NATIONAL OPEN UNIVERSITY OF NIGERIA

MPA 823

Project Management

Module 3

MPA 823 Project Management Module 3

Course Developer/Writer
Leon Ikpe, National Open University of Nigeria
Course Editor
S.O. Israel Cookey, National Open University of Nigeria
Programme Leader
Dr. O. J. Onwe, National Open University of Nigeria

Credits of cover-photo: Mr. Gbenga Aiyejumo, National Open University of Nigeria.

National Open University of Nigeria - 91, Cadastral Zone, Nnamdi Azikiwe Express Way, Jabi, Abuja, Nigeria

www.nou.edu.ng centralinfo@nou.edu.ng
oer.nouonline.net oerunit@noun.edu.ng OER repository

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Unit 1 Network Analysis

1.0 Introduction

Generally, we shall use the term "network analysis" to describe several planning methods which owe their origin to developments in Europe. Network analysis achieved great prominence during World War II and was used successfully for the planning of the United States of America defence projects. When we discussed charts, we saw that they were really easy to construct and also could be easy to understand.

Network analysis, on the other hand, is not as easy as it assumes a lot of familiarity with logic and argument.

Network diagrams simply show all the tasks within a project together with their logical sequence. Network diagrams are more powerful than bar charts since they clearly show the interdependencies between job tasks in a project. For example, before a building can be started, network analysis will inform the planner that the foundation of the building will be the starting point of the project.

A major strength of network analysis is that it enables all the tasks in a project to be clearly defined. The tasks deemed to be very critical are also identified and completion times of every task estimated.

2.0 Objectives

At the end of this unit, you should be able to:

- explain network analysis
- apply network analysis to project management.

3.0 Main Content

3.1 Net Notation Systems

In the literature, there are several network notation systems. Each network system usually reflects the thinking of its inventors.

3.1.1 Arrow Networks

Arrow networks are activity-on-arrow systems. There are various names used under arrow networks. Some of them include the following:

- Critical Path Methods (CPM)
- Critical Path Analysis (CPA)
- Programme Evaluation and Review Technique (PERT).

The strong point of the arrow network is the arrow diagram, logic diagram or network. Let us use a simple example to demonstrate the key elements of an arrow network.

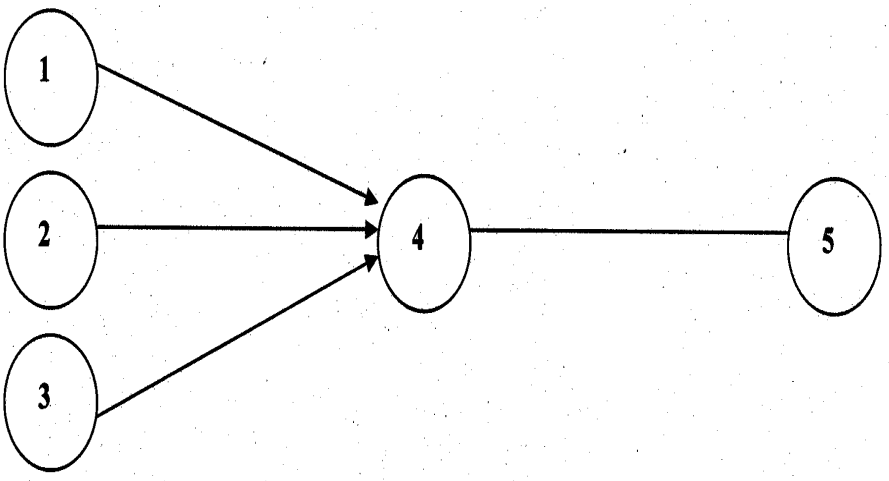

Fig. 1: Key Elements of Arrow Network Logic

Now take a look at fig. 1. Each circle represents a project event such as the start or finish of an activity. The arrow joining any two events shows the activity or time needed to progress from one event to another.

The numbers inside the circles are used to identify the events. If you note carefully, activities 1, 2, 3 must be completed before thinking of moving ahead to any other activity.

Another issue that should be clearly understood in network analysis is the issue of direction. Conventionally, activity arrows are drawn from left to right.

Another important element in arrow diagrams is the issue of logical dependencies. In an arrow diagram, no event can be considered complete until all the activities that lead into it have been completed.

For example. in fig. 1, activity 4 cannot be achieved until activities 1, 2 and 3 have been completed. Also, activity 5 cannot take off until activities 3 and 4 have been completed.

3.1.2 Activity Duration

In building the network, we should also break down the activities properly and attach time estimates to them. Consider a hospital project to be initiated at Calabar by the state government.

Activity	**Description Estimated Duration**
1 to 2	Build the hospital 6 months
2 to 3	Equip the hospital 3 months
3 to 4	Staff the hospital 2 months

The hospital project can now be displayed using arrow notation:

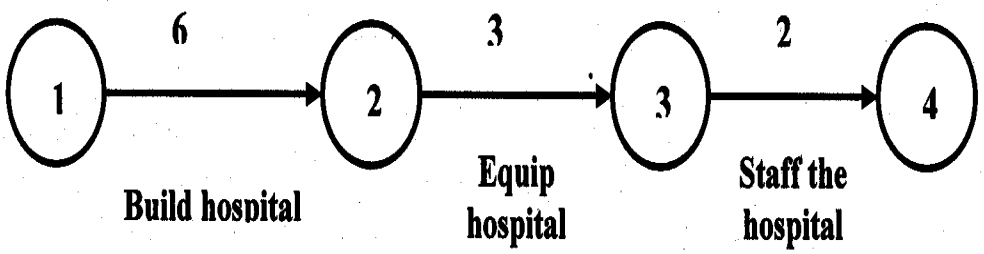

Fig. 2: The Hospital Project Network Using Arrow Notation

You will observe that the estimated duration for every activity is also indicated in the diagram.

Self-Assessment Exercise 1

You have been appointed project manager to construct a new university at Lokoja. Develop an activity duration using arrow notation for the project.

3.1.3 Dummy Activities (Dummies)

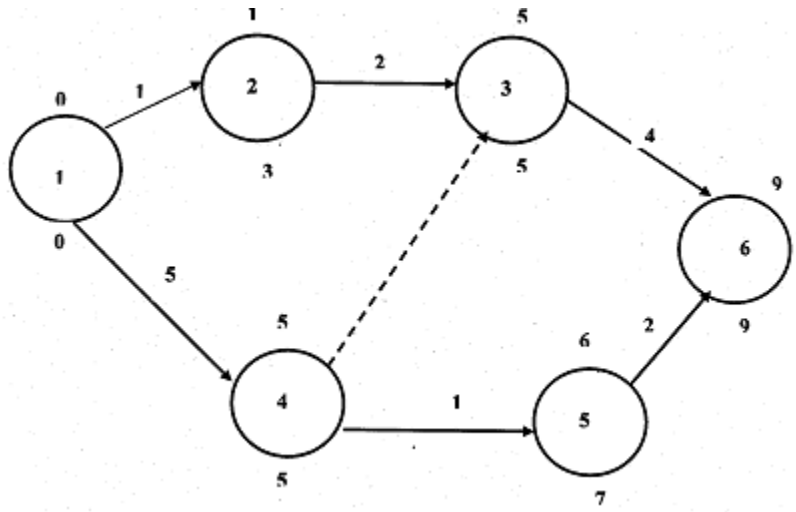

Fig. 3: Example of Arrow Network Time Analysis

In fig. 2, we saw a very simple network with which we displayed a hospital project. Fig. 3 is a much more complex network. As you can see, there are so many activities in the network with time notations. There is more than one path to the completion of the network activities. If you note properly, there are three possible routes to the final event 6.

One of the possible routes passes through the dotted linking event 4 to event 3. The dotted arrow linking event 4 to event 3 is called a dummy activity. A dummy activity does not represent work and so has no time duration. A dummy activity though having zerotime duration acts as a logical link or constraint on activities that follows it.

For example, in fig. 3, the start of activity 3 to 6 depends not only on completion of activity 2 to 3, but, because of the dummy, also on the completion of activity 1 to 4.

