Civinnovate

Discover, Learn, and Innovate in Civil Engineering

Chapter-1 Construction management Framework

1. Construction Landmarks
2. Scope of Construction Management
3. Construction project Characteristics
4. Construction project life cycle Phases
5. Construction project management
6. Relation between client, consultant and Contractor.

1. Construction Landmarks

Construction and the ability to build things is one of the most ancient of human skills. In prehistoric times it was one of the talents that set *Homo Sapiens* apart from other species. Humans struggled to survive and sought shelter from the elements and the hostile environment that surrounded them by building protective structures. Using natural materials like earth, stone, wood and animal skins, humans were able to fabricate housing that provided both shelter and a degree of protection from wild animals and climatic adverse impacts.

Construction can be traced as under-

1. Stone age construction
2. Ancient construction,
3. Modern age construction

Continued--

1. **Stone age Construction**: The first bridges constructed by humans were perhaps wooden logs put across a river. The first buildings were simple tents, huts, and houses meant to satisfy the basic needs of protection from the calamities.
2. **Ancient Construction:** As cities emerged, sections of professional expertise like metalworking, masonry, wood working etc. started taking shape. In the urban planning division the governments started regulating construction sector. Simple machines viz. levers and pulleys were used. Vaults, arches, and domes were leveraged to create spans. In ancient Rome, concrete was discovered. Occasionally, slaves were utilized as labors, but not as frequent as manifested in popular culture. Some construction works were undertaken as corvée.

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3. **History of Construction in the Modern Age Building techniques :** Bricks were accepted as a widespread building tool during the modern era, as it was easy to produce. There were many tools which have gone obsolete after the advent of modern technology, but which were earlier significantly used by all builders.

Industrial Revolution: The industrial revolution was displayed in new types of transportation establishments. like railways and macadam roads. It required large investment. The construction tools facilitated in this time were machine devices, steam engines and optical surveying. Elevators and cranes facilitated high rise buildings and skyscrapers in the early 20th century with Second Industrial Revolution.

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In this era, heavy equipments and power tools took the place of time consuming man power. Other technologies were computer aided designs.

By the end of the 20th century, energy preservation, ecology, and sustainable development became more magnificent aspects of construction.

History of Construction

a. **Ancient Egypt:** In Ancient Egypt and other early cultures, people believed in the omnipotence of Almighty. Thus, the founding and planning of the city and the most significant buildings were generally executed by priests or by the ruler himself and the construction was followed by rituals. The architect should be a priest or the ruler, but, he was not the sole prominent figure; he was just a part of the tradition.

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b. **Pre-Columbian History of Construction:** Mesoamerican construction is the series of architectural traditions invented by pre-Columbian tradition and civilizations of Mesoamerica. The distinctive features of Mesoamerican construction envisages a number of various regional and historical designs, which albeit are specifically associated. Mesoamerican architecture is generally famous for the pyramids which are the biggest such structures other than Ancient Egypt.

c. **Greek History of Construction:** Greek civic life was supported by new, open spaces termed as agora which were crowed with public buildings, temples and stores. Each place had its own specialty, thus temples were constructed atop mountains stretching towards the heavens.

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In response to the changing social environment which asked for new buildings of increasing complexity — the coliseum, bigger hospitals, residential blocks and academic buildings were constructed. General civil construction like roads and bridges started to be constructed.

Roman History of Construction : The Romans widely deployed, and further established, designed the vault, arch, and dome, all of which were occasionally used earlier, specifically in Europe. Roman domes allowed construction of vaulted ceilings and huge covered public spaces like public baths viz. Baths of Diocletian or the huge Pantheon in the city of Rome.

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Asia

Persian Architecture: The post-Islamic construction of Iran got inspired by its pre-Islamic predecessor with surfaces that are decorated with lazed tiles, carved stucco, brickwork artifacts, calligraphy, and floral motifs.

Although Iran has witnessed its share of destruction, that includes Alexander the Great's decision to burn Persepolis, there are ample remains to create a picture of its great architecture.

Indian History of Construction: India's urban civilization is manifested in the form of Mohenjo-Daro and Harappa, now situated in Pakistan. From then onwards, Indian civil engineering and construction consistently developed and was manifested in the designs of palaces, temples, and forts across the Indian subcontinent and neighboring places.

Continued-

Indian architecture covers a wide spectrum of historically and geographically disseminated structures, and was inspired by the history of the India. It led to an array of architectural production. Although it is tough to identify a particular representative style, it sustains a significant quantity of continuity throughout history. The diversity of Indian tradition and culture is manifested in its architecture and construction.

Chinese History of Construction: Islamic architecture is an embodiment of wide array of both religious and secular architecture designs from the foundation of Islam to the current day, effecting the design and construction of structures within the sphere of Islamic tradition. Some unique structures in Islamic construction are mosques, palaces, tombs, forts, although Islamic architects have also facilitated their exclusive design precepts to domestic architecture.

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Africa: Great Zimbabwe is the greatest medieval city in sub-Saharan Africa continent. In the late nineteenth century, most structures reflected the stylish European eclecticism, or even Northern European designs. In the Western Sahel province, the architectural development and construction was influenced by Islamic culture from the period of the Kingdom of Ghana. At Kumbi Saleh, civilians dwelled in domed-shaped houses in the city, surrounded by a magnificent enclosure.

Europe

Medieval History of Construction

Medieval secular construction and architecture basically served for defense. Palaces and fortified walls offer the most significant non-religious examples of medieval construction. Windows owned a cross-shape for mostly aesthetic purposes: they also provided a suitable crossbowman to carefully attack invaders aiming from inside.

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As society became more organized, the ability to build things became a hallmark of the sophistication of ancient civilization. The wonders of the ancient world reflect an astounding ability to build not only structures for shelter but monuments of gigantic scale.

The Pyramid and Greek Temples such as the Parthenon are impressive testimony to the building skills of the civilization of antiquity. Great structure punctuate the march of time and many of the structures of ancient times are impressive even by modern standards.

The great Church of Saint Sophia in Constantinople, constructed during the 6th century, was the greatest domed structure in the World for nine centuries. It was ingenuity of the builders and mastery of how forces can be carried out to the ground using arches in one dimension and in three dimensions as domes.

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Satellite view is showing the Pyramid Fields from Giza in Egypt.

The Ancient Egyptian complex is located on a plateau on the outskirts of Cairo. The archaeological site consists of a number of edifices: the Pyramid of Khufu (known also as the Cheops Pyramid or the Great Pyramid), the somewhat smaller Pyramid of Khafre (or Chephren) and the relatively modest-size Pyramid of Menkaure (or Mykerinos) and a number of smaller satellite edifices, known as "queens" pyramids. The Great Sphinx lies to the east side of the complex.

The Pyramids of Giza and others are thought to have been constructed to house the remains of the deceased Pharaohs who ruled over Ancient Egypt.

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Until today it is not known how the Pyramids actually were made. There are various theories about the construction techniques, but the ancient builders keep their secrets.

Pyramids of Giza at night

Continued--

Everybody knows the most famous landmarks in the world, you can name it, or? Anyhow, on the next pages you will find some, if not all, most famous landmarks and monuments around the world, as well as some, not everybody knows. Each of these cultural icons is a symbol with various meanings, it may represent an epoch, an area, a belief, a culture, a country or a city.

Giza Pyramid and the Great Sphinx near Cairo,Egypt
The pyramids are a symbol of the high culture of dynastic ancient Egypt.

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India

The Taj Mahal is a monument of love, and a symbol for India.

Stone hedge, Wiltshire, Country, UK Europe

UK

the world's most famous prehistoric monument. People around the world consider it as a sacred site and they associate the ceremonial place with the super natural world.

Great Wall of China

China

The Long Wall is really an amazing landmark and today the most celebrated symbol of China. In pre modern times the Great Wall was also recognized as a symbol of the futility and cruelty of the first emperor's political and military ambitions.

Angkor, Siem Reap, Cambodia

Cambodia

Angkor was the ancient capital of the Khmer empire, in western Cambodia and one of the world's greatest cultural treasures, today the national symbol of the country,

Acropolis of Athens, Athens, Greece

Athens,

Colosseum, Rome, Italy

Rome, Italy

The Flavian Amphitheater is an iconic symbol for Rome the 'Eternal City' as well as for the civilization of the Imperial Roman Empire.

Potala , Palace, Lhasa, Tibet

Lhasa, Tibet
The Potala Palace at the peak of Marpo Ri, the "Red Hill" is the symbol of Lhasa (sacred land), a treasure of Tibetan history, religion, culture and arts.

Statue of Liberty, New York City, USA

New York City, USA
The Statue of Liberty, since 1924 a National Monument, is recognized as a universal symbol of freedom and democracy.

Construction – an Introduction

Construction consists of the following stages-

a. Conceptualization stage, C,
b. Design stage, D,
c. Execution Stage, E, and
d. Finish and commissioning. F.

Concepts, “C” regarding the need that has been arisen from the necessity are discussed or conclusions are drawn from discussions. Past experiences, reports of completed construction, demands of services for infrastructure development etc are shared and analyzed to draw a meaningful decision which is here recognized as conceptualization stage in the construction.

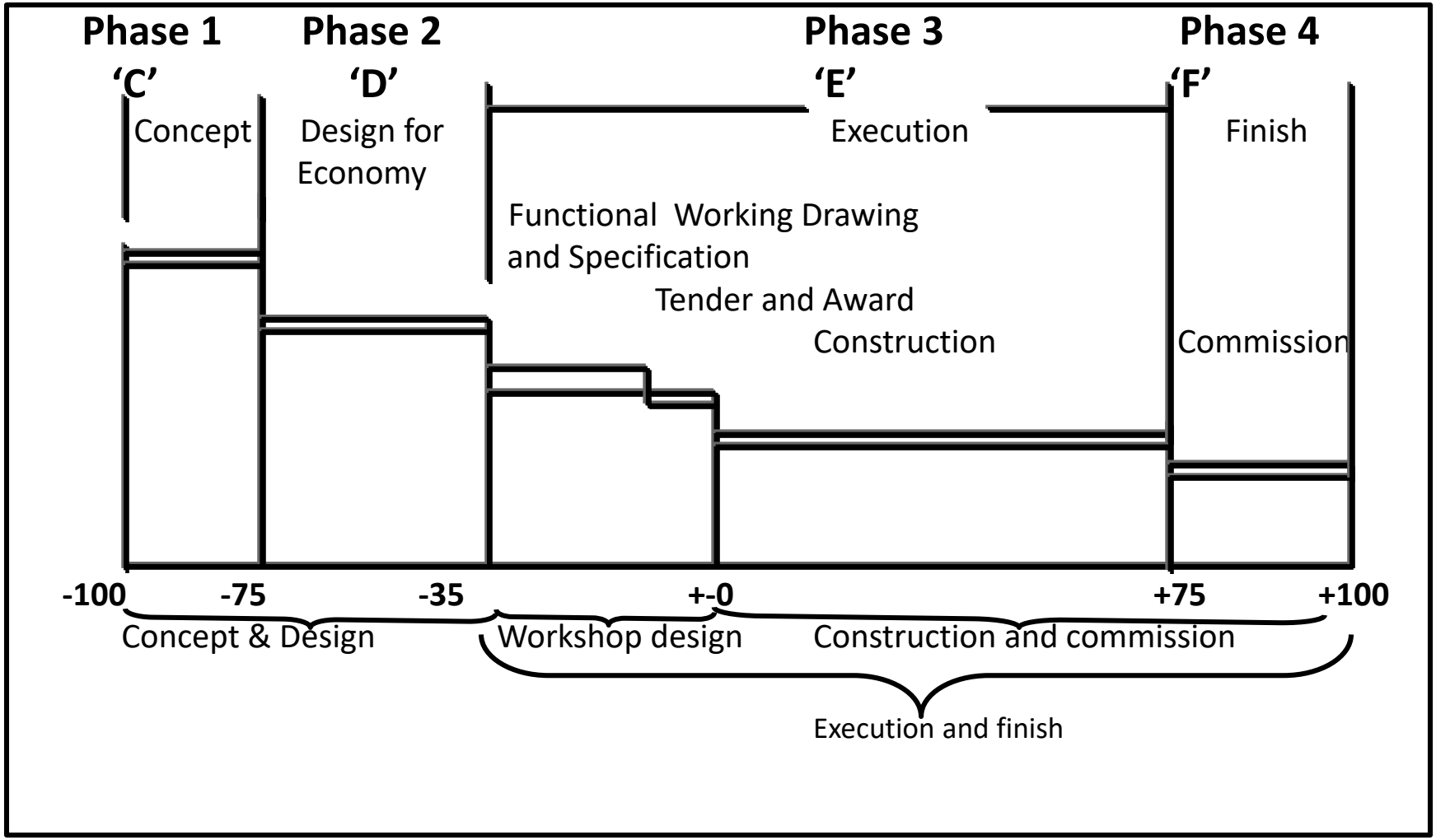
Continued--

Design, ‘D’ is for designing the accomplishments in paper, which is also known as table works, considering available resources and fund economically. It is also understood design for constructionability. It can be part of contract work also.

