2.1 Introduction:

(Antill.J.M. & Woodhead R.W, 1965). Stated that, “… the construction industry has special features that are not encountered in other industries. First, the wide range of operation all requiring different construction methods, equipment, and labor skills. Second, the construction sites are always temporary and often remote. Third, the local site management rarely has fully control of policy and finance and can never be self-sufficient. Finally, construction personnel are divided into two groups, permanent executives and the transitory operatives. Thus the planning and estimating of construction works must take into account these characteristics”. Construction projects must therefore be carefully planned and estimated so that they may be successfully completed with regard to time, cost and quality. It was concluded that the key of successful time, cost and quality, is mainly based on proper planning of the total project implementation process...

2.2 The historical development of planning techniques:

(Stuckbruck L, 1981) In the past, the planning of a project was done with little planning, the best known planning tool then was the Gantt Chart or Bar Chart, which specifies the start and finish times for each activity on a horizontal or vertical time scale. Its disadvantage is the interdependencies between the different activities cannot be determined from the Bar Chart.

The growing complexity and the increasing size of today’s projects have demanded more systematic and more effective planning techniques, with the objective of
optimizing the efficiency of project executing process. However, these technically sophisticated projects motivated the development of new planning methods. (Stukenbruch L’ 1981) stated, “In 1940s, the British added new methods with logical relationships to Gantt Charts. The new methods are superior to Gantt Charts for planning (by showing task interdependencies), for scheduling (by highlighting the critical path), and for control (by providing insights into time vs. resources tradeoffs).” These methods are called the network planning methods (or techniques); and they had their beginning as distinct and separate spheres. One of these is known as the Critical Path Method or (CPM) and the other as Program Evaluation and Review Technique or PERT.

The Critical Path Method – CPM- has its beginning in early 1957, as a result of the collaboration between the Du Pont Engineering services with the Remington Rond (Univac) in order to provide a more precise and dynamic model for scheduling purposes.

(Roy Plicher, 1992) PERT on the other hand was conceived by the Special Project Office of the U.S Navy in 1957-1958, and developed by Booz, Allen, and Hamilton in conjunction with Lockheed Missiles Systems Division on the Polaris Fleet Ballistic Missiles Program where the dominate emphasis was on meeting stringent schedules for internationally strategic reasons and taking a rather flexible view of cost control.

The U.S Navy credits PERT with making a considerable contribution to the completion of the Polaris Missile Programme ahead of time.

CPM and PERT are basically time oriented methods in the sense that they both lead to the determination of a time schedule. Perhaps the most important difference is that originally the time estimates for the activities were assumed deterministic in CPM and probabilistic in PERT (Roy Plicher, 1992).
(Hamdy A. Taha, 1997), stated, “…… today, PERT and CPM actually comprise on technique and the differences, if any, are only historical. Consequently, both techniques will be referred to as project scheduling techniques”. This was the opinion of many other authors in this field such as (Stuckenburck L, 1981.-.C., Pilcher R, 1992), etc

In 1960s, and as a result of implementing CPM and PERT, the resource allocation or (leveling) attached attention by using positive float available on noncritical paths through project, and by smoothing and leveling the peaks and valleys in the resources to be consumed. Following PERT/CPM, systems for tracking project cost by activity were developed also in the early 1960s. PERT/COST as a technique provides a tool for measuring project progress and for forecasting completion cost. Between1962-1964, the Precedence Diagramming Method – PDM- was introduced at Stanford University. It is also the same method expressed in a new format. In PERT/CPM networks, all relationships among tasks are finish to start relationships and constraints must be depicted by the so called dummy activities. PDM adds start to start and finish to finish relationship which offers certain efficiencies in modeling concurrent tasks (Roy Plicher, 1992).

An important addition to the network techniques for project management methods also occurred in the early 1960s known as WBS (the Work Breakdown Structure). It is a diagram of the work to be done, expressed in detail from the top down in a tree structure. The WBS establishes how the work will be performed and how cost and schedule data will be tracked and reported. The integration of schedule, cost, and WBS in project management had been an elusive goal unit the early 1970. Fundamental to this integration is cost tracking by activity and reporting of cost based on the schedule of planning work (Dr. Osman Ibrahim).
2.3 The Project:

A project is a temporary organization involving a connected sequence of activities and a range of resources, which is designed to achieve a specific and unique outcome and which operates within time, cost and quality constraints and which is often used to introduce change.

**Temporary** – means that every project has a definite beginning and a definite end. The end is reached when the project's objectives have been achieved, or when it becomes clear that the project's objectives will not or cannot be met and the project is terminated. Temporary does not necessarily mean short in duration, many projects last for several years. In every case, however, the duration of a project is finite, projects are not ongoing efforts.

**Unique Product** – projects involve doing something which has not been done before and which is, therefore, is *unique*. A product or service may be unique even if the category it belongs to is large. For example, many thousands of office buildings have been developed, but each individual facility is unique, different owner, different design, different location, different contractors, and so on. The presence of repetitive elements does not change the fundamental uniqueness of the overall effort.