Also you are to note that numbers written above event circles indicate the earliest possible time by which the event can be completed. This can be calculated by adding the activity

durations from left to right. Where more than one path exists, the longest path determines the earliest possible event time. Numbers below the event circle are found by subtracting activity durations from right to left from the final event again taking the longest path.

3.1.4 The Forward Pass

You are still required to refer to fig. 3. In the figure, the earliest possible time for each event and also the earliest possible time for the entire project completion have been calculated by merely adding up activity duration estimates along the arrows from left to right. This time analysis is known as the forward pass.

Also, in the fig. 3, we are using the forward pass is complicated because there are many routes to the project completion. For example, we might be tempted to think that the earliest possible time for event 3 might be 1 + 2 = 3 if the route of events 1, 2 and 3 are taken. That might not be really true. Event 3 may not be achieved until the end of week 5 because of the longer path through the dummy (activity path of 4 to 3).

3.2 Critical Path Analysis Using Precedence Notation

In our earlier discussion, we dealt with arrow networks. This time around, we shall discuss critical path analysis that uses precedence notation. In current times, precedence system has become very popular in project management for the following reasons.

- Precedence logic diagrams resemble engineering flow diagrams and are easy to understand.
- Precedence notations indicate clearly the start and finish of activities and even indicate overlapping activities.
- Precedence networks are supported by various computer software.

Generally, it is important to note that the flow of work in a precedence diagram is from left to right.

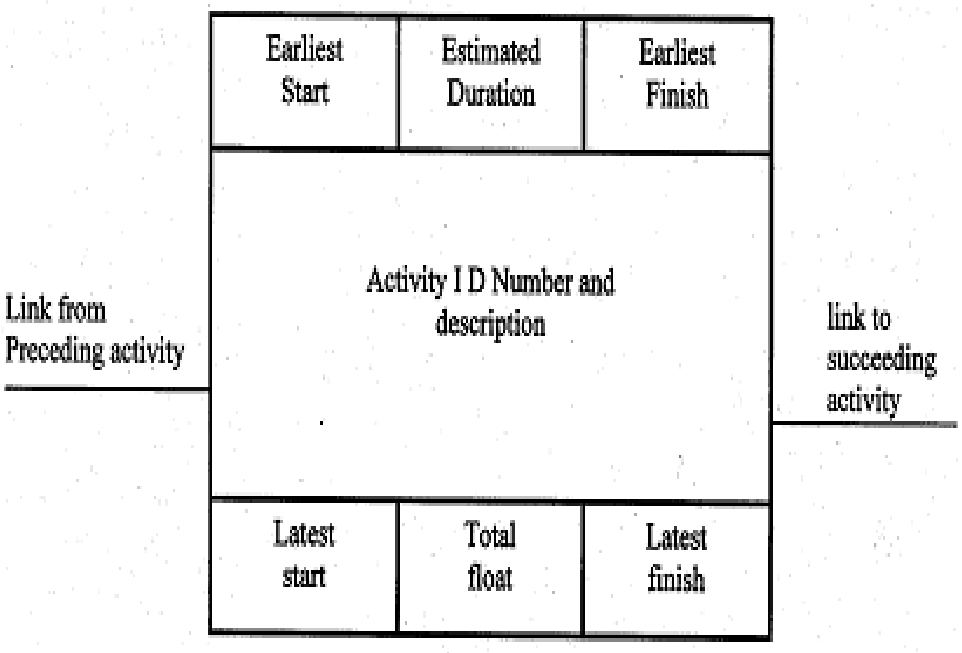

Fig. 4: An Activity in Precedence Notation

Let us now look at some features of the precedence system:

3.2.1 Identification Numbers

In a precedence system, every activity is usually given an identification number called the I D code. These codes are usually important especially for computer processing. The I D codes range from small serial numbers to complex alphanumeric codes with 10 or more characters.

3.2.2 Logical Dependencies

In the precedence system, all activities are joined by lines. You should recollect that they differ from arrow networks which use arrows to link activities. Now back to precedence systems. The precedence notation system allows the project manager the complete freedom to display relationships between various activities.

3.2.3 Activity Duration Estimates and Descriptions

Now let us go back to our simple project which we discussed in section 3.1.2 of this unit.

Activity	**Description Estimated Duration**
1 to 2	Build the Hospital 6 months
2 to 3	Equip the Hospital 3 months
3 to 4	Staff the Hospital 2 months

The hospital project can be built into Fig. 5.

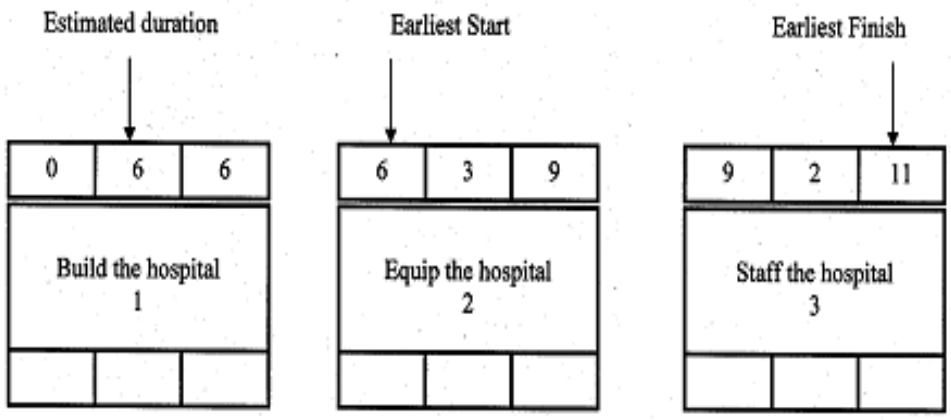

Fig. 5: Hospital Project using Precedence Notation

You are to note that fig. 5 shows the estimated duration, earliest start and finish times for the three activities in the hospital project.

3.3 Implementing Network Analysis

All along, we have been discussing the basic techniques of project network analysis. We discussed arrow networks, activity duration, dummy activities and the precedence notation in network analysis. All these are tailored towards our understanding of basic networks.

In this section, we shall discuss the procedures and methods used in the implementation of network analysis in an organisation. We shall take them one by one.

3.3.1 Arranging a Project Meeting

In an organisation, when a project is to be initiated or executed, someone is usually appointed as the project manager. The project could be the building of a general hospital, the building of a federal government secretariat complex or the building of a refinery complex.

In most cases, the project manager is appointed with members of the project team. The first step in a project meeting is to assemble all the members of the team and hold a brainstorming session. In an ideal situation, members of the project team will be chosen from various units or departments and also will be senior members of staff.

During the brainstorming session, the project will be laid bare and all the activities connected with the project will be discussed. Here the basic network of the project will be drawn so that all the team members can see it and make their own contributions.

Ideally, a digital projector can be used for the brainstorming exercise. In this case, arrow notations are better. After a lot of discussions have taken place, a final network analysis diagram will be produced which temporarily serves as the guide to the execution of the project.

3.3.2 Identifying Critical Details in Network Planning

We have just said that in implementing projects, there is the need to call a project meeting. Part of the things that the project meeting will seek to achieve is to identify the critical details in a network. Such critical details will include the following:

- Identification of all activities involved in the project
- Allocation of activities to people
- Work authorisations
- Work supervisors
- Start and finish times for every activity
- Obtaining building permits where necessary
- Issue of invitations to tender for supply of materials or equipment
- Receipt of tenders
- Approval of tenders
- Supplies of materials deadlines
- Handover of project.