In it, sometimes all working drawings are also prepared, which are liable to change during construction because of time variation.

Execution, ‘E’ is for execution of the construction works. It is either done through Amanat or through Contract as per Government of Nepal. Shop or working drawings are some time prepared herein

Finish, ‘F’ is the finishing works which includes finalizing the contract works both financially and physically and handover and takeover or commissioning. Also, it si a final certification by the engineers.



1.2 Scope of Construction Management

In developing countries like Nepal, construction activities as in the form of infrastructures is of utmost important. Without construction, infrastructures can not be developed and without development of infrastructures, development activities can not be started. Following can be some of the scopes of construction management-

1. Construction is a fundamental function of development in any country. So it is necessary to manage it properly.
2. In Nepal, about 10% of total GDP is covered by construction, Proper management can increase it.
3. Construction works give millions of people employment,
4. Construction from the very civilization step of human being has been one of the important major functions, and has been coming since then.

Continued--

5. Construction is by its nature involve lot of budget and the budget must be spent in the right work,
6. Construction involves many stakeholders like owner, contractor, consultancies, all of them seek their roles and contributions rightly invested, and this can be done only through CM.
7. Because of construction, it is likely to bring natural imbalances and severely affecting the environment, as a result, human beings survival may be endangered in due course of time, and hence CM is necessary,
8. Documentation and keeping ther stakeholders on their right roles is one of the human parts of roles of CM,
9. Timely completion is one of the major factor needed in construction, which can be attained onlly through CM.

Continued--

10. As the construction work costs millions of rupee and it it defers from the estimated cost, its amount becomes millions, which is very hard to finance, so it is necessary to manage properly,
11. Quality work is very necessary in such multimillion projects, which are done once in a life time for most of the people. Considering it, it scope is extends even in quality control of the construction.
12. As the project involves many stakeholders, and as their interests are different, which in due course of time present distinct differences arising misunderstanding and they by a slim chance of ceasing the work, and hence coordinating and even supplying true technical data to the court is construction management.

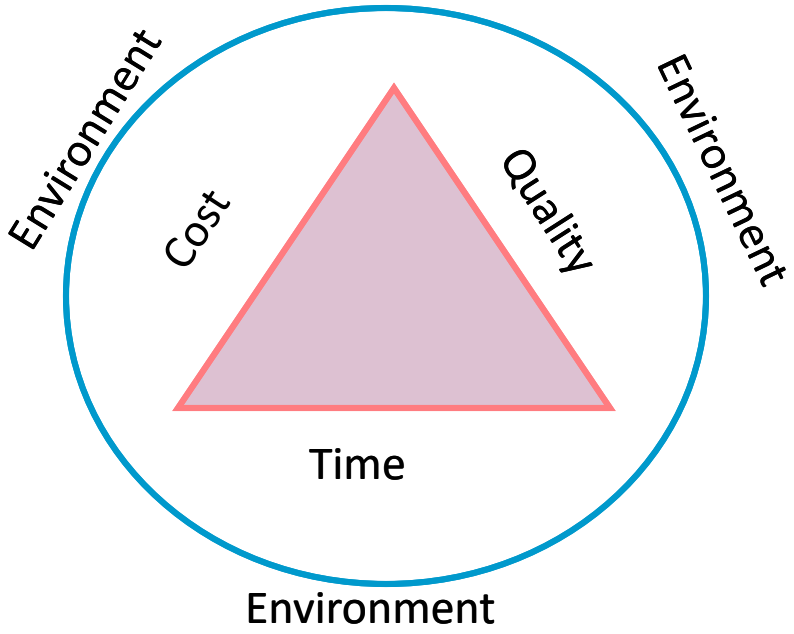
There are many others scopes of construction management.

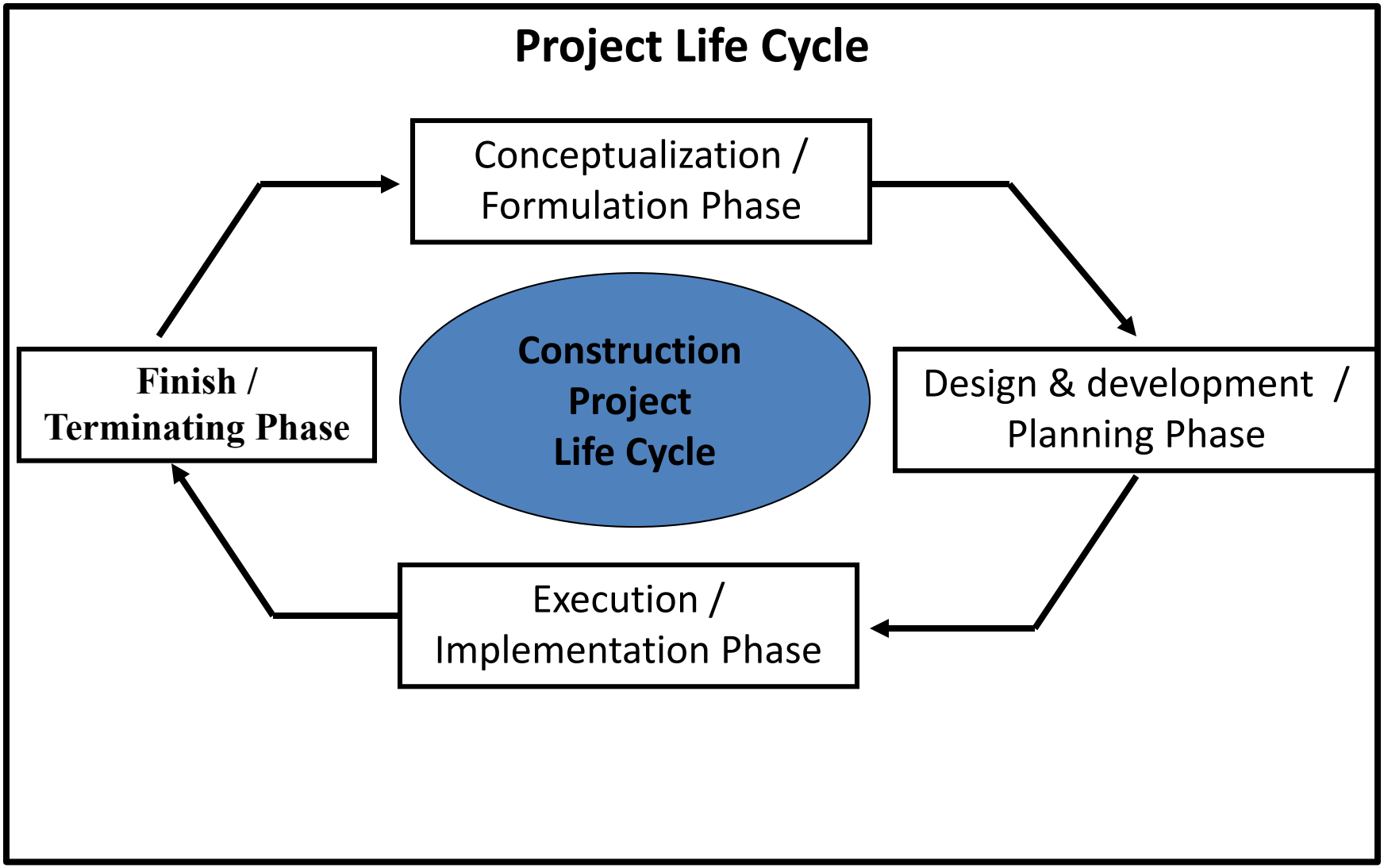
1.3 Construction project Characteristics

Construction works are temporary projects. As the projects are time bound, budgeted and a anticipated quality standard to be accomplished in an open environment satisfying all stakeholders, it also bears all the characteristic of a project as follows-

a. It involve many stakeholders like owner, consultant, contractor, supplier, financer, users' groups etc,
b. It takes long preparation time and long execution time,
c. It is sold before it is built,
d. It involves many skilled trades,
e. Quality is controlled through specifications materials, labor and process,
f. It functions in an open environment,
g. Money, time and quality are interrelated.

A project can be shown in the following figure with its major elements-





1. **Conceptualization / Formulation Phase**

Project formulation phase is performed by-

1. Project identification task, and
2. Project formulating task.

Identification of Project can be made from **internal sources** and **External sources**.

Following can be the internal sources-

- corporate objectives, National Planning Commission's projection or budget from Financial announcement at the end of each fiscal year projection
- Problems / opportunities identified by the management / R & D,
- Suggestions made by Task force, committees or quality circles.

Following can be the External sources-

- customers' needs, e.g. client specifies need-based projects,
- Donor agencies may identify projects to suit their aids,
- Outside consultants / experts may suggests ,
- Politicians may speak out some projects to serve the interests of their constituent people,
- legal provision or government regulation mandatory works,
- Technological development may demand change

Project formulation task is done by –

writing a broad statement defining the objectives and outputs of the projects, and

Preparing preliminary estimate of schedule and resource allocation required to achieve the project objectives is performed. These are done by conducting Pre-feasibility study and preliminary design of the project.

2. Planning Phase

In this phase, the following three tasks are performed -

- ❖ Feasibility study,
- ❖ Appraisal of the project, and
- ❖ Detailed design and drawing.

In feasibility study, the implementability of the project is examined. The areas of examining the project are-

- Technical analysis, whether technical specifications are met or not
- Financial analysis, financial sustainability meaning capital needs and capacity to meet financial obligations,
- Management analysis, adequacy of management system to direct and control the project,
- Marketing analysis, project capacity and market demands and sales forecasts,
- Economic analysis, contribution to the national economic or to the benefits of the society.
- Environment analysis Impacts of the project on the environment, legal compliances to environmental issues.

Feasibility study should base on accurate and reliable data and information.

Project appraisal is the evaluation of project for its ability to succeed. The findings from feasibility analysis are appraised. While appraising a project, the following two aspects are focused-

- Ability of the project to achieve the objectives set before,
- Comparability of the project with other projects in terms of investments, costs/benefits, job creations etc.

Donor agencies usually employ special missions for project appraisal.

Projects selected after appraisal are approved by competent authority. Approval involves the following functions-

1. Finalization of funding proposals, agreements and contract documents,
2. Allocation of resources to the project, and introduction of appropriate regulations for the project.

It involves –

- Preparation of blue prints, specifications, facilities and equipments [Preparations of drawings, facilities and equipments]
- Implementation plans and work schedule [plans for implementations and the date for executing them]

The tasks required at this phase are-

- preparing operation plans and performance standards [detailed plans for each activity at pre determined quality standards are set],
- Allocates responsibilities to people or party [work breakdown and organizational breakdown and corresponding levels are determined]
- Determines activities and resources [activities are worked out and required resources are allocated to them] , and
- Sets down work schedules [preparation of work schedule at activity level].

It is a phase in which designs and plans are implemented to get a physical reality. It has two tasks-

1. Implementation, and
2. Control.

Implementation task concerns with the mobilization of resources to get activities performed. For this, an organization setting is necessary in which people and technology and line of control is established.

- People in the organization at various levels are provided with tasks,
- Decisions are made about the procurement of equipment, resources and services,
- MIS is set up,

- Project manager is assigned job to motivate and lead the people in the project,
- Time schedule of activities are prepared for implementation,
- Project plans are pursued and adjustments are made.

Control task-

It involves supervision and control of project performance and feedbacks are adjusted to meet the time, quality and cost targets. The following techniques are used-

a. Techniques such as Bar Chart, CPM, PERT etc are used,

b. Monitoring of the project performance is done,

Monitoring tasks gather information regarding constraints of the progress and adopt corrective measures to meet the set targets.

