be covered during the inspection. Also, identify the premises that you intend to inspect. It would be best if you remembered to inform the team on site of your intention to visit for inspection. Once preparation is done, you can now visit the site. On the site, the following should be done. One is to put on protective gear. This is to protect yourself from any risks. Carefully inspect the progress of the work and note every step-in detail. This data will help in report preparation. Besides monitoring the work, inspect and note down the following; the welfare of the workers, housekeeping issues, readiness for emergency procedures, employee relationships, wages and compensations, working hours, rest periods, and any other necessary issue related to the project. Upon completion, close the inspection, and most importantly, prepare a detailed progress report.

## **6.4 Manage project information**

To successfully manage project information, you need to come up with a proper project information management plan. This is a document that outlines the responsibilities and actions involved in information management. The plan should capture the following.

- It should define which information is available to who and when
- It should define how the information on the project is collected
- It should define who has access to any information.
- Should define the responsibilities and qualifications of all the personnel involved in collecting information.

## **6.5 Prepare project implementation report (Daily, Monthly, Project progress report)**

You should be able to complete project implementation reports.

**Daily report.** This report captures daily construction progress. At the end of the closure of the day's business, you should check on how much work was done and how much work remains. This report aims at informing the management of the deliverables and milestones. Remember to focus on the day's results other than activities. Make use of charts, graphs, tables, pictures, videos, and graphics. Use short sentences and instead use data points.

**Monthly report**

This captures the monthly progress report. The procedure for preparing this report is just like that of the daily report. However, the monthly report should also capture the combined daily progress.

**Project progress report**

Just as it sounds, this document explains how far you have gone towards implementing the project. Start by writing the heading of the progress report. This will capture the writer's name, the position of the recipient, and the report subject.

Write the introductory paragraph. This is a brief composition that explains the project. It talks about its purpose. Then proceed to the "works completed" part where a description of the works done is captured. Any findings should be mentioned.

In the next section, you should capture any problems encountered by the Implementing team. Prepare another section that highlights what your team intends to do moving forward. Finish with a summary of the report.

## **Conclusion**

This learning outcome covered project contracts management. The student is now confident on the procedures and documents involved in monitoring progress of a civil engineering project.

## Further Reading



Read further on project management from

[http://www.uredjenazemlja.hr/UserDocsImages/dokumenti/oprojektu\\_dokumenti/Annual\\_Report\\_2012\\_v.1.0.pdf](http://www.uredjenazemlja.hr/UserDocsImages/dokumenti/oprojektu_dokumenti/Annual_Report_2012_v.1.0.pdf)

## 22.3.7.3 Self-Assessment



### Written Assessment

1. Which one of the following is not done during inspection?
  - a) Inspect works progress
  - b) Take pictures
  - c) Write the report
2. Which one of the following is not captured in the progress reports?
  - a) Structural Drawings
  - b) Images
  - c) Videos
  - d) Tables
3. Which one of the following is not a possible stake holder in a project
  - a) Politicians
  - b) Engineers
  - c) Investors

### Oral Assessment

Explain the reason for your choices of stakeholders.

### Case Study Assessment

Visit a nearby ongoing project, with permission from the necessary authorities, do an inspection and prepare a daily progress report.

### Practical Assessment

Visit a nearby ongoing project, with permission from the necessary authorities, do an inspection and prepare a daily progress report.

#### 22.3.7.4 Tools, Equipment, Supplies and Materials

- Scientific Calculators
- Relevant reference materials
- Stationeries
- GPS
- Design Software
- Computer lab
- Relevant practical materials
- Laboratories (chemical, biological & soils)
- Internet
- Manuals and guidelines
- Project management software
- Measuring and drawing tool
- Printer/plotting device
- Codes of practice

#### 22.3.7.5 References




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## 22.3.8 Learning No 7: Manage Construction Materials, Plant, Tools and Equipment

### 22.3.8.1 Learning Activities

Learning Outcome No 7: Manage Construction Materials, Plant, Tools and Equipment	
 <b>Learning Activities</b>	<b>Special Instructions</b>
7.1 Prepare site storage facility 7.2 Prepare <b>construction materials</b> (Roofing, Walling, Flooring, Finishing, and Reinforcing) schedule 7.3 Prepare <b>construction equipment</b> (Excavation, Lifting, and Transporting) schedule 7.4 Procure construction materials and equipment 7.5 Issue construction materials and equipment	<ul style="list-style-type: none"> <li>• Group discussions</li> <li>• Demonstration by trainer</li> <li>• Online videos</li> <li>• Power point presentation</li> <li>• Exercises by trainee</li> </ul>

### 22.3.8.2 Information Sheet No22/LO7: Manage Construction Materials, Plant, Tools and Equipment



#### Introduction to learning outcome

This learning outcome deals with management of construction materials through the preparation of site storage facilities, preparation of material schedules, equipment schedules, and the procurement of materials and inspection.

#### Definition of key terms

**Construction materials:** Also known as building materials, these are materials that are added to the constructed structure. Examples include concrete, sand, cement, steel, aggregates bricks etc.

**Construction equipment:** These are machinery, structures, materials, tools or systems designed for carrying out/executing construction works.