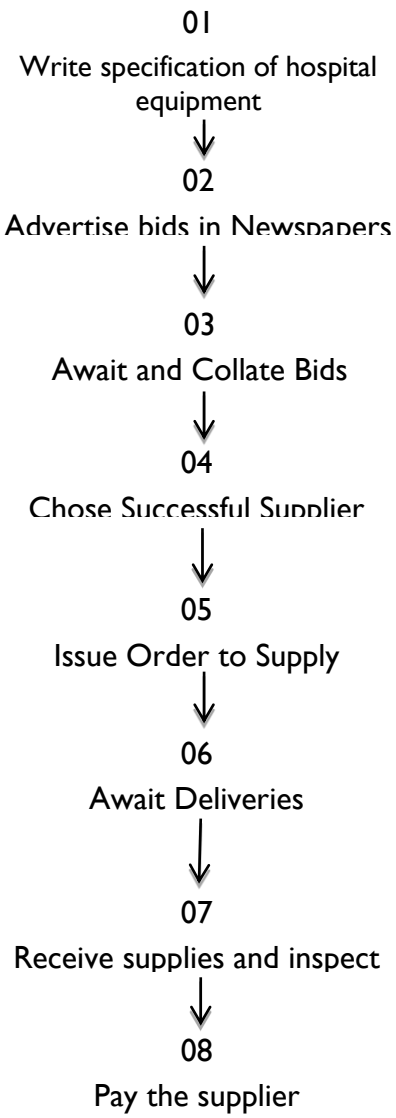

Fig. 6: Details in Purchasing Sequence for Supply of Medical Equipment to a Hospital

Self-Assessment Exercise 2

Discuss the procedures and methods used in the implementation of network analysis in a chosen organisation.

4.0 Conclusion

This unit has treated network analysis which we saw as a very important management tool in project management. We discussed network notation systems especially arrow networks. We also discussed activity duration, dummy activities and critical path analysis using precedence notation. Finally, we discussed the identification of critical details in network planning.

5.0 Summary

Network analysis is a management tool in the practice of project management. It equips project managers with the necessary skills for managing various projects. It emphasises the breakdown and analysis of project activities in a sequence that leads to project conclusion.

6.0 Self -Assessment Exercise

Why do you think that network analysis is important in project management?

7.0 References/Further Reading

Meredith, J. R. & Mantel, S. J. Jnr (1995). *Project Management: A Managerial Approach.* (3rd ed.). New York: Wiley.

Reiss, G. (1995). *Project Management Demystified: Today's Tools and Technique*. (2nd ed.). London: Spon.

Unit 2 Principles of Scheduling Resources

1.0 Introduction

Research shows that scheduling of resources is a fairly complex topic because of the complexities of various types of projects in the environment.

Resources scheduling can be seen from many viewpoints. It can be seen from point of view of a large industrial establishment like Nigerian Breweries Plc. where it is employed in the formulation of long-term plans. Resources scheduling can even take a wider dimension when one considers the complexities involved in running a refinery that produces petrol, diesel, kerosene, engine oil, aviation fuel and other petrochemicals.

We are not going to discuss resources scheduling from wider perspectives. Rather, we shall discuss it from the point of view of a project manager whose concern is basically with the short-term operations of a business or a specific project.

Resources scheduling problems differ from firm to firm or from organisation to organisation. An organisation which has a large percentage of its labour force as causal labour may not have the problem of scheduling of its labour resources. On the other hand, an organisation that handles its projects using its own workforce cannot ignore scheduling of resources. This is more applicable to engineering and road construction companies.

Principles of scheduling resources have come to the forefront of project management techniques as project managers find themselves in situations that require good knowledge of resources scheduling.

2.0 Objectives

At the end of this unit, you should be able to:

- define scheduling
- enumerate project resources
- discuss the priority rules for scheduling resources.

3.0 Main Content

3.1 Project Resources

All along, we have been using the work "resources" but we did not define what resources are. So let us now define a project resource. A project resource is any person (labour) equipment, tool or money that is needed for work on a project. Having briefly defined a project resources, we can now go ahead to list the various types of resources that can be used in a project.

- Land
- Natural gas
- Water
- Rubber

- Cocoa
- Cement
- Granite
- Sand
- Generator
- Factory buildings
- Offices
- Labour (causal labour)
- Labour (management)
- Computers
- Radio Stations
- X-ray machine
- Blow molding machine
- Dam
- Tractor
- Time

Before a project commences, there must be a total breakdown of all the activities that are required to execute the project. Also, there should be a list of resources required to execute the project. The type of resources will include the following:

- Skilled personnel, e.g. building engineers
- Skilled personnel, e.g. technologists
- Unskilled personnel, e.g. labourers.

Again, there should be a breakdown of the materials required for the execution of the project. Usually for the materials, there should be funds made available for their purchase.

Consider, for example, a project that involves the construction of a students' hostel in a university. The activities are shown in table 1, table 2 and table 3.

Table 1: Construction of a Student Hostel in a University

Dig soak away and drain trench (1)	Lay rubber and drain pipes inside trench (2)	Prepare chamber slabs with cement and iron rods (3)
Dig hostel foundation (4)	Lay concrete foundation works (5)	Lay floor base (6)
Mount bricks (7)	Fit lintel (8)	Build parapet (9)

Table 2: Construction of a Student Hostel in a University

Fit roof timber (10)	Fit and run fascia board (11)	Fit roof sheets (12)
Seal the roof (13)	Fit ceiling boards (14)	Fit gutters (15)
Hang doors and windows (16)	Fit electrical fittings and do plumbing work (17)	Paint (18)

Table 3: Students' Hostel Project: Task List and Time Analysis

Activity Description	**Duration (days)**	**Resources available**
1. Dig soak away and drain trench	2	Yes
2. Lay rubber and drain pipes	2	Do
3. Prepare chamber slabs with cement	2	Do
4. Dig hostel foundations	3	Do
5. Lay concrete foundation works	3	Do
6. Lay floor base	2	Do
7. Mount bricks	21	Do
8. Fit lintel	5	Do
9. Build parapet	4	Do
10. Fit roof timber	4	Do
11. Fit and run fascia board	4	Do
12. Fit roof sheets	6	Do
13. Seal the roof	10	Do
14. Fit ceiling boards	10	Do
15. Fit gutters	4	Do
16. Hang doors and windows	5	Pending
17. Fit electrical fittings and plumbing	10	Pending
18. Paint	10	Pending

Self-Assessment Exercise 1

Define a project resource?

3.2 Priority Rules for Scheduling Resources

Scheduling of resources is based on two options or priority rules. One option is whether the scheduling of the resources should be resource-limited or time limited. We shall now consider each of the options.

3.2.1 Resource Limited Scheduling

In resource limited scheduling, the levels of available resources are known well in advance and as a matter of fact should not be exceeded. Following this, the completion time of the project will be a secondary objective. In real life, resource limited scheduling is found mainly in government establishments and parastatals where the annual or supplementary budget sets a limit to the amount that can be expended by a ministry or parastatal.

3.2.2 Time Limited Scheduling

In a situation where time is of essence in a project, the scheduling should be time-limited. For example, if a university is due to reopen in October and it is expected that a new students' hostel under construction will accommodate 2,000 new students, it means that at least the new students' hostel should be ready by September of the same year.

When a project is subjected to time-limited scheduling, overtime and hiring of excess labour usually resorted to in order to meet the time schedule.

In practical situations, project managers resort or fall back to a second-tier resource level.

Self-Assessment Exercise 2

Using a practical example, explain the "time-limited scheduling."

4.0 Conclusion

In this unit, we discussed principles of scheduling resources. We discussed the meaning of resources and also the priority rules for scheduling resources. The options available to the project manager are resource-limited scheduling and time-limited scheduling of resources.

5.0 Summary

Principles of scheduling resources guide the project manager in project management. It provides project managers with tools with which to schedule resources.

6.0 Self Assessment Exercise

What do you understand by resource-limited scheduling?

7.0 References/Further Reading

Meredith, J. R. & Mantel, S. J. Jnr. (1995). *Project Management: A Managerial Approach.* (3rd ed.). New York: Wiley.

Reiss, G. (1995). *Project Management Demystified: Today's Tools and Techniques.* (2nd ed.). London: Spon.

Unit 3 Practical Scheduling of Resources

1.0 Introduction

In the last unit, we discussed principles of scheduling resources. We defined the meaning of resources and also the priority rules for scheduling resources. We also discussed the options available to the project manager for scheduling of resources.