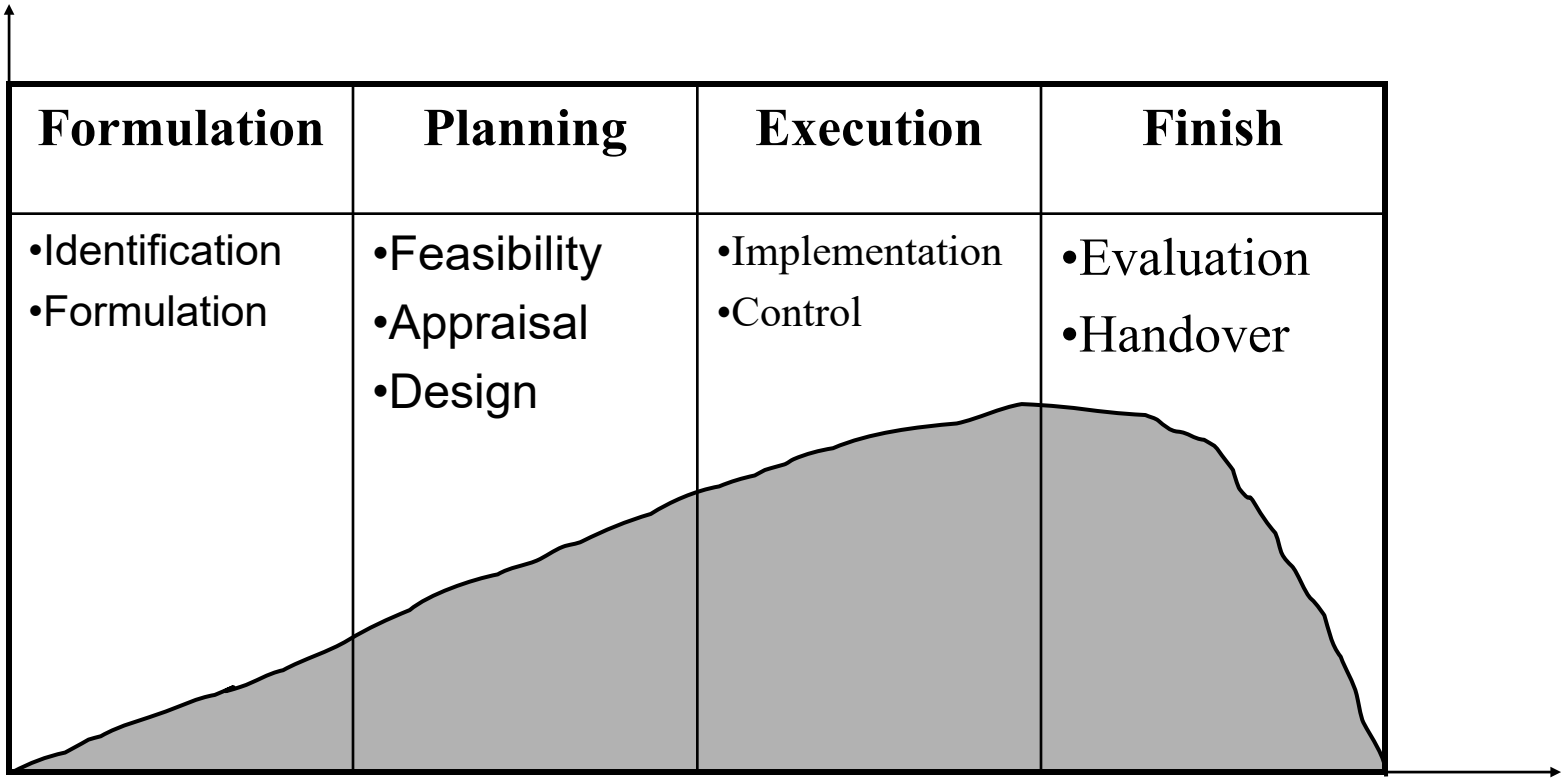
This is the last phase of the project. It includes the following tasks-

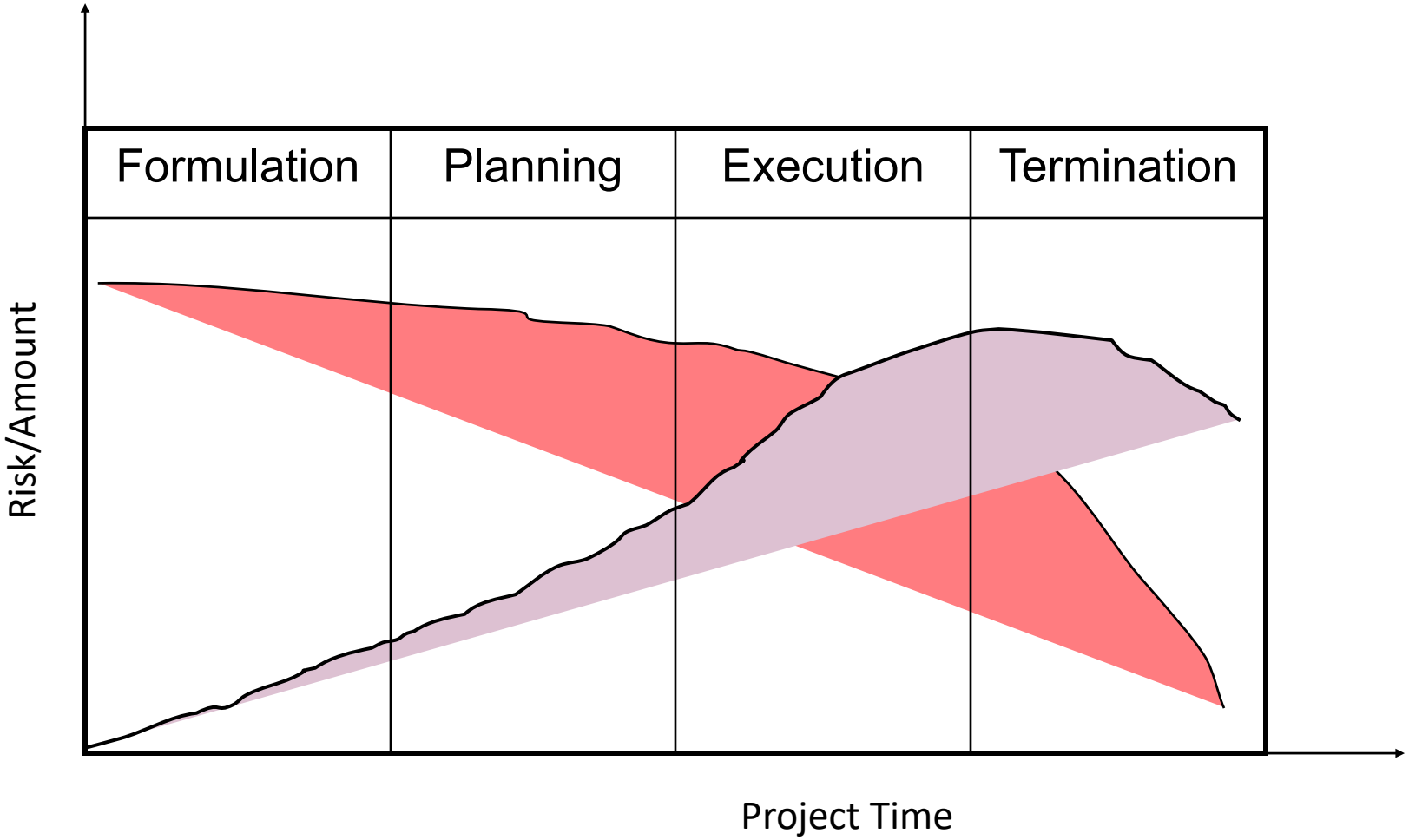
- Project evaluation, and
- Project Handover.

In evaluation, effects and impacts of project are analyzed. It can be during execution or after the project completion. Those effects and impacts are considered in the future projects formulation.

In handover task, completed project is handed over to the client or any organization. The project organization is dissolved thereafter.

Resources remained from the project are allocated to other organization and a permanent project records are finalized.





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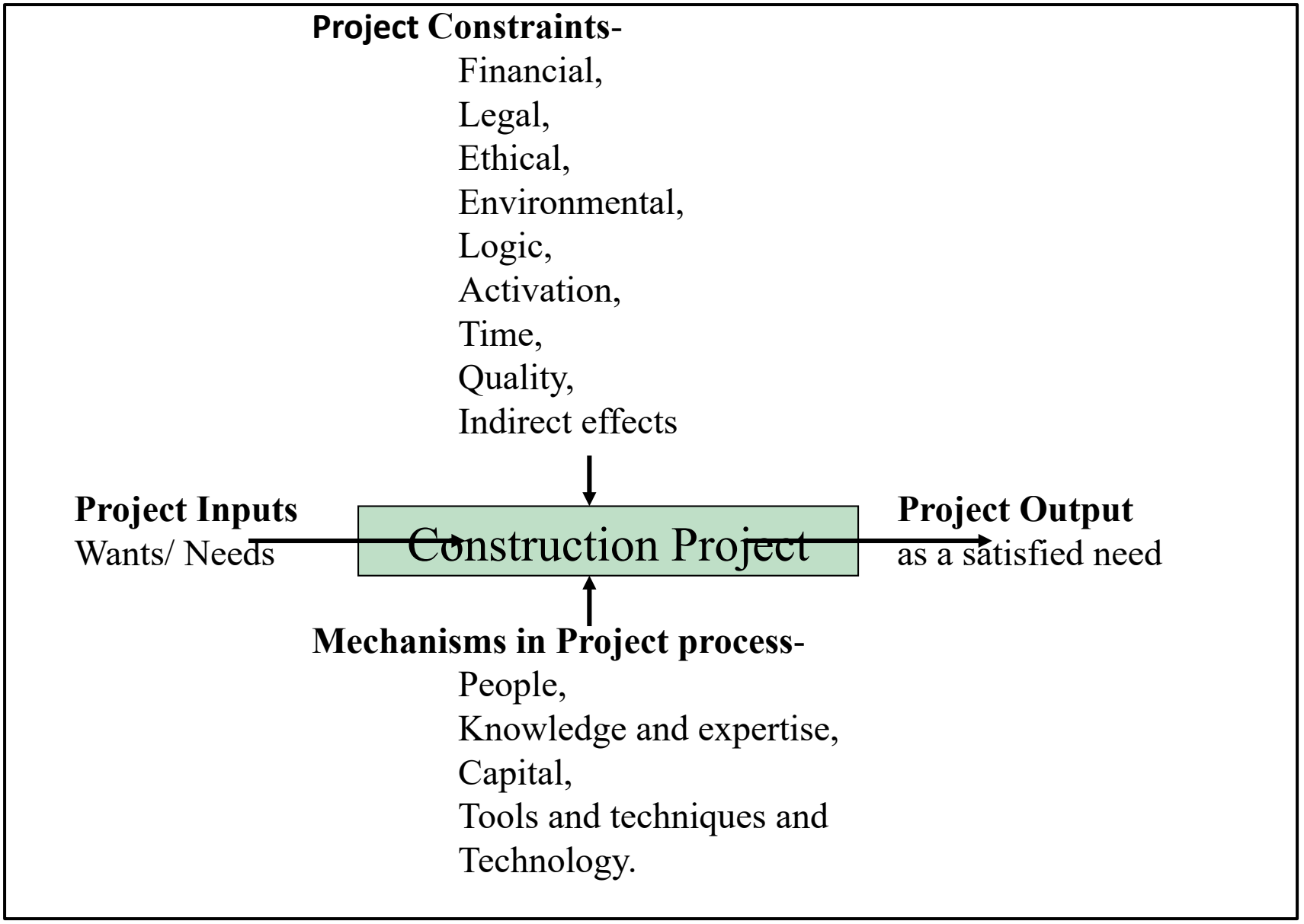
1.5 Construction project management

From above description, construction management project is a time bound, budget limited and anticipated quality standard maintenance project mobilizing all sort of resources required for the construction.

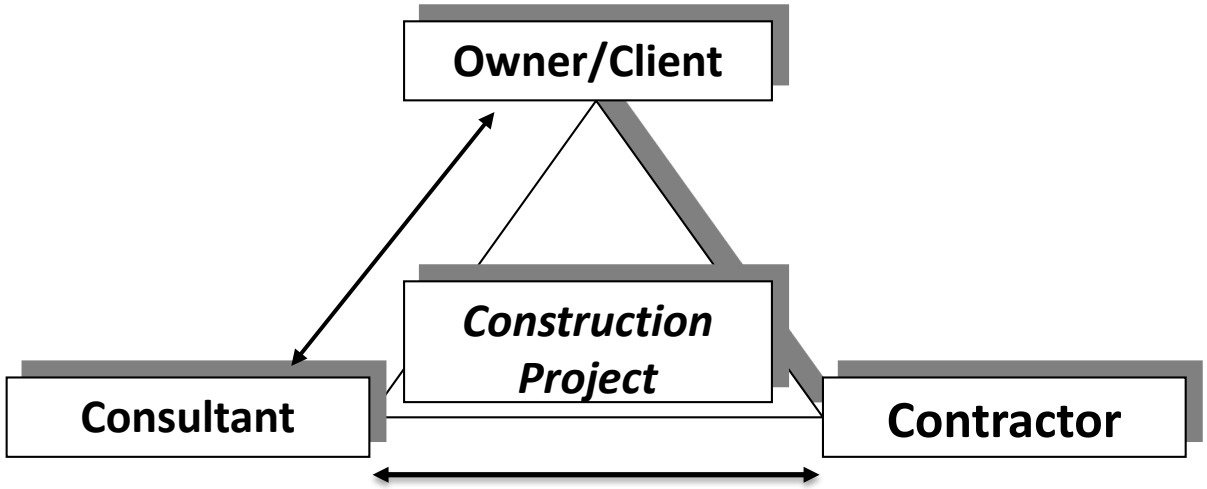
As human resources are required to mobilize effectively so that timely attainment of the project can be made. Extra or additional cost results from the delay in any stages of the construction. Human relations to effectively attain the objective becomes important.

The quality standards are written in specification of both detailed and brief. Specification specifies how to do the task and also when to make payments.