#### Content/Procedures/Methods/Illustrations

##### 7.1 Prepare site storage facility

These are facilities for keeping civil construction equipment and even machines safely.

All engineering items are properly stored and managed under the stock management department. This will for instance determine the storage volume and subsequently the amount of space required. The store of these goods should be selected properly based on its accessibility, size and proximity among other factors. Inspection by the store keeper must be done upon supply and delivery of these goods.



They are also piled and properly managed for ease of removal whenever need arise.

Safety precautions through the use of precaution guidelines must be adhered to.

All civil engineering materials require proper handling, storage and usage for instance when carrying them manually to work sites, stacking bricks and building stones or driving trucks loaded with concrete. Given the number of hazards the employees face during storage such as falling objects, improperly stack objects among others, training and education is necessary.

Factors to consider on preparation of site storage facility include:

- physical properties,
- organization
- security
- costs
- control
- Protection.

## 7.2 Prepare construction materials (Roofing, Walling, Flooring, Finishing, and Reinforcing) schedule

Table 62: Construction materials

	Construction materials	Uses
Roofing	Timber Glass Iron sheets	Roofing. After the building is complete.
walling	Concrete Stone Brick Steel sheets Timber Clay blocks	Construction wall building
Flooring	Cement Brick Wood	Floor construction:
Finishing	Terrazo Tiles Rubber Wood Glass and cork stones	Construction work finishing
Reinforcing	Steel bars BRC mesh	Absorbs tensile and shear and stresses

### 7.3 Prepare construction equipment (Excavation, Lifting, and Transporting) schedule

Table 63: Construction equipment

	Construction Equipment	uses
Excavation	Excavators Graders Loaders Backhoe Bulldozers	Earth moving equipments. Excavating large volumes of mass.
Lifting	Equipment Crane Conveyors Hoists Forklifts	Material handling-lifting
Transporting	Tippers Dumpers Trailers Tankers	Transporting construction materials and equipments into and out of site. Also moving wastes out of site.

### 7.4 Procure construction materials and equipment

Procurement of construction materials is normally done through a logical order. One first plans what to contract then how to do it. You need to think of all the work that one will do so as to plan for any purchases and acquisitions. Procurement procedures are followed.

**i. Choosing of Suppliers to be invited to tender.**

A client carefully chooses the list of suppliers to be invited to apply for the available tenders for example when procuring construction materials and equipment.

**ii. Request, appeal and tender submission**

Tender request is delivered to potential suppliers and they carry the terms and conditions of the tender contract. They are then required to submit back the proposals.

**iii. Technical Evaluation.**

Technical proposals is evaluated before the opening of the financial proposal so as to ensure that it conforms to the conditions and requirements that was set.

**iv. Process of negotiation and Awarding of contract:**

Contract price is negotiated and other terms and conditions listed among tenderers.

**v. Delivery, Inspection and Payment.**

Equipment are delivered as agreed in the contract. Inspection is done to ensure the entire delivered equipment meet the requirements.

## 7.5 Issue construction materials and equipment

Lee and Dobler define materials management as “a confederacy of traditional materials activities bound by a common idea-the idea of integrated management approach to planning, acquisition, conversion, flow and distribution of production materials.

Inspection

This can happen in two ways

- Pre-dispatch inspection
- Receipts from internal divisions.

The inspector inspects to inspect all the materials delivered to the site prior to being used in the work.

### Conclusion

This learning outcome covered management of construction materials, plant, tools and equipment.

### Further Reading



Read further on construction equipment as illustrated in Construction Equipment Management Book by Giovanni Ciro, October 1998.

### 22.3.8.3 Self-Assessment



#### Written Assessment

- 1 Which equipment is used to remove earth?
  - a) Elevator
  - b) Crane
  - c) Excavator
- 2 The following are construction equipment, which among them is used to level the ground and spread loose material.
  - a) Excavator
  - b) Grader
  - c) Tractor

- 3 Which of the following is not a flooring material?
  - a) Timber
  - b) Tiles
  - c) Concrete
  - d) Glass
- 4 Discuss the procedure for procuring construction materials and equipment
- 5 Distinguish the equipment and materials used to construct a slab.
- 6 Evaluate factors to consider for site storage facilities.

### **Essay question**

Construction activities have an effect to the environment. With reference to road and building construction, discuss. (20mks)

### **Oral Assessment**

Why is it important to study how construction activities affect the environment?

### **Case Study Assessment**

Make a visit to the nearest facility being constructed in your area and prepare a report on how they manage their construction materials on a daily basis.

### **Practical Assessment**

Make a visit to the nearest facility being constructed in your area and prepare a report on how they manage their construction materials on a daily basis indicating the financial allocation in each stage of construction.

### **22.3.2.4 Tools, Equipment, Supplies and Materials**

- Scientific Calculators
- Relevant reference materials
- Stationeries
- GPS
- Design Software
- Computer lab
- Relevant practical materials
- Laboratories (chemical, biological & soils)
- Internet
- Manuals and guidelines
- Project management software
- Measuring and drawing tool
- Printer/plotting device
- Codes of practice

#### 22.3.8.5 References



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