2.0 Objectives

At the end of this unit, you should be able to:

- outline areas of practical scheduling of resources
- discuss practical scheduling of resources.

3.0 Main Content

3.1 Factors in Project Resource Scheduling

In practical terms, before practical scheduling can be carried out, the appointed project manager with his or her team will first of all be faced with a number of critical questions that concern the project in question. They may have to highlight problems associated with the project and offer solutions. Let us now look at fig. 1 which highlights competing factors in project resource scheduling.

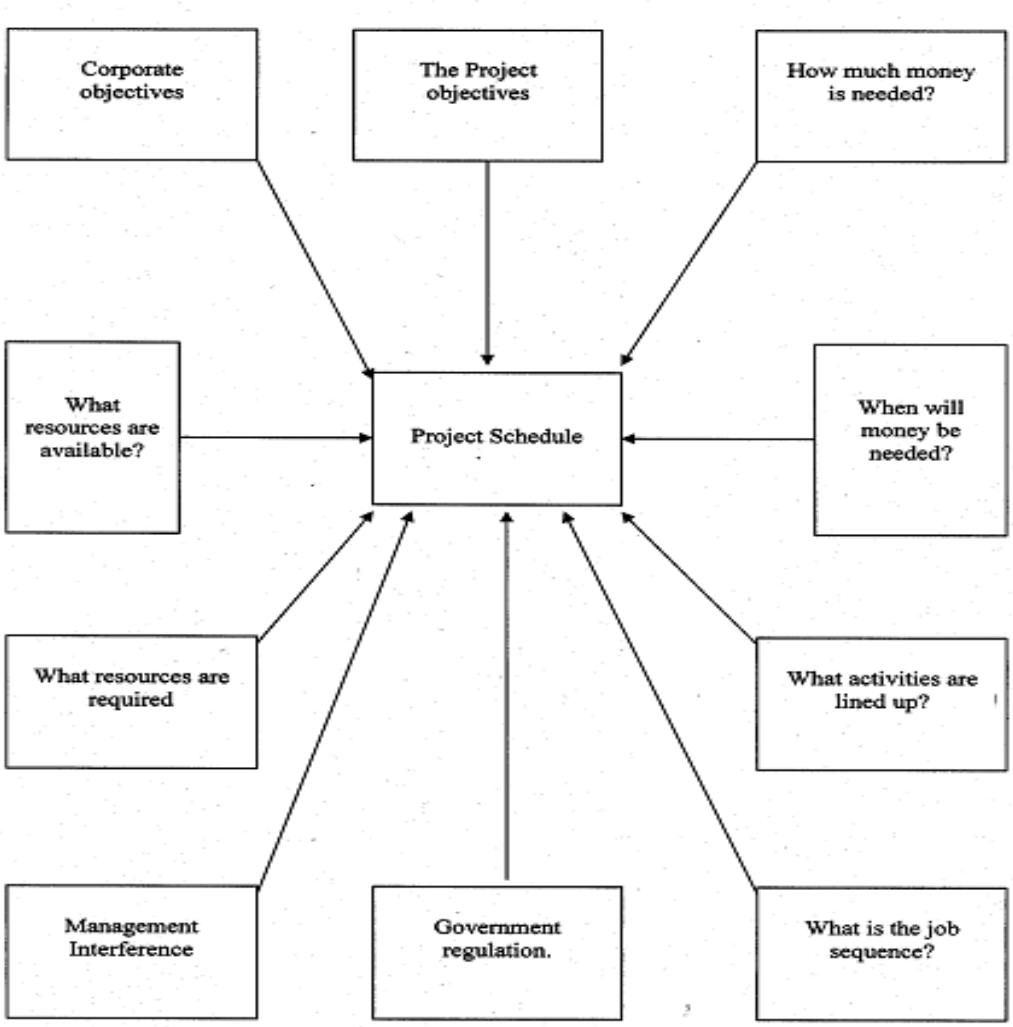

Fig. 1: Competing Factors in Project Resource Scheduling

Self-Assessment Exercise 1

Explain the competing factors in project resources scheduling.

3.2 Labour Resources to be Scheduled

In Fig. 1, we displayed the competing factors in project resources scheduling. Although a lot of factors have been highlighted, a very important resource that needs scheduling is labour. Whatever the nature of the project concerned, the starting point is labour since it is labour that organises all the other factors that take part in a project. So whether it is large construction project, manufacturing project or a large petrochemical project, we will find that the following work activities should be scheduled. They include the following:

- Project layout design
- Civil engineering jobs
- Mechanical engineering jobs
- Structural engineering jobs
- Electrical engineering jobs

- Plumbing and hydro engineering jobs
- Production engineering jobs
- Chemical engineering jobs.

3.3 Scheduling Labour Costs

In Section 3.2 we listed a number of work schedules that should be scheduled. In terms of schedules, we are specifically looking at labour intensive schedules. For example, in project design we are looking at the labour content of project layout design.

So in practice, it will be necessary to schedule the estimated expenditures for labour. The ideal thing to do is to choose a specific cost rate per unit of labour resource. For example, we could have the following estimates for labour costs in a project:

Category	**Rates per Day**
(N)	
Civil engineering jobs	2,500
Structural engineering jobs	2,000
Plumbing jobs	1,000

3.4 Scheduling Costs for Other Materials

Apart from labour cost in a project, there is the need for other materials costs to be estimated and scheduled. In practice, all activities identified in a project should be recognised and the associated materials also identified for cost purposes.

Usually, the project accountant collects information about project activities from the project manager. He/She then matches the material cost with the associated activity.

Based on the network analysis, the accountant is issued with the priority list for the project so that adequate purchase arrangements could be made. The cost of materials to be scheduled will vary depending on the nature of the project, the activities involved and of course the duration of the identified activities.

3.5 Scheduling Cash Flows

Cash flow schedules basically are schedules which show inflows (income) of a project and also outflows (expenditures) of a project.

As we discussed earlier, money is a very critical resource. Again, it is to be stressed that most resources for a project will be paid for with money. Therefore, schedules which show how money will flow in a project is very important.

It is also very important to note that the cash flow schedule is not an accounting statement or schedule. It is basically a schedule that shows the receipts of money and the spending of money in relation to a project.

The cash flow schedule is divided into two sections, namely: the cash inflow section and the cash outflow section. Two of them combine to form the cash schedule.

The cash inflow section of the cash schedule shows the various sources of cash for a project. Sources of cash for a project may vary. In the private sector projects, they will consist mainly of equity or bank loans. But that is understandable.

However, the sources of funds for a public sector project might be different. They may consist of local government, state or federal government funds. Also, public sector projects might attract external funds sources from outside Nigeria.

To drive home the practical construction of a cash flow schedule, we produce for your study two cash flow schedules for the following projects:

A refinery project - Table 1

A hospital project - Table 2

An important point to note about cash flow schedules is that apart from the fact that the schedule highlights the activities, the timing of the activities are duly captured. For example, in the refinery project (table 1) you will observe that the Bank of Industry loan is expected to come in by January and not February. The logic is simple. The loan will be required to undertake the engineering design work, civil engineering and other works.

At a glance, therefore, the project manager can see what activities will come up at different times and the amount of funds they will require.

In more complex cases, the cash flow schedule will highlight when the project will require external funding, etc.

Self-Assessment Exercise 2

Discuss the scheduling of cash flow for a project with an example.