Condition of contracts describe how to resolve claims or clarifies misunderstandings between the major teams of construction. Documentation when and where required must be supplied by engineers. The following are some constraints that Construction Management has to manage-



A construction demands multi trade human resources, multi folds of materials at different stages, remaining within the allocated budget and financial functions need to happen at the right time. So, the construction team is generally comprises of the following parties of 3Cs-



Relationship between client, consultant and contractor

- Owners or Client (C),
- Consultants (C), and
- Contractors (C)

Owner or Client: This party approves the concept of construction, pays the bills of construction works and utilizes or start up the facilities for benefits. Its roles are-

- Pays the bills of the work performed,
- Decides and approves changes if any in the project,
- Approves the quality of materials and construction,
- Fixes the project times,
- It instructs the consultant for quality correction for him,
- Decides the start up date and owns the returns from the cervices or facility

Consultants: The client hires the consultant to perform engineering works for his side. Whatever engineering decisions are taken, it is the consultant at first to accept them and then to convey to the owner for final approval. Its roles are-

- Design and plans the facility for the owner for construction,
- Control the quality of work for the owner,
- Approves the technical aspects for the owner,
- Instruct the contractor for any change for the owner,
- Recommend the bills for payment to the owner

The contractor is bound to carry out construction work as per directions and instruction of the consultant. The instructions issued by the consultant make legal bases for payment. The contractor has the following roles-

- Constructs the facility as per design and drawings,
- Obeys the changes instructed by the consultant in written on behalf of the owner,
- Prepares bills of his work and submits to the consultant for the recommendation to the owner for payments,
- Improves and rectifies the defects,
- Clears taxes and prepares bills for the finals etc.

Chapter-2
Construction Planning and scheduling

2.1	Construction Planning – Introduction
2.2	Steps and stages of Planning
2.3	Planning by contractor and client in different stages,
2.4	Preparing schedule,
2.5	Time Cost trade off

Planning: Planning is a process by which managers set objectives, assess the future , and develop courses of actions to accomplish these goals (Boone and Kurtz, P. 119).

Planning is predetermination. It is the process of setting goals and choosing the actions to achieve goals (Agrawal, P. 85).

Planning conveys the following three meanings-

a. It bridges the past experiences and the proposed future actions for favorable functions,

b. b. Precautions are taken to minimize undesirable effects or unexpected happenings and thereby eliminating confusions, waste and loss of time and increasing efficiency and resources,

Continued--

c. t is a predetermining and specifying the factors, effects, forces and relationship necessary to accomplish the desired goals.

The purposes of planning can be holistically summarized in the following four purposes-

1 To eliminate uncertainty of the future activities,

2 To improve efficiency of the operations without loss of efforts and confusion,

3 To obtain better understanding of the objectives so that every efforts are targeted towards achieving the goals, and

4. To provide bases for monitoring and control during implementation of the plans.

Continued--

For a operational plan the following nine elements are necessary, without any one of them makes the plan ineffective-

1. **Objective**
2. **program**
3. **Schedule**
4. **Budget**
5 **Forecast**
6 **Organization**
7. **Policy**
8. **Procedure , and**
9. **Standard.**

Continued--

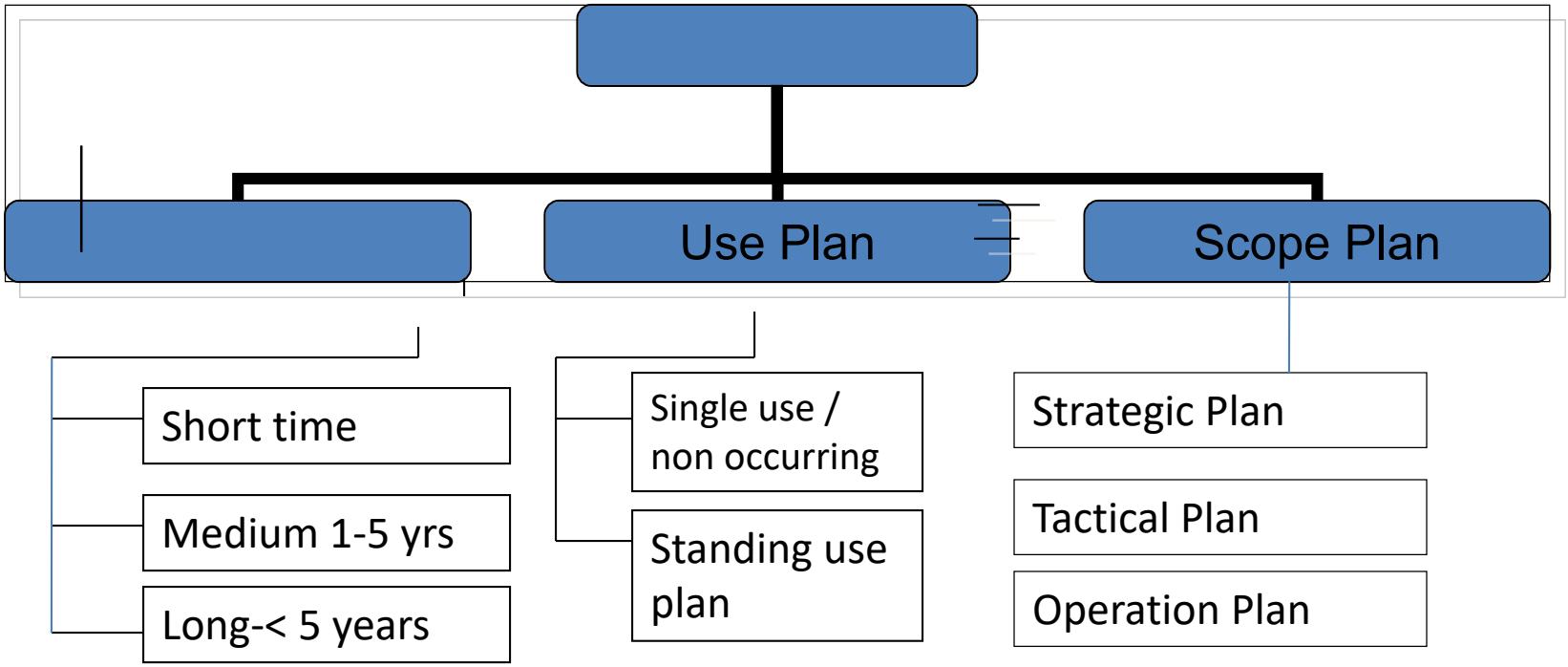
Objective: Objectives are the destination at which the project has to be completed. It may be cost, quality and time constraints. Therefore, if an objective of a plan is to meet the above constraints, the active stakeholders shall be aware of them and the plan fulfills.

Program: Programs are the actions to taken by various involved people in the project. Programs' fulfillment leads to successful completion of the project. These are various activities to be done.

Schedule: The programs must be laid on the time scale. This schedule indicates what activity has to start and what should be completed at what time.

Budget: nothing is free, so, budget for each activity is necessary from which loss or gain can be computed. Budget plan is a must for any work to be performed.

Plans are categorized according to time, use and scope of plans. The plans are accordingly called as time plan, use plan or scope plans. They are also differently categorized as follows-



2.2 Steps and stages of Planning

Planning activities require the information of availability of resources – human and non humans. Human resources may be skilled or unskilled manpower. Their tasks of their excelled work must be known.

Similarly, nonhuman resources may include machines, money materials etc. Their task or quantity of work per unit time is necessary to know so that total amount of the resources can be known while planning.

The technology is another factor to be considered. Technology affects the efficiency of performance. Therefore, following may be the stages of planning for construction work-

1. Estimate of the work, 2. Task or capacity of doing work,
3. Information of the locality available resources, and
4. Financing or Allocating resources..

Continued--

Estimate of the works, which are obtained from estimation of various works involved from design and drawings. In it, the quantity of different items of work, the quality of the work, the unit of measurement and the rates per item of works are ascertained.

Task or the capacity of doing work by a skilled man or machines is determined in the Norms- Nepal. The capacity, the situation and the possible height are presumed. That cannot be changes and is changes are necessary, that should be approved from one senior above.

As the rates of items of works are determined considering the availability of various resources, that should be assumed accordingly while planning for successful implementation.

Continued--

Financing is another factor that should be paid attention while planning. Usually financial planning is done prior to execution.

It is necessary sso because huge amount of budgets are incurred while executing and most of the workers are dependent on the wages they earned. At the same time, the builders are executing construction works under loans / advances from various institutions and whenever they submit the bills of the work done, usually it is necessary to make payment within a month or so, otherwise delay in the progress of work results.

Therefore, finance planning must be done accurately. It will state at what time or period of project, what amount of money for payment shall be required and accordingly, the manager or owner shall make arrangements.

2.3 Planning by contractor and client in different stages,

Planning by Contractor:

Contractor also known as builder need to synchronize the available every resources so that the dynamism of the work progress accelerates day after day till it completes. Major resources need to be made available at site, possible at the form of JIT (Just in Time) to save expense of storage and quality degradation due to poor storage.

At the same time it needs to keep good relation even with the local people at the site. In case of large projects, the contractor needs to manage its labors for schooling, health care and other recreation centers for the people involved in it. Various materials, in case the contractor has to supply and build the work, needs to develop proper procurement system to secure nebefits.

Continued--

Summarizing the planning of a contractor, the following can be done-

1. Prepare construction detail plans if necessary from the master plans to suit the available resources,
2. Allocate time for delivery of materials at site,
3. Manage adequate skilled manpower for the required time period in the site,
4. Coordinate with the local authorities for felling any trees, water supply arrangement and electricity and telephone,
5. Labor planning is another work of plan at site so that every attended workers get work,
6. Fabrication of D & W and others like truss arrangement,

Continued--

With the list of actions and the time required for delivery are worked out from the contract schedule, action Plans are based upon-

a. resources available, - manpower, materials, equipment etc available in the project that can be efficiently used,

b. time allocated to each tasks, - time available for each task from the master plan are allocated to each task, but if the task is larger than the time available, double or triple shift or increase of resources are arranged,

c. attainment date of each tasks- if the dates of attainment are nearer of the task, it may need extra resources or extra time or additional resources so that performance can be speeded up.

Continued--

The difference between the planning by client or contractor is that the plans of clients are usually of milestone plan, in which events are indicates for achievement, whereas the plans of contractor is of operational type in which activity are given priorities and accordingly events are met.

Events are the attainments whereas activities are performed to attain the events. Master Plan and Milestone Plans are Clients' plan, whereas other types of plans like activity Bar charts are contractor's plan, in which start and finish times are distinctly indicated. In case failures occur in attainment of start and or finish of any activity, extra resource mobilization is the only way to keep up with the master schedule.

Planning is a preparation of schedules. Schedules are the laying out the activities of a work over the time available for completing it. The following can be the steps for preparing a schedule-

1. Usually the activities of a work / job or projects are broken down into smaller activities through a work breakdown structure (WBS) so that they can be performed with a single skill.
2. They are prioritized in the first performing activities.
3. A start date of the work is determined.
4. From the start date, first prioritized jobs are laid in the start time and the rest accordingly in the corresponding times.
5. It can be laid either in a tabular form or in a bar chart with distinct start and finish date for each job.
6. The dates are usually the calendar dates.

Every construction works consume various resources like materials, machines, time and manpower of different skills, kinds and sizes. All of those resources required for a particular job cost a lot and also may not be available at the required time instantly, hence scheduling is necessary to make available the resources.

Hiring, borrowing and employing scarce resources for its requirement in the work requires scheduling so that on the time of requirement, it can be made available at the site.

Also, it gives a precautionary indication of ordering, inspecting and moving to the site of the required resources and estimates accordingly can be made to acquire total budget.

There are various techniques of scheduling of activities of a project, among them Bar-Chart, CPM and PERT are some important ones in practices –

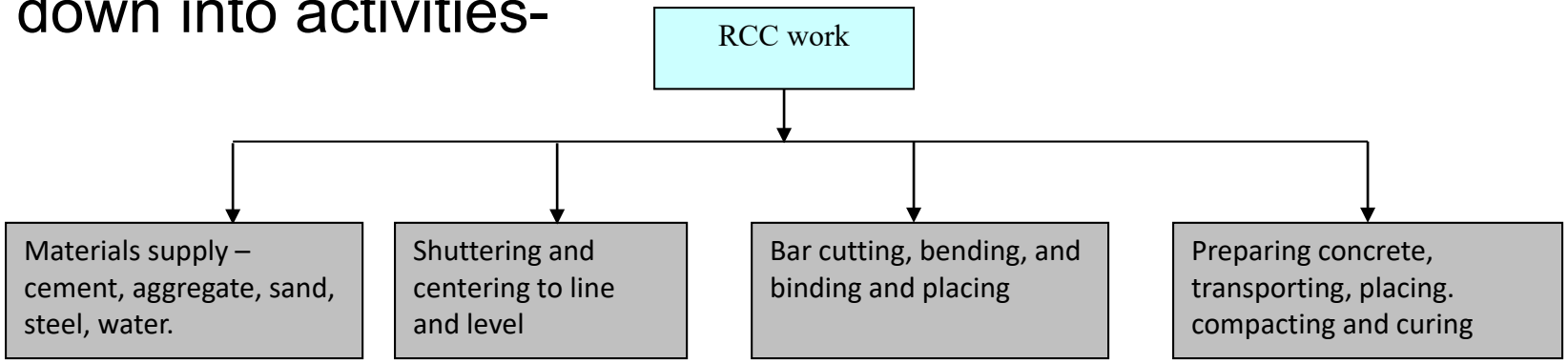
Bar-Chart:

Bar chart was first developed by Henry Gantt, who was an associate of the Father of Scientific Management – F. W. Tailor in the first World War. It was long time till 1955 that there was no significant development in scheduling from the Bar chart.