2.4 The Management:

Is the process of working with and through others to achieve organizational objectives in a changing environment. Central to this process is the effective and efficient use of limited resources.
2.5 The Project Management:

Project management is the planning, organizing, monitoring and control of all aspects of a project and the motivation of all involved to achieve project objectives safely and within a defined time, cost and performance. It’s also the usage of knowledge, skills and tools to manage a project from start to finish with the goal of meeting the project requirements. It involves using the appropriate processes.

2.6 The Project Planning:

Project planning is one of the most important project management functions. The project planning can be described as the optimal systematic arrangement of project resources to achieve project objectives. Project planning requires that project objectives be defined first; thereafter, the strategies to achieve them are formulated. Project planning can be described as the process of defining project objectives, determining the framework, methods, strategies, tactics, targets and deadlines to achieve the objectives and communicating them to project stakeholders. The process of project planning requires that the client’s expectations or requirements and the available resources be defined first, and then matched to set project objectives, available options identified and evaluated and the most appropriate frameworks, strategies and tactics to achieve the objectives selected. Project planning also involves communicating the objectives and the frameworks, methods, strategies, targets and deadlines to achieve them to the persons, parties and organizations concerned with their implementation, monitoring and control. The process involves preparing numerous project plans, each representing defined strategies to achieve defined project objective(s). The project planning also can be described as the process of determining the appropriate strategies for the achievement of predefined
project objectives. Several plans are required for the effective delivery of a project. While a plan may comprise two or more objectives, two or more plans may concern the same objective. Planning is a continuous process that commences as soon as the decision on the investment is taken and does not end until the project is delivered. Accordingly, there are three levels identified of project planning:

1. The end-user level, where the planning focuses mainly on the functional characteristics of the project end product.
2. The technical level, which focuses on the technical specifications of the project deliverables that are needed to support the functional requirements.
3. The project management level, which focuses on planning the activities and processes that need to be performed to ensure that the technical work proceeds effectively.

2.7 The Project Planning Activities:

2.7.1 Describing Project Scope, Alternatives and feasibility
Purpose: is to understand the content and complexity of the project.

2.7.2 Dividing the Project into manageable tasks (WBS)
Project must be divided into manageable tasks and then logically order them to ensure a smooth evolution between tasks.

The definition of tasks and their sequences is referred as the Work Breakdown Structure (WBS).

WBS is essential in Planning and executing the Project because it is the foundation for developing project schedules (PERT / and GANNT chart) for identifying Milestones in the Scheduling and for managing Costs.
2.7.3 Estimating and creating a Resources Plan
PURPOSE: Is to estimate Resource Requirements for each project Activity and use this information to create a Project Plan.

2.7.4 Developing a Preliminary Project Schedule
Using the information on Tasks and Resources availability to assign TIME ESTIMATES to each Activity in the WBS.
TIME ESTIMATES will allow you to create Target Starting and Ending Dates for the Project.
The Preliminary Schedule may be represented as a GANTT Chart or as a Network Diagram (i.e. PERT/CPM Chart).

2.7.5 Developing a Project Communication Plan
PURPOSE: Is to outline the communication procedures among Management, Project team members and the Customer.

2.7.6 Determining Project Standards and Procedures
Specify how various Project Deliverables are produced and tested by you and your Project team.
Setting Project Standards and Procedures for work acceptance is a way to assure the development of a high quality System.

2.7.7 Identifying and Assessing Project Risks
PURPOSE: Is to identify sources of Project Risk and to estimate the consequences of those Risks.
Risk might arise from the use of new technology, availability of critical resources, team member inexperience with technology or business area etc.

YOU SHOULD CONTINUALLY TRY TO IDENTIFY AND ASSESS PROJECT RISK

2.7.8 Creating a Preliminary Budget

You need to create a Preliminary Project budget that outlines the planned expenses and Revenues associated with the Project. The Preliminary Budget will be used for Project Justification.

2.7.9 Developing a Statement of Work

Develop primarily for the Customer. It outlines work that will be done and clearly describes what the Project will deliver. It is useful since all parties have a clear understanding of the intended Project Size, Duration and outcomes.

2.7.10 Setting a Baseline Project Plan

The baseline project plan provides an estimate of the project tasks and resources requirements and is used to guide the next project Execution Phase. As information is acquired during project Execution, the baseline will be continued to be update.

2.8 Productivity:

Productivity is the ratio of output to all or some of the resources used to produce that output.

Productivity = output/resources used
Where:
Output = can be homogenous or heterogeneous
If output is homogenous (e.g., amount of concrete poured) it can be measured in physical units (e.g., cubic meters), if output is heterogeneous, it must be measured in value terms.
Resources emprise = labour, capital, energy, raw materials, etc...
In the case of construction, these output measurement issues are especially difficult and complex owing to the extreme heterogeneous of constructed products.
The three most commonly used productivity ratios, based on (resource used) are:
1. Total factory productivity – output in relation to all resources used.
2. Labour productivity – output in relation only to labour used.
3. Capital productivity – output in relation only to capital used.
Productivity = output/ labour input
Labour can be measured as:
Persons employed (the most available)
Hours worked (the most accurate)
Labour cost
Productivity = output/ capital input
Capital “refers to physical capital, not investment. Physical capital is machinery and equipment.

2.9 performances
The accomplishment of a given task measured against preset known standards of accuracy, completeness, cost and speed. In a contract, performances are deemed to be the fulfillment of an obligation, in a manner that releases the performer from all liabilities under the contract.