Table 1: Cash Flow Schedule for a Refinery Project

Cash Inflows	**January**	**February**	**N' Million March**
Bank of Industry loan	10,000 -	-	-
European Investment Bank loan	-	-	10,000 -
Federal Government of Nigeria Equity	**10,000**	10,000	**10,000**
Total Cash Inflows		**10,000**	
	200		-
	300	-	1,000
Cash Outflows	2,000	1,000	1,000
Engineering design	100	1,000	1,000
Civil engineering works	100	5,000	2,000
Structural engineering works	200	2,000	100
Mechanical engineering	-	100	100
works Electrical engineering works	**6,000**	-	-
		-	-
Office buildings	4,000	-	9,600
Salary and wages	-	**9,200**	**14,800**
Environmental impact	4,000		

studies		800	(4,800)
Permits		4,000	4,800
Refining chemicals		4,800	-
Total Cash Outflows			
Inflows Less Outflows			
Opening Cash Balance			
Closing Cash Balance			

Table 2: Cash Flow Schedule for a Hospital Project

	N' Million		
	April	May	June
Cash Inflows			
World Health Organisation grant	200	100	-
Federal Government of Nigeria equity	300	-	50
TOTAL CASH INFLOWS	**500**	**100**	**50**
CASH OUTFLOWS			
Engineering design	10	-	-
Civil engineering works	100	10	-
Structural engineering works	30	10	-
Electrical engineering works	10	10	-
Wards and offices	200	30	-
Hospital equipment	100	10	10
Drugs and medicaments	-	-	30
Salary and wages	40	40	10
Total Cash Outflows	**490**	**110**	**50**
Inflows Less Outflows	10	(10)	-
Opening Cash Balance	-	10	-
Closing Cash Balance	10	-	-

Table 3: Steps in Project Resource Scheduling

S/No.	Step	Notes
1.	Define the objectives of the project and break them down into technical, financial and time objectives	Study the feasibility of the project
2.	Divide the project into manageable tasks using the network analysis	
3.	Make a list of all the tasks and their sequence	Use the Network Analysis
4.	Estimate all task durations and identify the critical paths	You may use a bar chart here plus the network analysis
5.	Match the tasks with the available resources	
6.	Assign tasks to team members or team units	

4.0 Conclusion

In this unit, we discussed practical scheduling or resources. We looked at the competing factors in project resource scheduling. We discussed labour resources to be schedules and the scheduling of labour costs. We then discussed project cash flow schedules. We concluded the unit by highlighting steps in project resources scheduling.

5.0 Summary

In this unit, we treated practical scheduling of resources which is a very vital topic towards our understanding of project management. We saw practically how resources are scheduled and using a cash flow schedule. We demonstrated scheduling of project resources. In the next unit, we shall discuss materials management.

6.0 Self Assessment Exercise

What are the competing factors in project resource scheduling?

7.0 References/Further Reading

Wallace, T. F (1995). *MRPH – Making it Happen: The Implementer's Guide to Success with Manufacturing Resources Planning.* Chichester: Wiley.

Baily, P (1991). *Purchasing Systems and Records.* (3rd ed.). Aldershot: Gower.

Unit 4 Materials Management

1.0 Introduction

Materials management concentrates on the key aspects of purchasing and control that take place after a purchase order has been issued for materials of a project. Also, materials management concentrates on the purchasing procedures in projects defined as capital projects.

Purchasing is a vital function in project management because the supply of materials is very critical to ensuring that there are no delays in the supply of materials to projects. Also, buying on competitive terms and prices is considered to be very important to project managers.

Materials management also concentrates attention on the schedule inspection of project materials and goods when they are delivered to the project stores or sites. Stores management is also part of materials management.

Besides, it is to be realised that shortage of material can frustrate a project. So project managers in managing materials purchase must ensure that on no account should materials shortage occur once a project commences. Materials shortages delay projects if they are allowed to occur.

2.0 Objectives

At the end of this unit, you should be able to:

- explain the purchasing cycle
- appraise the principle of materials management
- discuss stores administration.

3.0 Main Content

3.1 The Purchasing Cycle

There is this misconception that a purchasing department consists of people (staff) whose only functions are to issue purchase orders and take delivery of materials and goods. This is not true. The purchasing function goes beyond issuing of local purchase orders (LPOs). We shall now discuss the purchasing cycle which will throw more light on the purchasing function.

The purchasing function may start with the project manager who discovers that some materials are needed for a project. Instructions are then issued to the purchasing department asking it to purchase the materials required. It may also start from the stores department of a project when it is discovered that certain materials are in short supply.

After the need for materials has been identified, the next stage in the purchasing cycle is to specify the materials or goods to be purchased. It is important to specify the required materials especially if they are engineering or specialist goods. They may even be chemicals which are also specialist goods not sold everywhere.

After specifying the materials, the next step is to shortlist vendors and invite tenders from the shortlisted vendors. When the tenders have been received from the shortlisted vendors, some organisations pass on the tenders to the tenders' committee which chooses the vendors. After the vendor has been chosen, the purchasing department now issues the local purchase order (LPO) for the materials.

When the materials are received, it is the duty of the purchasing department to inspect the goods before receipt. After receipt of the goods, payment will then be made to the vendor.

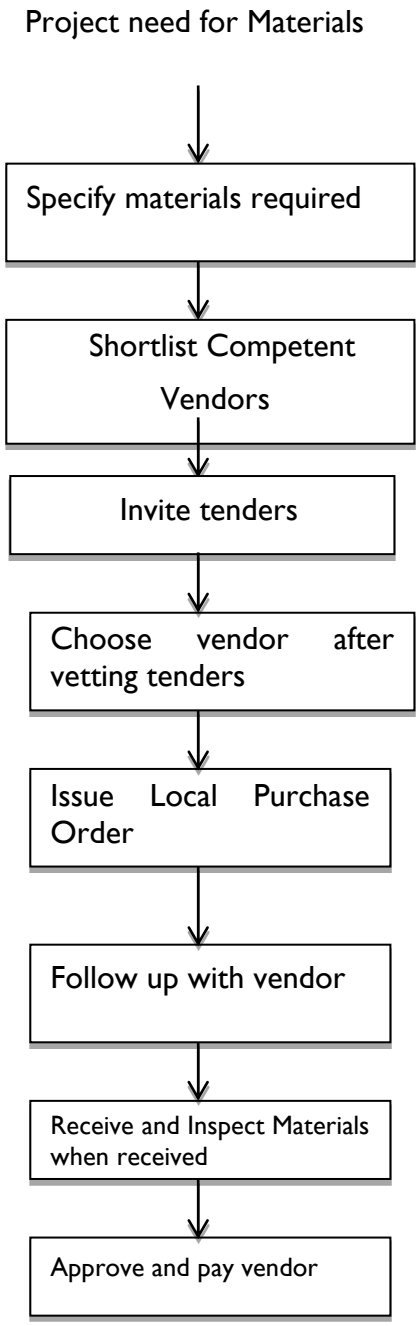

Fig. 1: The Purchasing Chain

Self-Assessment Exercise 1

Describe the purchasing functions.

3.2 Commercial Conditions of Purchase

Since some projects purchase will run into billions of naira in monetary terms, it is important that the commercial conditions of purchase for any project be properly spelt out. In most organisations, the commercial conditions of purchase are usually spelt out on the reverse side of their local purchase order (LPO). Here is a list of some commercial conditions of purchase which appear in many purchase orders.

Goods: mean the supply and delivery of the goods specified in line with the organisation's purchase order.

Payment terms: Payment may be made on delivery or against shipping documents.

Prices: Prices are usually fixed for the period of the contract (LPO) and cannot be varied.

Quality of the goods or materials shall conform to description or specification given by the organisation to the supplier.

Rejections: The company may at any time before or after receipt of the goods reject the goods if they are found to be of inferior quality.

Delivery time: The delivery time must not exceed the time stated on the LPO. However, if for any cogent reason, the supplier cannot deliver goods within the delivery time, the supplier shall notify the company in writing.

We have discussed the commercial conditions of purchase which we said should be written at the back or reverse side of a local purchase order (LPO).

In practice, however, for larger projects, project managers should engage the services of legal experts to draft the local purchase orders so as to reduce losses from legal actions.

Self-Assessment Exercise 2

List and discuss the conditions of purchase which can appear in a local purchase order?

3.3 Timing of Purchase Orders and Deliveries

You will recall that in unit 1, we discussed network analysis. There we discussed project plans and schedules. An important aspect we discussed was activity duration. We identified the start and finish time for an activity.

Every activity should have an earliest start time and earliest finish time. It follows logically therefore, that if the project manager knows when an activity should commerce, then he/she should ensure that the materials required for an activity must be in place before the start of the activity. For example, if the foundation for a stadium project is scheduled to start on December 1, then the cement for the foundation laying must be on the project site latest by November 29 of the same year.