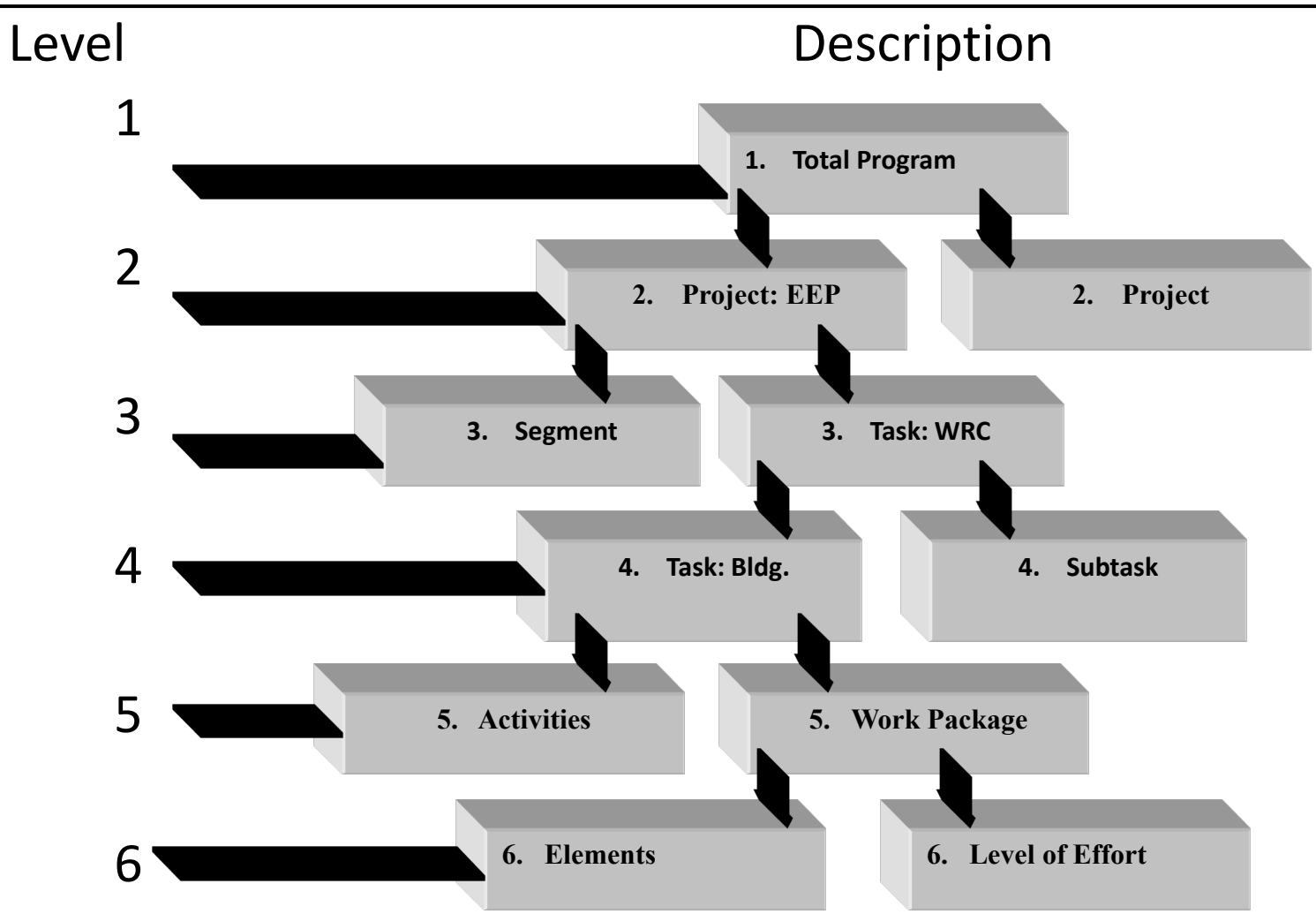
Bar Chart is a pictorial representation of the activities drawn in a thick horizontal bar (line) against a calendar date or time sale. It shows the start date and end date of proposed activities drawn across time scales. Times scales are drawn with vertical lines distributing horizontal time span in a time unit considered. The activities are obtained from Work Breakdown structure.

"Work Breakdown structure is a systematic and disciplined approach for breaking down a project into its many components and sub-components"

Work Breakdown Structure groups project activities in hierarchical order for each stage of the project. The Project work is broken down into smaller activities, which are measurable, manageable and Integra table in total package at the top. An example of RCC work broken down into activities-



The work breakdown structure (WBS) acts as a vehicle for breaking down the work into smaller elements, thus providing a greater probability that every major and minor activity will be accounted for. Six levels indentured structures as shown below:



Hierarchical order of WBS

Following can be steps for preparing a bar chart-

- Break down the project in to a number of activities that require separate knowledge and skill to perform and can be individually performed,
- Considering the available resources and time provision for the project, allocate each activities a reasonable time for doing them,
- Note the start calendar date of the project and work out to get calendar dates for each of the activities,
- Consider the calendar dates of each of the activities for favorable climatic condition for performance,
- Also note those activities which can be started independently without considering predecessor,
- Also consider resource utilizing up to a reasonable level without over or under loading the project with them.

7. Write each activity under activity column systematically as per construction proceeds and draw a bold line under time scale column up to allocated time provision.
8. The bars, also known as activity bar, can be drawn parallel with different color to show performance.
9. Previously completed activities and following activities to them can be linked with a line and arrowhead. Example

SN	Activities	Time allocation
1	Materials (cement, sand, aggregates, steel)	2 weeks
2	Shuttering and centering,	2 weeks
3	Cutting, bending, placing and binding reinforcements,	3 weeks
4	Concrete mixing, transporting, placing and compacting	1 week

Starting Date: Falgun 1, 2059 BS

Activities	Weeks					Remarks
	1	2	3	4	5	
Materials (cement, sand, aggregates, steel) supply	2/11					
Shuttering and centering,	3/11					
Cutting, bending, placing and binding reinforcements,		14/11				
Concrete mixing, transporting, placing and compacting					1/12	

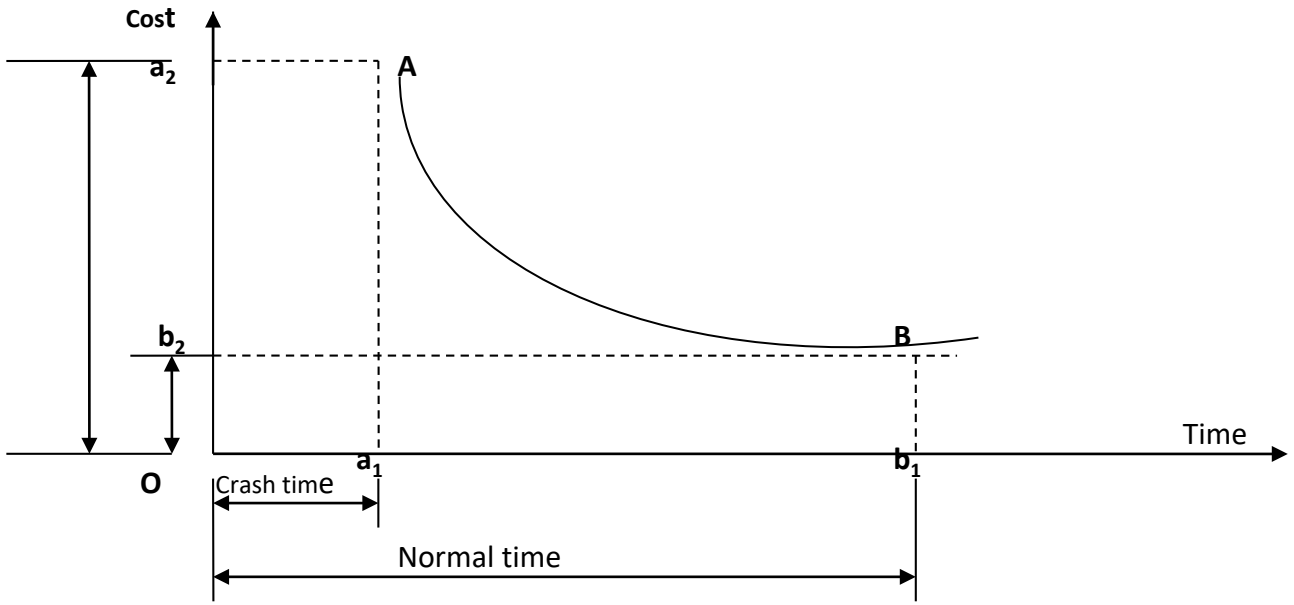
When cost is reduced, certainly time will to some extent increase and when time is shortened, certainly cost will increase. Both of these two resources cannot be reduced together. Also, the client may sometimes want to shorten project time without mattering cost and at some time in other project, the owner may want to reduce cost whatsoever the time will be taken up. Any project cost comprises of the following two components-

a. Direct cost that decreases with time increase, and

b. Indirect cost that increases with the time increase.

The total cost curve can be obtained by combining the direct cost curve and indirect cost curve as shown below.

Normal and Crash time relationship of an activity –



The shape of the curve **AB** reveals that the cost completing the activity cannot be reduced below '**ob_2**'even if more than '**ob_1**'is allowed. Also, the duration of activity cannot be reduced below '**oa_1**' even if we prepared to spend extra amount (probably more than **oa_2**) towards speedy completion of the project.

Chapter – 3
Planning Construction Materials 5

3.1	ABC Classification of construction materials,
3.2	Materials wastage standard
3.3	Materials provisioning process
3.4	Materials Inventory Basics,
3.5	Inventory Planning process,
3.6	Application of Value Engineering in the procurement of materials,

3.1 ABC Classification of construction materials,

Stockroom inventory is classified into categories called ABC, (activities based classification).

"A" - items are the highest priority, the tightest control, frequent deliveries, close follow-up, and accurate records. Planning and Scheduling these parts utilize MRP (Material Requirements Planning), DRP (Distribution Requirements Planning, or EOQ (Economic Order Quantity) or other lot sizing techniques such as Lot for Lot. **10 % of the "A" items volume accounts for 70% of the total inventory value**

"B" - items are the priority when low or out of stock. Normal control is used and good records are maintained. EOQ and other lot sizing methods can be used effectively with these items.

Continued-

"B" items account for **20% of the total inventory value, and 20% of the inventory volume.**

"C" - items are the lowest priority, simplest method of control. Min/Max used for ordering. These parts are usually expensed, as there are no records for them. These parts represent **10% of the total value**, and 70% of the volume.

Managing Inventories by ABC:

ABC analysis is the method of classifying items involved in a decision situation on the basis of their relative importance. Its classification may be on the basis of monetary value, availability of resources, variations in lead-time, part criticality to the running of a facility, new customer partsunique to that product, and others.

Continued--

Management needs to look at a descending dollar and volume chart in order to make decisions on ABC analysis. Once the top dollar items of usage are identified, and its corresponding volume.

Parts can be coded by the proper classification. Through this report ABC analysis can begin and recommended lists on stock codes, inventory levels to maintain, obsolescence recommendations, and discontinued items can be determined. A typical ABC analysis is shown in the following example:

ABC Analysis (inventory)

In supply chain, ABC analysis is an inventory categorization method which consists in dividing items into three categories, A, B and C: A being the most valuable items, C being the least valuable ones. This method aims to draw managers' attention on the critical few (A-items) and not on the trivial many (C-items).

Prioritization of the management attention

Inventory optimization is critical in order to keep costs under control within the supply chain. Yet, in order to get the most from management efforts, it is efficient to focus on items that cost most to the business. The Pareto principle states that 80% of the overall consumption value is based on only 20% of total items.

Continued--

In other words, demand is not evenly distributed between items: top sellers vastly outperform the rest.

The ABC approach states that, when reviewing inventory, a company should rate items from A to C, basing its ratings on the following rules:

A-items are goods which annual consumption value is the highest. The top 70-80% of the annual consumption value of the company typically accounts for only 10-20% of total inventory items.

C-items are, on the contrary, items with the lowest consumption value. The lower 5% of the annual consumption value typically accounts for 50% of total inventory items.