Project managers when handling projects must see to it that all items required in a project are fully identified. Also, when the various materials will be required should be identified and charted. If this is done, notice will be given in advance to the purchasing department to make the necessary purchase. There is therefore, a very strong link between timing of purchase orders, delivery and commencement of project activities.

Fig. 2: Purchase Order Deliveries Project Activity Chain

In management of timing of orders and deliveries, project managers are relying on just-in-time (JIT) management techniques which were perfected by the Japanese. Just-in-time approach to purchasing and manufacture was adopted to reduce stock holdings by manufacturers to almost zero.

Just-in-time techniques require that suppliers of materials should supply them direct to the work site at the right time.

In just-in-time techniques, a great deal of trust is built between the purchaser and the supplier and this ensures that the supplier delivers the goods at the work site at the right time and of the right quality.

Purchasing managers, fully aware of the time lag between issue of purchase orders and deliveries from suppliers, should plan purchases properly so as not to frustrate project activities due to late deliveries or non-delivery of materials.

3.4 Call-off Orders

Consider for example, a situation where a new university is to be built at Bauchi. The university will contain students' hostels, lecture halls, administrative buildings, senate buildings, roads, playgrounds, etc. The project no doubt will gulp billions of naira to complete and will also require a lot of cement, sand, concrete, wood, electrical parts, plumbing parts, etc.

If all the materials required for the university project are ordered at once, then there will be no storage space to receive the goods. In practice, if a large quantity of a particular material is required for a project, then the delivery of the materials (e.g. cement) can be arranged to be made in batches arranged between the purchaser and the supplier. This type of order is known as a call-off order. This is so-called because the materials are called off as they are required to suit a project schedule. However, call-off orders delay expenditures which will only be incurred when materials are delivered.

3.5 Purchasing for Capital Projects

So far, we have built the necessary background for the understanding of materials management. We shall now focus attention on purchasing for capital projects which are mainly what most of us will be faced with in practice.

Capital projects involve large commitment of resources (money and people) and therefore, it is important for us to understand the structure for managing purchases relating to them.

Capital projects will include the following:

- Design and construction of a new university complex
- Design and construction of a federal secretariat complex
- Design and construction of a new teaching hospital
- Design and construction of a national stadium.

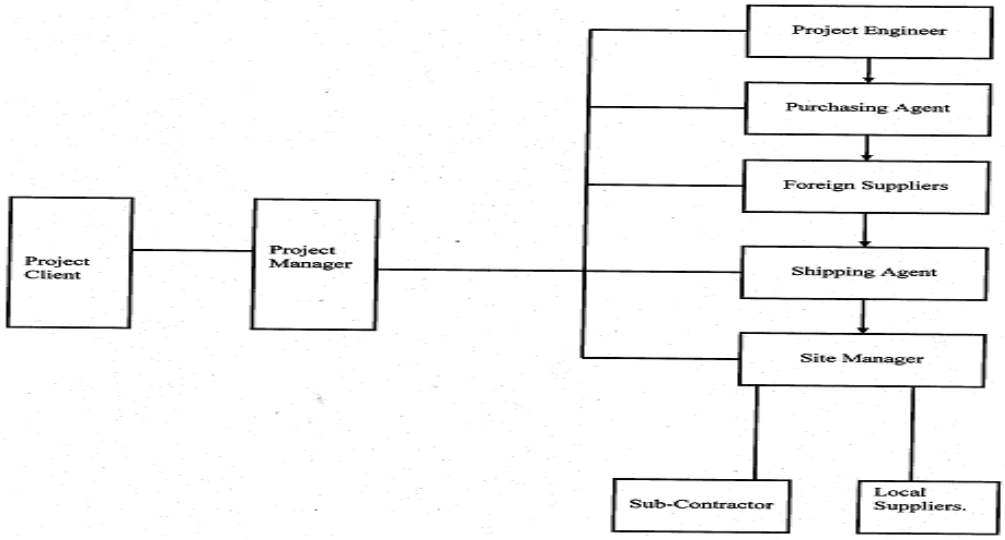

Fig. 3: Purchasing Organisation for a Capital Project

Table 1: A purchasing schedule for a capital project

Title	Schedule
Project Manager	Responsible to the client for scheduling and supervising all project activities until completion.
Project Engineer	Assists the project manager. Provides support to the purchase agent. Writes the purchase specifications for every item or equipment to be purchased.
Purchase Agent	Assists the project engineer. Issues invitation to tender to suppliers. Maintains suppliers records.
Foreign Suppliers	Prepare equipment bids and send same to the purchase agent. Proceeds with supply if bid is successful.
Site Manager	Examines equipment on arrival and arranges storage.
Local Suppliers	Supply equipment and materials direct to site manager.

Self-Assessment Exercise 3

Describe the purchasing schedule for a capital market.

3.6 Stores Administration

Although purchasing is a critical aspect of materials management, stores administration complements the purchasing function. If materials and equipment for a project are delivered on site and not properly accounted for, pilfering and other vices can frustrate a project. Stores administration includes the following:

- Accommodation for equipment and materials
- Labeling the materials for easy identification
- Preservation and paying attention to peculiar storage arrangements
- Handling and issuing of equipment and materials records
- Security.

Self-Assessment Exercise 4
What is the relationship between purchasing and stores administration?

4.0 Conclusion

In this unit, we discussed materials management generally. We discussed the purchasing cycle, commercial conditions of purchase, the timing of purchase orders and deliveries. Call-off orders was also discussed in addition to purchasing for capital projects. All these helped us to improve our understanding of project management.

5.0 Summary

Materials management concentrates attention on the purchase, scheduled inspection of materials and deliveries. Stores management is an important aspect of materials management.

6.0 Self -Assessment Exercise

What do you understand by the term "purchasing cycle" with reference to materials management?

7.0 References/Further Reading

Farmer, D & Van Weele, A. J. (Eds.) (1995). *Gower Handbook of Purchasing Management.* (2nd ed.). Aldershot: Gower.

Lamar, L. Dobler, D. W. & Burt, D. N. (1996). *Purchasing and Supply Management.* (6th ed.). Maiden Head: McGraw-Hill.

Unit 5 Project Implementation: An Introduction

1.0 Introduction

In practical terms, project implementation starts from the time that a project has been conceived, designed and authorisation duly given to proceed on the project. Authorisation can be given by a customer or project owner.

A project owner may be, for example, the Federal Ministry of Works and the project in question may be the dualisation of the Owerri-Onitsha highway.

Project implementation runs through the entire process of organisational initiation of a project to its full implementation. Project implementation highlights the basic principles and processes that are to be followed to ensure that a project is eventually implemented.

2.0 Objectives

At the end of this unit, you should be able to:

- explain the process of project implementation
- discuss project implementation.

3.0 Main Content

3.1 Project Implementation Stages

Generally, project implementation is broken into various stages. This is shown in Fig. 1:

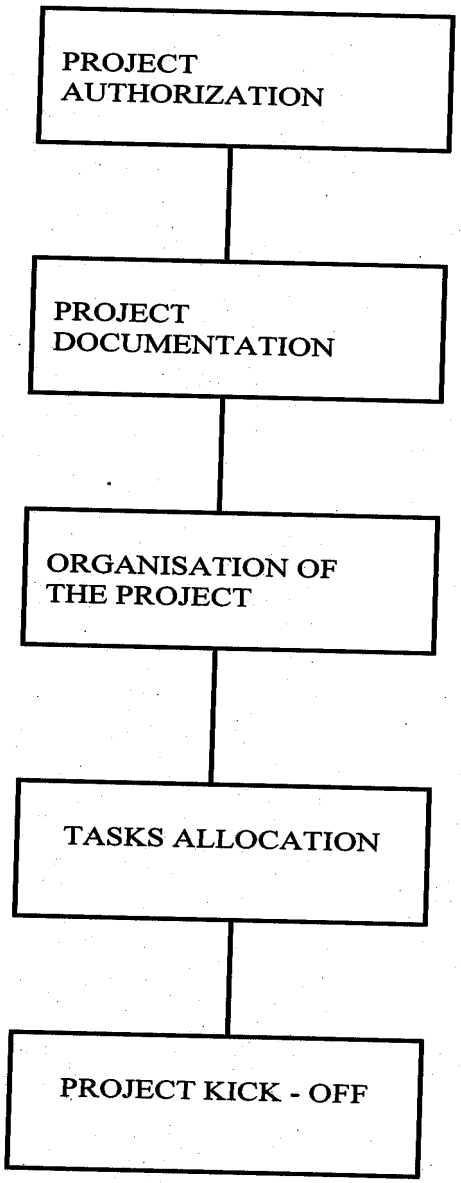

Fig. 1: Project Implementation Stages

3.1.1 Project Authorisation

Before we go into the discussion of project implementation proper, we shall first discuss project authorisation because it is the starting point to describe the process of project implementation. When project authorisation occurs, it means that the project manager has been given proper authority and instruction to proceed with a project.