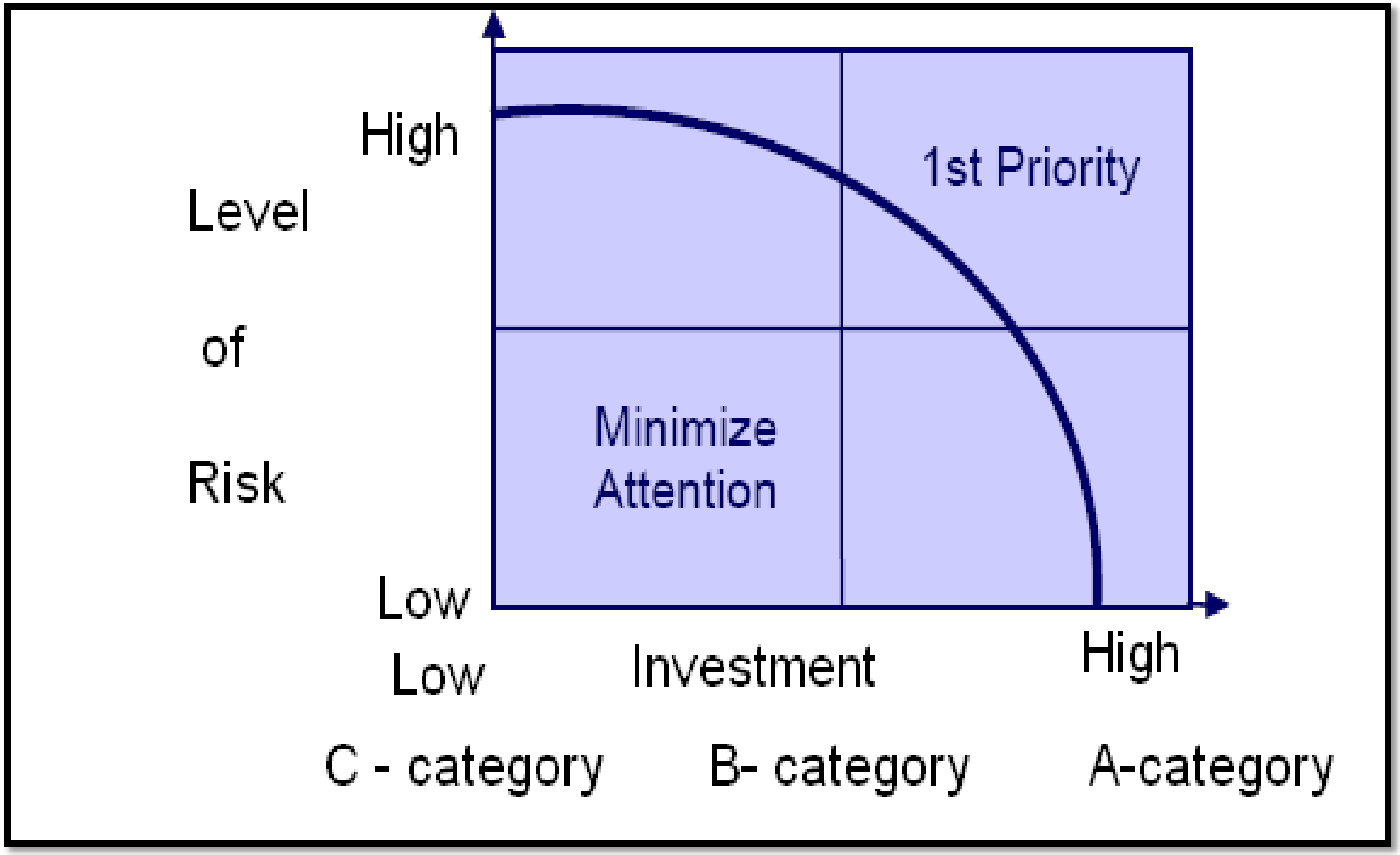
Continued--

B-items are the interclass items, with a medium consumption value. Those 15-25% of annual consumption value typically accounts for 30% of total inventory items.

The annual consumption value is calculated with the formula: (Annual demand) x (item cost per unit).

Through this categorization, the supply manager can identify inventory hot spots, and separate them from the rest of the items, especially those that are numerous but not that profitable.

Continued--

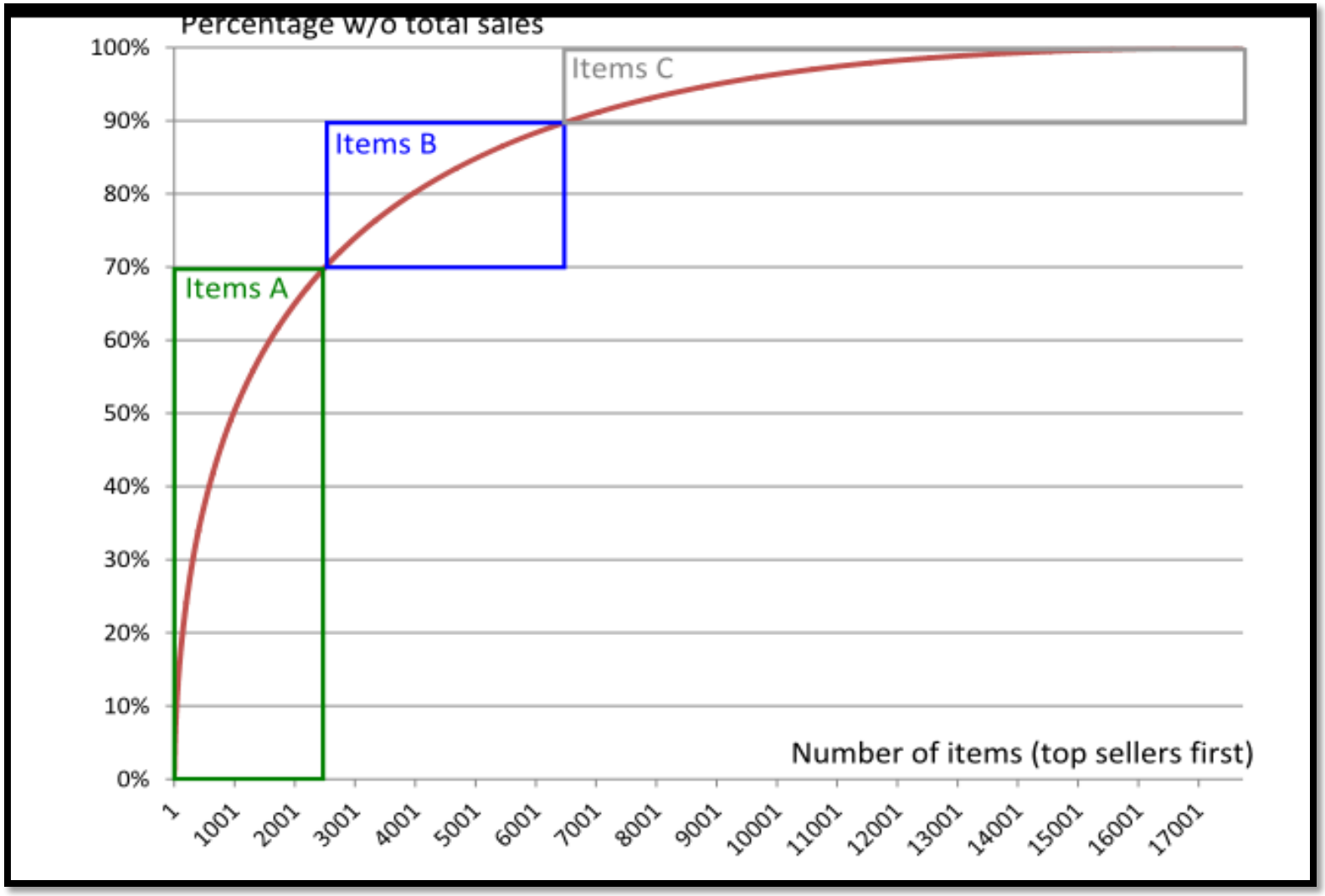

High
Level
of
Risk
Low
1st Priority
Minimize
Attention
Low
Investment
High
C - category
B- category
A-category

Continued--

The following steps will explain the classification of items into A, B and C categories.

1. Find out the unit cost and the usage of each material over a given period.
2. Multiply the unit cost by the estimated annual usage to obtain the net value.
3. List out all the items and arrange them in the descending value. (Annual Value)
4. Accumulate value and add up number of items and calculate percentage on total inventory in value and in number.
5. Draw a curve of percentage items and percentage value.
6. Mark off from the curve the rational limits of A, B and C categories.

eCommerce Example



Continued--

The graph above illustrates the yearly sales distribution of a US eCommerce in 2011 for all products that have been sold at least one. Products are ranked starting with the highest sales volumes. Out of 17000 references:

Top 2500 products (Top 15%) represent 70% of the sales.

Next 4000 products (Next 25%) represent 20% of the sales.

Bottom 10500 products (Bottom 60%) represents 10% of the sales.

Inventory management policies:

Policies based on ABC analysis leverage the sales imbalance outlined by the Pareto principle. This implies that each item should receive a **weighed treatment corresponding to its class:**

Continued--

A-items should have tight inventory control, more secured storage areas and better sales forecasts. Reorders should be frequent, with weekly or even daily reorder. Avoiding stock-outs on A-items is a priority.

Reordering C-items is made less frequently. A typically inventory policy for C-items consist of having only 1 unit on hand, and of reordering only when an actual purchase is made. This approach leads to stock-out situation after each purchase which can be an acceptable situation, as the C-items present both low demand and higher risk of excessive inventory costs. For C-items, the question is not so much *how many units do we store? but rather do we even keep this item in store?*

B-items benefit from an intermediate status between A and C. An important aspect of class B is the monitoring of potential evolution toward class A or, in the contrary, toward the class C.

Continued--

Splitting items in A, B and C classes is relatively arbitrary. This grouping only represents a rather straightforward interpretation of the Pareto principle. In practice, sales volume is not the only metric that weighs the importance of an item. Margin but also the impact of a stock-out on the business of the client should also influence the inventory strategy.

Procurement and Warehouse Applications

The results of an ABC Analysis extend into a number of other inventory control and management processes:

1. Review of stocking levels – As with investments, past results are no guarantee of future performance.

Continued--

However, “A” items will generally have greater impact on projected investment and purchasing spend, and therefore should be managed more aggressively in terms of minimum and maximum inventory levels. Obsolescence review – By definition, inactive items will fall to the bottom of the prioritized list. Therefore, the bottom of the “C” category is the best place to start when performing a periodic obsolescence review.

2. Cycle counting – The higher the usage, the more activity an item is likely to have, hence the greater likelihood that transaction issues will result in inventory errors. Therefore, to ensure accurate record balances, higher priority items are cycle counted more frequently. Generally “A” items are counted once every ¼ yr; “B” items once every ½ yr and “C” items once every 1year.

3.2 Materials wastage standard

According to the new production philosophy, waste should be understood as the output of any inefficiency that results in the use of resources in larger quantities than those estimated as necessary for the production of an item.

Waste indicates both, the incidence of resource and energy losses and the execution of unnecessary work. It generates additional cost to the product but does not add value to it. Therefore, waste should be defined as any losses produced by activities that generate direct or indirect costs, but do not add any value to the product from the point of view of the client. So the need of wastage minimization arises.

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Continued--

It is seen that in executing major Civil Engineering projects there happen to be wastages related to materials used for construction.

Construction material wastages can be defined as the difference between the value of materials delivered and accepted on site and those properly used as specified and accurately measured in the work, after deducting the cost saving of substituted materials transferred elsewhere in which unnecessary cost and time may be incurred by materials wastage.

Generally, the material cost contributes to about 40% of the total construction cost of which cement and steel account for 60% of that cost. Hence it is necessary to curb wastages in this area to have control over the economy of the project cost.

Continued--

It is observed that, 5 –10 percent of construction materials end up as waste on construction sites. It is reported that construction waste constitutes 26% of the total amount of waste produced in the Netherlands and 29% of the solid-waste stream in the USA . About one third of the waste contribution is done by construction industries, wherein these materials add to the cost of the project. R Navon, M.ASCE and O.Berkovich stated in their paper that as materials constitute a major portion of the project's total cost, effective control and management can increase the productivity by 6%. Wastage of materials though inevitable can be reduced to a lesser value, if the materials that form bulk of the project cost structure; it is to be efficiently monitored.

Continued--

This waste if minimized will help not only in reduction of project cost but also benefit the environment. Minimizing waste is an opportunity to increase profits.

The best way to reduce wastage is to not create it, firstly Various reasons that involve wastage include multiple materials handling, poor inventory control, untrained labour, rework and time related wastage (like in case of cement storage). Gavilan and Bernold organized the sources of construction waste under six categories:

(i) design;

ii). procurement;

(iii) handling of materials;

(iv) operation;

(v) residual related; and

(vi) others

Continued--

SPSS (Statistical Package for the Social Sciences) is a computer application that provides statistical analysis of data. It allows for in-depth data access and preparation, analytical reporting, graphics and modeling.

It can be used in Planning Department and for survey authoring and deployment (IBM SPSS Data Collection), data mining (IBM SPSS Modeler), text analytics, statistical analysis, and collaboration and deployment (batch and automated scoring services) Add-on modules provide additional capabilities. The available modules referred are:

SPSS Regression - Logistic regression, ordinal regression, multinomial logistic regression, and mixed models SPSS Correlation- Partial correlation, bivariate correlation

Continued--

SPSS Decision Trees. Creates classification and decision trees for identifying groups and predicting behavior. SPSS forecasting.

ANOVA (Analysis of Variance) and ANCOVA (Analysis of Covariance) Out of the above mentioned list of various versions of the software highlighted versions will be worked upon in the later part of the thesis to generate a correlation analysis and regression equations. For the case history mentioned below, analysis of wastage for different methods of concreting is done by mathematical calculation by Regression and correlation method. The outcome is compared with analysis done by SPSS software.

Continued--

A Regression and Correlation Analysis records are worked out against the estimated quantities as per approved drawing of components. The work involved construction of flyover with eight piers of which at present seven are completed. Data is compared to find wastages at stages to find the same in components (i.e. footings, piers, pier caps, box girders). We then use Correlation and Regression analyses to wastage causing various factors and compare the results using mathematical model.

The factors affecting wastage in cement were considered for different methods of placement of concrete The different methods are, placing the concrete to required point using: i) pump ii) buckets & iii) using chutes made of GI sheets, such that the concrete directly flows into the required place.

Causes of Wastage:

1. Changes in design at initial stages (DC): This factor can cause wastage because the design is not complete at the start of the construction activity for a project or due to error in contract.
2. Record keeping mistakes (RM): The records if not properly maintained will lead to wrong estimation of quantity of materials in stock and cause wastage.
3 Absence of authorities (A): Authorities are required to be present for works no matter how insignificant to supervise the labor.
4. Over ordering (O): Procuring excess quantity that gets wasted due to wrong interpretation of drawings also causes wastage.

Continued--

5. Unskilled labour (UL): This factor can also lead to wastage due to unskilled labour involved in construction of larger quantity of work like in case of piers or box girders.
6. Transit losses (TL): Wastage occurs due to transit loss where time is a factor and due to traffic conditions the concrete delivered is not fresh.
7. Excess handling (H): concrete once prepared should be handled as minimum and applied to the prepared surface as soon as possible as excess handling leads to wastage.

For reinforcement steel, instead of absence of authorities, transit loss, and over ordering: theft, cut pieces that cannot be used and short supply were added.

3.3 Materials provisioning process

Materials required for construction are worked out from the bill of quantity and design and drawings. Some times, from the brief specification can be a great help to work out the quantity. Rate analysis is another source of material provisioning. What types of materials and how much of it is required can be calculated from the quantity of the items of work and when is it required is worked out from the schedule of the project.

The schedule recognized by the consultant becomes the base schedule. During the time of consideration for provisioning, the kind of works or item of works are considered for execution, from those items of works the materials quantity are calculated. Accordingly the materials are provisioned for procurement and storage.

Continued--

Provisioning a kind of materials for a certain period of time, the kind of materials required during that period are worked out, summed up and scheduled for procurement considering the delivery at site.

The quantity of material arrived at referred to the new construction works. But many a times it is found that reconstruction or redo happens because of incorrect construction and as instructed by the site engineer.

Usually 5 to 10% of the total quantity of the materials are provisioned for those kind of redo. A properly and correctly executed works do not require additional materials and that controls quality of the work execution. As the quality standard of execution of work varies from work to work and site engineer to site engineer, the only way of saving redo is execution of works properly and systematically.

3.4 Materials Inventory Basics,

From the estimate or BoQ, material analysis is done to find out various materials and their quantities required for the project. From different parts of the project, the type of item of works that seek the same materials are grouped together to find total quantity of the materials.

Materials are recorded against its name and from the schedule of the project, the quantity of requirement of materials is worked out. In fact, after working out different materials required for the construction, they are scheduled for procurement. From it, procurement schedule is prepared in which needs are collected from different parts of the job and the jobs are located from the project schedule to find out the time in which those materials required for that can be worked out.

Continued--

Procurement schedules of materials are prepared to meet the job requirement. Accordingly, the procurement is made. Once when the materials arrive at the disposal point e.g. it may be construction site office or head office of the project, the store men required a certificate of inspection of the arrived materials from which the store man will make entry in the ledger book with the date, quantity and the cost.

- Construction works consume various materials to build up facilities designed and planned for construction.
- Materials are not available at the spot where and when required, so, procurement of materials initiates in construction works.
- Too early or too late procurement from the requiring date causes unnecessary expenses like proper storage, supervision and maintenance or running for collection and collecting without quality choice render the construction works.
- Delay procurement may hinder the construction works by not being able to provide materials to the workers in the right time.

Thus, procurement becomes an important endeavor in construction works.

The quality and quantity of materials are drawn from design, plans and specification of the facility. The quality of materials is indicated by designers and the quantity is estimated from the detailed design and drawings.

From the schedule of the project, when what kind of materials for the construction is required are drawn whatsoever the variety of materials are. Various types of materials for a particular time point are calculated and accordingly procurement is processed.

Procurement is initiated from the needs initiated at the construction site. Construction itself is procured before it is built simply because it is contracted for the construction. As large sum of money involves in construction, and as one construction is not similar to another, its procurement becomes risky and hence complex.

Process of materials procurement-

The logical flow diagram of materials procurement can be as follows-

1. Needs of materials collection from different sites,
2. Group them according to their specification.
3. Cross check the type and quantity of each type of materials,
4. Check if they are available in stack.
5. Decide the time of delivery of each type of materials,
6. Decide either to tender, shopping, direct procurement from manufacturing company, or simply to put order for delivery,
7. For tender, prepare specification that include quality, testing, inspection and inventory entry,
8. Prepare tender document for the supply and delivery.

Continued--

Once the materials are delivered at site on the speculated date, then the next step is to inspect for its compatibility to specification. An inspecting committee of expert in that areas is formed with TOR to submit the report as soon as possible to the procuring office. The report helps the store man to make entry into the materials' account - Main ledger book and sub ledger book also. Main ledger book contains the date of entry, quantity of materials, and its cost.

Sub-ledgers are used to record consumption of the materials on various jobs and the works on various dates on issuing process.

The report of the experts helps the account office to make payment . Unless a report of inspection of the delivered materials are made, payment and book entry cannot be made.

3.5 Inventory Planning process,

Inventory is a record of materials and goods of an organization in various physical state along with its prime cost and date of entry into the records. The records that are made for the materials and goods are known as ledger. The central store maintain the main ledger, whereas sub-store maintain sub-ledger. It records the incoming goods and materials and also outgoing goods and materials for consumption along with the site and date.

While planning any jobs, one should know the future activities. When the construction at site is rigorously on going, the maintaining of inventory becomes speedy also.

In planning, the demands are sought from different construction site and the time of requirement also.

the quantity of similar goods or materials are summed up to find the quantity required for that particular point of time and procurement is processed accordingly.

Chapter-5
Contract Management 6

5.1	Method of Work execution
5.2	Types of Contract
5.3	Tendering Process-Preparation before Tendering; Tender Notice; Tender Document; Conditions of Contract; Prequalification; Tender; Evaluation; Selection and Award

5.1 Method of Work execution

Works can be executed either through Amanat or through Contract. When the works are executed by the owner itself, by hiring workers and supplying materials and equipment, it is known as execution of work through Amanat.

The record of labor employed each day and the part on which materials and equipment if any employed is maintained in book keeping. The record will also indicate the progress of work also.

It is useful when the work is small and necessary to do immediately, and the expertise are available within the organization. It saves the cost required for making profit by the contractor and VAT also. It also keeps the staff busy in the work.

Work Execution through Contract

Contract is an agreement between two or more parties to do or not to do any work. It is legal and time bound. Offer and acceptance must be there.

In construction, there are two types of contract-

1. Competitive bid contract,
2. Negotiated contract.

1. Competitive bid contract: It is executed on the competitive bid basis. It leads towards low contract price but with high quality works. it is practiced two ways-

a. Lump or stipulated sum contract, and

b. Unit price contract.

Lump or stipulated sum contract- In this contract, a single sum of money pays for all parts of construction of a project.BOT, BOO and BOOT contracts are some examples.

Continued (additional)

Engineering, Procurement and Construction (EPC):

Under an EPC contract, the contractor designs the installation, procures the necessary materials and builds the project, either directly or by subcontracting part of the work. In some cases, the contractor carries the project risk for schedule as well as budget in return for a fixed price, called lump sum or LSTK depending on the agreed scope of work.

*When the scope is restricted to engineering and procurement, this is referred to as an **EP**, **E and P** or **E+P** contract. This is often done in situations where the construction risk is too great for the contractor or when the owner does the construction.*

The 'keys' to a commissioned plant are handed to the owner for an agreed amount, just as a builder hands the keys of a flat to the purchaser. (One should recognise that some EPC contracts terminate at Mechanical Completion but before Commissioning while LSTK contracts always include Commissioning.) EPC is gaining importance worldwide. It requires good understanding by the EPCC to return a profit. An owner decides for an EPC contract for reasons that include:

Continued--

1. *Reduced stress for owner*
2. *easy work and growth of the company.*
3. *Single point of contact for owner simplifies communications.*
4. *Ready availability of post-commissioning services*
5. *Ensures quality and reduces practical issues faced in other ways.*
6. *Owner protected against changing prices for materials, labor, etc.*
7. *Cost is known at the start of the project*

Besides the plant siting, in an EPC contract the owner defines:

1) *Scope and the specifications of the plant*
2) *Quality*
3) *Project duration*
4) *Cost*

The cost (the price to be paid to the EPCC) is negotiated and finalised and paid in mutually agreed installments.

Continued--

Functions-_

a. Engineering Functions

- *Initiation*
- *Planning*
- *Estimating -> Request for Quote*
- *Design*

b. Procurement Functions

- *Purchasing*
- *Expediting*
- *Receiving*
- *Invoicing*

Continued--

3. Construction Functions

- ❑ *Construction Schedule*
- ❑ *On-site Material Handling*
- ❑ *Building Activities*
- ❑ *On-site Client Communications*
- ❑ *Closing*

Owner and contractor liabilities:

Once an EPC contract is signed, the EPC contractor becomes liable for completing the project according to the tender conditions. The EPC contractor, in turn, may hire sub-contractors or sub-vendors to complete different portions. Payment commensurate with the work completed (in addition to an advance) is normally preferred by a contractor.[citation needed]

Continued--

Projects are more likely to succeed when the owner:

- *Defines guarantees well*
- *Defines scope and quality very carefully*
- *Defines milestones meticulously*
- *Defines LD/penalty clauses*
- *Makes payment terms very specific*

The contractor also has ways to improve project success:

- ❖ *Adopts similar terms and conditions as owner regarding quality, guarantee etc., for subcontracts / vendors*
- ❖ *Do not keep terms open-ended*
- ❖ *Coordinate vigilantly to reduce chances of errors at site.*

Continued--

Global arena

An EPC contract is a complex agreement. In a global context, EPC management is more complex. The EPCC must have data and expertise in all the required fields. Some important areas are:[citation needed]

- *Local market conditions for materials and labour availability and capabilities*
- *Local code, statutory etc., requirements*
- *Availability of local supervisory personnel*
- *Availability of local engineering services*
- *Local and global subcontractor experience and performance*

Continued--

Cost certainty: One main reason an owner may prefer an EPC arrangement is "certainty of cost". An EPC contract binds the Contractor to deliver the project at a firm, predetermined price regardless of any increase in costs that the Contractor may incur after the contract is signed. However, changes to specifications initiated by the owner (better finishes for example) may be incorporated through a "change order". Here, the owner and the Contractor negotiate the price to make the changes and these changes/prices are recorded in the change order document.

Owner responsibility: To ensure quality, the owner must select an experienced EPC contractor. A third-party or in-house consultant can verify the design of major structures and inspect the main equipment installations.

Changes in scope of work can affect project schedule, cost and risk. Such changes are the responsibility of the owner.

Continued--

Unit Price contract- Rates are quoted for each item of works. As the bill of quantity (BOQ) is presented in the bid document, the final amount is worked out by adding the amounts of each item of work for comparison.

2. Negotiated contract: If the owner wishes to assign the construction work to a reliable party through a dialogue, it is then termed as Negotiated contract. The owner is free to select any party. FAR does not rule Negotiated contracts. They are of the following types-
    1. Cost + percent of cost,
    2. Cost + fixed fee,
    3. Cost + Fixed fee + Profit sharing clause, and
    4. Cost + sliding fee.

Continued--

1. **Cost + percent of cost**:
   Lucrative to the contractor,
   Possibility of increasing construction cost,
2. **Cost + Fixed Rate**:
   Possibility of delay in competition of the work,
   quality may be affected.
3. **Cost + Fixed fee + profit sharing clause:**
   Encourage the contractor to control cost on the work,
   owner need to be aware of the quality of work,
4. **Cost + Sliding fee**:
   It is presented by the following-
   Contractor's fee = R(2T-A), where, R = base %age rate allocated to the contractor, T = target / estimated cost, and A = Actual cost of the work.

Method of Procurement of Works

The methods of providing construction work to any reliable party is known as procurement of construction work. Public Work Document (PWD), which includes FAR of GoN, gives guidelines for procuring construction works under the following categories-

1. Sealed quotation,
2. Sealed bidding,
3. Direct purchase (negotiation),
4. Force account,
5. Public bidding,
6. User's or Consumer's committee.

Sealed quotation: Any public work within 100,000 to 10,000,000 can be executed by inviting sealed quotation from the registered firms through local or national newspapers.