In a public sector setting, project authorisation may involve the ministry signing a formal contract with the project contractor or project manager as the case may be.

Even in a private sector setting where a project will be executed in-house, there must be a formal written authorisation from the private organisation. The authorisation document will state essential information on the project. It will state the nature of the project and the

scope of work to be undertaken. It will also state the project amount. The project manager will also be stated.

Client	
Nature of project	
Scope of work	
Project amount	N
Project manager	
Project engineer	
Site controller	
Project start date	
Expected finish date	
Authorised by	

Table 1: Project Authorisation Format for a Construction Company

Self-Assessment Exercise 1

List and discuss the information that you can find in a project authorisation document.

3.1.2 Project Documentation

Normally, most organisations may have many projects at the same time. For example, the Federal Ministry of Works at every point in time may have well over 200 projects going on. Some of the projects may be road projects. Others may be building projects.

Practically therefore, there should be ways of distinguishing one project from the other. Whenever any new project is authorised, it has to be registered and given an identification number. For example, in the Federal Ministry of Works, we could have the following pattern of identification numbers.

Project I.D. No.	**Project Title**
R.	101 Kano – Zaria expressway
R.	102 Kano – Maiduguri Road
R.	103 Yola – Biu Road
R.	104 Lagos – Ibadan Expressway
H.	101 Federal Housing Estate Ikoyi
H.	102 Federal Low Cost Housing Estate, Kano
H.	103 Federal Low Housing Estate, Calabar

The identification numbers are usually entered into a project register. Other information that should be entered in the register with respect to every project will be:

- The title of the project
- Nature of work to be done
- Scope of the work to be done
- Project amount and disbursement pattern
- The project manager
- The design architects for the project
- The structural engineers for the project
- The mechanical engineers
- The electrical engineers
- The supervising agent
- Project start date
- Project finish date.

With the advent of the computer and information technology, most project registers are available in computer systems and this makes the retrieval of information about any project very easy.

Self-Assessment Exercise 2

Why is it necessary to document the project?

3.1.3 Organisation of the Project

Once the project documentation stage of a project has been concluded, the next stage in the implementation process is the organisation of the project. In most situations, the project manager as the leader of the project team with his close subordinates will draw up the comprehensive organisation chart for the project which will clearly detail the following information:

- Teams that will work at head office level
- Teams that will work at the project sites
- Principal sub-contractors and their locations
- Supervising agencies
- Other logistics.

Item/Question	Position and Action Plan
How many project teams do we have? What are their locations? How many people will be involved? Is accommodation available at sites? If yes, what standards? Has accommodation been arranged? Has staff medical care been arranged? What is the access to the site? By air, road, rail or sea? What of the vehicle fleet? What no of vehicles are required? When will they be moved to site? Who will be responsible to move them? What are the things needed at the site? Electricity and generators Have equipment been moved to sites?	

3.1.4 Tasks Allocation

You will recall that network analysis identifies the principal activities that are involved in a project. That we have understood. In tasks allocation, the project manager identifies every activity that will be undertaken and goes ahead to allocate the tasks to the various units.

Every unit or team that is involved in a project must know what it is expected to do and the time frame allocated for every activity. A tool that assists the project manager to allocate tasks in a project is the responsibility matrix. The responsibility matrix consists of task types on one side and responsibilities on the other.

Each task in a project is allocated to the project team or unit that is responsible for the task.

A project responsibility matrix is shown in table 3.

Responsibility

Table 3: A Project Responsibility Matrix

	Project Manager	Purchasing Manager	Design Office	Project Accountant	Project Engineer
Task					
Designs			X		
Approval of designs	X				
Purchase orders (P.O)	X	X			
Planning and logistics	X				X
Progress report	X				X
Cost reports	X	X		X	

3.1.5 Project Kickoff

We have traced project implementation from the authorisation stage to the tasks allocation stage. The next stage which is the last stage is the project kick-off stage. Ideally, every project has a kick-off date which is usually known in advance. The kick-off date is arranged following series of meetings of the project team members. Before the project kick-off, grey areas must have been resolved.

In practice, most project managers will arrange a pre-kick-off meeting with key team members. The objective of the pre-kick-off meeting usually is to ensure that all critical aspects of a project have been covered and also to evaluate the readiness of all team members and leaders towards ensuring the success of the project.

The actual kick-off of the project is the beginning of proper project implementation.

4.0 Conclusion

In this unit, we treated project implementation. We discussed the various stages of project implementation. We discussed project authorisation, project documentation and organisation of a project, tasks allocation and project kick-off. All these are essential stages in project implementation.

5.0 Summary

This unit treats project implementation at an introductory level. It highlights the key stages that are involved when a project is being implemented. Project implementation is not a one-off thing. It is an on-going process.

6.0 Self Assessment Exercise

The Federal Government of Nigeria has approved the construction of a new Lagos-Ibadan expressway at a cost of N4 billion. Discuss the stages in the implementation of the project.

7.0 References/Further Reading

Healey, P. L. (1997). *Project Management: Getting the Job Done on Time and in Budget.* Oxford: Butterworth – Heinemann.

Randolph, W. A. (1991). *Getting the Job Done: Managing Project Teams and Taskforces for Success*. Helmel Hempstead: Prentice-Hall.

Unit 6 Managing Progress In Projects

1.0 Introduction

In the last unit, we discussed project implementation. We discussed the various stages of project implementation which include project authorisation, project documentation and organisation of a project, tasks allocation and project kick-off.

In this unit, we shall discuss managing progress in projects. This unit will conclude our study of project management.

2.0 Objectives

At the end of this unit, you should be able to:

- explain managing progress in projects
- discuss the management of progress in projects.

3.0 Main Content

3.1 Managing Progress

Once a project has been commissioned, there will be need to monitor its progress. For example, when the Federal Ministry of Works awarded the contract for the dualisation of the Onitsha-Owerri highway, it detailed the supervisory unit to periodically inspect the progress of work on the road project and report back to the headquarters.

When we discussed network analysis, we saw that every activity in a project has duration. Duration refers to how long it will take to finish an activity. We also noted that every activity has an earliest start time and earliest finish time. In managing progress, the project manager must compare the progress achieved on every activity against the planned schedule.

In situations where the project site is far away from the head office or headquarters, it becomes very necessary for the project manager through the necessary communication lines with the site managers to get on the spot progress of work at various locations.

Practically, there is resort to the use of a progress report questionnaire. The progress report questionnaire is designed to measure the progress of work in a project. It will usually describe the various activities in the project, their durations, earliest start dates and earliest finish dates. The respondent to the questionnaire is expected complete the relevant columns. Headquarters uses the questionnaire to monitor progress of various projects.

Consider, for example, a project that involves the construction of a students' hostel. A progress report questionnaire is shown in table 1:

Table 1: Progress Report Questionnaire for Students' Hostel under Construction in a University

Activity Description	Scheduled Start	Scheduled Finish	% Complete
Dig soak away and drain trend	1/1/2007	3/1/2007	100
Lay rubble and drain pipes	1/1/2007	7/1/2007	100
Prepare chamber slabs	7/1/2007	17/1/2007	100
Dig hostel foundations	4/1/2007	14/1/2007	100
Lay concrete foundation works	16/1/2007	21/1/2007	100
Lay floor base	22/1/2007	30/1/2007	100
Mount bricks	1/2/2007	30/4/2007	100
Fit lintel	1/5/2007	20/5/2007	100
Build parapet	21/5/2007	30/5/2007	100
Fit roof timber	1/6/2007	10/6/2007	100
Fit and run fascia board	11/6/2007	25/6/2007	-
Fit roof sheets	26/6/2007	10/7/2007	-
Seal the roof	11/7/2007	11/8/2007	-
Fit ceiling boards	12/8/2007	12/9/2007	-
Fit gutters	12/9/2007	25/9/2007	-
Hang doors and windows	26/9/2007	10/10/2007	-
Fit electrical fittings	12/8/2007	10/10/2007	-
Paint	11/10/2007	11/11/2007	-

The frequency of the reports will depend on the nature of the projects. Where computer systems are available, data and information on various activities can be keyed in at the various project sites.

3.2 Management by Walk About

The ideal methods in managing progress in projects involve the use of reports from team members on the various aspects of the project they are involved in. In that respect, all project team leaders usually will prepare periodic project reports which will be sent to the project manager for review and further action. But whilst the preparation of periodic reports is commendable, a practical project manager must be prepared to pay scheduled and unscheduled visits to the project sites to get firsthand information on the state of work at the site.

This type of visits to the project sites is known as management by walk about. Apart from seeing things as they are on the site, one advantage of scheduled visits to sites is that it helps to boost the morale of workers at the site when they see their project managers and team members at the site reviewing progress. During such scheduled visits, project managers may take photographs of the project site which serve as documents at the headquarters. Photographs also will document the level of construction progress especially for a building project.

It has to be stressed that when a project is being monitored the control areas relate to:

- The state of progress at the various levels of activity of the project.
- Manpower deployment and utilisation including shortages.
- Expenditures of the projects and whether they are within the project budget.

Self-Assessment Exercise 1

In managing progress in projects, a manager must be prepared to pay visits to the project sites. What are the benefits of this?

3.3 Managing Sub-Contractors and Agency Staff

In practical terms, most organisations use main contractors, sub-contractors and agency staff for project execution. This fact introduces the complexity involved in managing a project. First, the organisation's staff may differ widely in quality and conduct from that of the main contractor and also the sub-contractor.

Depending on their scope, most projects have their main contractor and also sub-contractors. Sub-contractors are usually engaged in projects especially where they are required to undertake tasks for which they are specialised and which may not be available to the main contractor. For example, the design and construction of a National Stadium at Abuja definitely involved the main contractor and a lot of other sub-contractors with different areas of specialisation.

Let us assume that Company A was awarded the contract to construct the new national stadium at Abuja at a cost of N20 billion. In this case, Company A is the main contractor but it has to engage many sub-contractors for various jobs related to the stadium project. A lot of sub-contractors may be hired for the following jobs:

• Foundations and piling jobs	Trevi Foundation Ltd.
• Wood works	- Ashly and Bred Ltd.
• Plumbing works	- Asea, Orly & Co.
• Electrical works	- Newman Nig. Ltd.
• Painting	- Bonalux Painters Ltd.

If you take a good look at the jobs that the sub-contractors were engaged to do, you will realise that they are outside the areas of competence of Company A which is the main contractor to the stadium project. So when we are talking of managing progress in a project, the project should be seen in totality.

Although the main contractor has the duty to supervise and manage the progress of the sub-contractor, the project manager's function is all encompassing. The project manager supervises and monitors progress in a project from a holistic point of view.

Apart from managing sub-contractors, some projects involve the use of agency staff that may either be deployed to work at the main contractor's location or deployed to work at other designated locations.

Usually, a main contractor resorts to the use of agency staff on a temporary basis; this usually is to cover staff shortage which normally arises in the course of project execution. All agency staff that are absorbed to work at the main contractor's premises must be properly supervised and monitored. A practical way of doing this will be to have induction training for them at the inception of the project.

Self-Assessment Exercise 2

List three control areas that should be monitored in a project.

3.4 Construction Site Management

A lot of projects may involve construction sites and the management of these sites are crucial if projects are to be properly executed. Also, in many projects, the headquarters of the project manager may be very far away from the various construction sites. Take, for example, MTN which is involved in communications. The construction and deployment of communications masts nationwide involve many construction sites. Work at all of these sites must be properly supervised and managed. Therefore, there is the need for proper coordination and management of construction sites.

In construction site management, the primary focus is on the facilities at the various project sites. Some of the facilities will include the following:

- Road network
- Staff accommodation
- Office accommodation, e.g. Portakabin
- Communication equipment
- Computers
- Telephones
- Stationery.

All these facilities must be on site with other necessary items. If there is no power or water at the site, the project manager or main contractor must ensure that these are also provided. The health of the site workers must also be taken care of. In this case, local arrangements will have to be made to provide regular and emergency medical services to the staff at project sites. In more complex cases, banking facilities in addition to catering services will need to be provided for the workers at the project site.

3.5 Conduct of Project Meetings

Along the line when the project is ongoing, there is always the need to conduct project meetings to monitor and evaluate progress of work at different sites. Project meetings are very important. Project meetings may be held at a project site or at the headquarters of the project manager depending on the circumstances.

As with any other meeting, the following must be in place:

- Agenda
- Meeting room with adequate ventilation
- Visual aids
- Refreshments
- Accommodation for visiting members.

To ensure the best out of project meetings, the agenda for the meeting should be given well in advance to the various members so that they can study it and prepare their reports where necessary.

As we have indicated earlier, the objective of many project meetings is to evaluate progress of work. Also, meetings serve as avenues to identify problems associated with a project. At times, problems (especially engineering problems) arise during a project implementation. We discover that in most cases, teams working independently may be unable to solve the engineering problems. Such engineering problems if they arise may be brought to the attention of a larger audience, i.e. the project meeting. Also, project meetings may highlight interdepartmental or inter team problems which may be affecting work progress.

Self-Assessment Exercise 3

Why is it necessary to conduct project meetings?

Table 2: Project Meeting and Action Sheet

DATE OF MEETING : PLACE OF MEETING : TIME OF MEETING :	
MEETING AGENDA :	
THOSE IN ATTENDANCE : 1. 5. 2. 6. 3. 7. 4. 8.	
KEY DECISIONS REACHED 1. 2. 3.	UNRESOLVED ISSUES: 1. 2 3
ACTION TO BE TAKEN AND BY WHOM 1. 2. 3	
Signatures	
Chairperson	Secretary

3.6 Project Progress Reports

Progress reports are usually addressed to any of the following:

- Company management
- Customer or client, e.g. The Federal Ministry of Works.

The progress report seeks to set out details of the technical and financial status of projects especially to compare the results achieved so far with the target objectives of the project. In most project contracts, reports may be required to be sent in weekly or monthly depending on the nature of the project. The progress report should contain, amongst other things, the following:

- Details of work done so far
- Details of outstanding work to be done
- Estimated project completion time of project
- Project cost discipline
- Project cost escalations – (if any).

4.0 Conclusion

In this unit, we have generally discussed managing progress in projects a very vital part of our study of project management. We discussed the concept of management by walk about which is a more practical approach to managing progress in projects. We also discussed the management of sub-contractors and agency staff, construction site management, project meetings as well as project progress reports.

5.0 Summary

This unit treats managing progress in projects. It tries to examine the key features in the management of progress in a project. The importance of managing progress by walkabout cannot be underestimated in project management.

6.0 Self Assessment Exercise

As a project manager, how do you manage progress in your projects?

7.0 References/Further Reading

Morris, P. W. G. (1997). *The Management of Projects*. London: Thomas Telford.

Crosby, P. B. (1979). *Quality is Free: The Art of Making Quality Certain*. New York: McGraw – Hill.