Continued--

2. Sealed bidding: Bidding documents including BoQs are supplied to the potential parties by the owner and they fill-in the rates and submit or bid for the owrks. The time of submission depend upon the amount of the work- larger the amount longer the time provided. The following are the types of sealed biddings-

a. National / Local competitive bidding (NCB/LCB),

b. International competitive bidding (ICB), and

c. Limited international bidding (LIB)

National / Local competitive bidding (NCB/LCB): Contractors are invited from within the nation or local. It is exercised for the budget between Rs. 1m to 60m as per FAR. Foreign bidders can only take part if they are joint with national firms. The PWD gives guideline under Standard Bid Document.

Continued--

International competitive bidding (ICB)

When domestic firms do not possess sufficient capability and resources for large work, ICB procurement is practiced. Prospective bidders are invited from eligible countries with sufficient time given. Foreign and domestic firms are encouraged to bid jointly by making enough capabilities.

The PWD gives the guidelines of procuring large works under SBD for large works. ICB is used for more than Rs. 60m of works.

Limited international bidding (LIB)

When the works requires specialized or expertise to perform to perform the work, LIB is practiced. For complex industrial plants, for highly specialized equipment, emergencies reasons like in major disaster, it can be used.

Continued--

3. Direct purchase

   It is like negotiation and dealt previously.

4. Force account

   When government agencies produce required goods, the public office need not go for bidding. It can procure direct from the production office at government rate and it is known as Force Account. This account should not exceed NRS. 100,000.0 as per FAR.

5. Public Bidding

   FAR allows public bidding under the following conditions-

   Sufficient reasons not to complete in time, possibility of damaging to existing infrastructures and loss to GON, and possibility of hindrances to local persons, it need to be practiced.

Continued--

6. Users' or consumers' committee

   It is used on small and labor intensive works where the objectives are as follows-

   a. To provide employment and incomes directly to the persons living in that work areas,
   b. To increase the utilization of local know-how, appropriate technologies and materials,
   c. To handover the completed works for operation and maintenance directly by the persons utilizing the project.

It can be used for labor intensive works up to NRs. 2.5m. If the works requires equipment, the user's committee can allocate the work to 'D' class contractors.

Quotation and Quotation Notice

When the contractors are asked to quote their rates of the construction work or supply of materials through in a sealed envelope, it is termed sealed quotation.

In sealed quotation, single price, specification of the work to obtain the required output or branded products may be asked either in detailed rates or in one price.

Quotation is limited to its budget allocated for the work. FAR permits sealed quotation up to NRs.1million.

Necessary information is supplied to the interested parties similar to small work Standard Bid Document.

Any public construction, repair, maintenance or improvement works costing more than NRs 100,000 but not exceeding NRs 1 million can be carried out by inviting sealed quotation from eligible registered contractors.

Continued--

Notice shall be published in a national or local news papers displayed at public concerned offices.

Evaluations of the sealed quotations shall be exactly the same as for National Bidding Competition (NCB).

The Invitation for Bids[1] shall be issued as:

(a) an advertisement in at least one newspaper of national circulation in Nepal for two days;

(b) an advertisement displayed on the Notice Board of the office inviting the bids; and

© advertisement forwarded to the following offices for display on their notice boards:

- District Administration Office

- Land Revenue Office

- District Development Committee

Continued--

- District Treasury Comptroller Office,

-Offices of the contractors, if any, at the headquarters of a district

Its purpose is to supply information to enable potential Bidders to decide on their participation. The Invitation for Bids should also indicate any important bid evaluation criteria.

The Invitation for Bids may be incorporated in the bidding documents for the record, or it may be omitted. In either event, the information contained in the Invitation for Bids should conform to the bidding documents and, in particular, to the relevant information in the Appendix to be attached herein.

1 PWD Part III Standard Procurement Documents, Procurement of Works Small Contracts, January 2002

The quotation notice should contain the following

- The name of the office inviting the quotation,
- Date of the first notice publication,
- Types of materials or work,
- Types of bidders,
- Price of the quotation form and its deposit procedure,
- Bid bond price,
- Name and types of Financial institution for bid bond guarantee,
- Date and time of the bid submission,
- Requirements of the work or materials,
- Any other information relevant to the invitees.
- Quotation notices are available in National and local newspaper

Tender and Tender Notice

Tender documents should be prepared before inviting tenders. While preparing the tender documents, one should pay attention to the minimum necessary expenses. The format of tender should be as per Public Works Documents to have uniformity.

The tender document bought on one's name shall not be transferred to another person or institution. So, the document number and the person or the institution name should be registered.

When the person or party wants to buy drawings, the cost shall be as per decided by the chief of the office.

The sale of the tender document and the submitted tender documents should be maintained in separate books. At the end of the sale or submission of tender document, the chief of the office must close and sign the register books

Continued--

The tender notice should provide the total amount of the work up to 10,000,000 except contingencies and profit of the contract work in NCB or LCB, except in international bidding.

After the tender documents have been approved by the authority, while tendering for the works more than NRs 5,000,000/-, the tender notice should be given twice in the national level news paper.

The office shall obtain the evidences of notifying the same from the offices such as CDO office, revenue office, DDC office, District treasury control office (DTCO) and office of the contractor association. This also applies to quotations too.

The **Tender Notice** contains the following-

- Methods of tender submission,
- Tender submission office or authority,

Continued--

- Amount of Bid bond,
- Last date and time for submission the tender,
- Date for making decision on the tenders,
- Estimated amount excluding contingencies and contractor's profit,
- The place, date and time for the opening of the tenders,
- Period of bid bon, bid amount, and bank guarantee types,
- Description of the potential bidders, type, financial position, technical experiences and capability,
- Any other related information to the tender

Tender Guarantee / Bid Bond

Tender guarantee, also known as Bid Bond, is required to initiate genuine bidders in the contract processing. Genuine bidders mean the potential bidders that have submitted the required and asked information true and real.

Any contractor found deceiving the office shall have to loose its bid bond. Forgery information or false documents submitted to the office, shall have to be forfeited its bid bond or bid guarantee. It is only necessary to initiate genuine bidders.

The bidder should submit in cash guarantee or bank guarantee along with the tender. The bid bond according to FAR is **2.5% of the total bid amount**. But while submitting the bid guarantee, the amount should be at the upper 500 or 1000. It should be mentioned in the tender notice

Continued--

The bid bond should be separate for each tender. The winning bid shall have to submit another 2.5% for making **5% of the total contract amount as performance bond.** Those who have failed to win the contract shall be returned their bid bond after the award of the contract to the wining one is made.

Tender once submitted shall not be returned. When asking for deducting the bid amount from among the bidders, it should be done from among the registered contractors (submitted bidders) according to Contractor Regulation 2031.

Tender Documents and its preparation before inviting tender

Tender document is the package for quoting rates of items of works under given terms and conditions that consists of contract conditions regarding quality of works, execution, time span, and mode of payment and roles of stakeholder.

It consists of the following documents-

1. Notice inviting tender
2. Tender form, and forms for bid security,
3. Schedule of bill of quantities, tools and plants,
4. General conditions of contract,
5. Special conditions of contract,
6. Technical specifications,

Continued--

7. Forms of agreement, bank guarantee, performance security forms, and Bank guarantee for advance payment,
8. Drawings.
9. Post qualification
10. Dispute resolution procedure

3.6 Pre-qualification works of contractors

Pre-qualification is carried out in advance of bidding to establish a list of capable firms to be invited to tender while ensuring that a proper level of competition is safeguarded.

Its intension is that the invitation to bid (ITB) can be extended only to those perspective bidders who have adequate capacity and resources to do the particular contract work satisfactory.

In pre-qualification, the following are looked for-

- experience and past performance on similar contracts,
- capabilities with respect to personnel, equipment and construction or maintenance facilities,
- financial position and
- Litigation history.

Post qualifications is that in which bids are invited at large from one or more classes of contractors, and carried out after bids are received as part of the bid evaluation process. Post qualification has the advantage of reducing the total procurement time cutting out the pre-qualification steps.

FAR rule 65 states that manufacturer / supplier, builders shall be pre-qualified for supply of goods and or works costing more than NRs. 10m according to amendment in October 2001 for all GoN funded works.

Continued--

The following guidelines apply when preparing pre-qualification document for use in a specific project-

1. General instruction to applicants shall remain unchanged and project specific provisions shall be provided in the special instructions to applicant,
2. Domestic preference, no. of copies, last date for submission, language and currency to be used,
3. Fee charged is nominal usually sufficient to cover printing and transmittal costs.

Inviting to pre-qualify and issuance of pre-qualification document, an advertisement will be made containing the following information-

- Name and address of the employer

Continued--

-Name and or position of a contact project,

-Location and description of the project,

-Source of funding,

-Anticipated program (e.g. award of contract, competition and any other key dates).

-Planned dates for issuance of bid documents and submission,

-Instruction for applying for pre-qualification documents,

-Dates by which application must be submitted,

-Minimum qualification requirement. Such as contractors' class, any other particular aspects which could be of concern to perspective bidders

Advertisement notice

PQ for ICB:

Notice for invitation to submit pre-qualification-

- Diplomatic mission in Nepal,
- United Nation Development Business if requires by donor,
- National News paper two time,

PQ for NCB/LCB:

- National newspaper two times,
- Regional/divisional/district office of the implementing office
- CDO office,
- Land revenue office,
- DDC,
- District treasury controller office,
- Office of the contractors, if it is there

Continued--

Submission period of PQ shall be 30 days for NCB and 80 days for ICB from the date of publication.

The project office shall evaluate all applications based on the approved criteria. Instructions on selecting appropriate criteria are given in PWD part-III. It is recommended that consultant be hired to assist in the evaluation in large and complex project.

Those meeting the minimum requirement shall be qualified and listed for inviting the bids. Applicants, eligibility for domestic preference shall also be determined where permitted.

The evaluation result shall be approved by the competent authority, who have the authority to approve the bid.

Applications, which fail to meet minimum requirement, are considered unsuitable and excluded form the qualifying list.

6.7 Evaluation of tenders and selection of contractor

The evaluation of tender / bid is done in the following four steps-

Step-1: Preliminary examination of bids,

Step-2: Determination of substantial Responsiveness of Bids,

Step-3: Detailed Evaluation of Bids

Step-4: Bid Evaluation Report

Preliminary examination of bids: Its purpose is to see whether the bids are not complete as instructed in the bidding documents. The following are done -

Verifications: Properly signed, bidder's registration, JV agreement and authorizations, stamps etc

Eligibility: Bidders satisfy all eligibility criteria,

- **Bid security:** provided in the conformity with the instruction to bidders.
- **Completeness:** Bids should offer all the items required in the drawings, specifications and bill of quantity.
- **Qualification** information should be provided.

  Other requirements of the FAR is satisfied.

2. **Determination of substantial Responsiveness of Bids**: The purpose is to reject those, which are not substantially responsive to the major commercial and technical requirements. Bid security is substantial responsiveness. Commercial reasons for rejecting bids are as follows-

1. Bid security and bid validity period are not in accordance with bidding documents,

2. Inability to meet critical work schedule clearly specified in the bidding document,
3. Failure to comply with minimum experience or financial capability specified in the bid document,
4. Bids containing conditions, which limits the bidders' responsibility to accept an award,

Technical reasons for rejecting bids are as follows-

1. Failure to bid for the required scope of works,
2. Failure to bid for each item in the BoQ,
3. Failure to satisfy major requirements in the specifications

3. **Detailed Evaluation of Bids:** The detailed evaluation of the substantial responsive bids are done as per evaluation criteria specified in the bid document. The detailed evaluation is based upon the criteria as specified in the bid document.

The following are principal factors for evaluation-

1. **Correction of errors**: As described in the bidding documents, all the fill-ups should be as per instructions to bidders.
2. **Correction for Provision sum**: Provisions sums are the same for all bidders and hence such provisional sums should be excluded from the bid comparison,
3. **Modifications and discounts**: modification and discount shall reflect fully in evaluation as ITB.
4. **Evaluation currency**: Conversion to a common currency for comparison should be as described in the bidding document,
5. **Omissions:** any omission should be compensated for by adding the estimated cost for remedying the deficiency,

6. **Adjustment:** for performance or service factors if prescribed in the bidding documents,
7. **Price deviation:** minor deviation is considered substantially responsive, provided that the evaluation assigns a monetary cost / penalty to the bid for the purpose of bid comparison,
8. **Domestic preference:** Domestic preference should be provided as described in the bidding document,
9. **Cross discounts:** It may depend on the outcome of awards of other contracts. The Bid Evaluation Committee shall seek the optimum combination of awards on the basis of the least overall cost consistent with the pre-qualification.

The evaluation shall take account of all above factors to determine the evaluated cost of each bid

The basis for award of contract shall be the bidder with the lowest evaluated sum and substantially responsive bid subject to-

1. Qualification,
2. Technical Responsiveness,
3. Comparison with cost Estimate,
4. Rate analysis.

Bid Evaluation Report:

The bid evaluation committee shall prepare a bid evaluation report, following the format contained in the Standard Guide for Bid Evaluation in Part-III, and submit it to the project manager or competent authority to further consideration and actions

(*Formats from PWD – Part – III*)

RECORD OF BID OPENING

Name of Project: Loan/Credit/Grant No:

Name of Contract: ……..Contract Identification No: ……..

1. The following bids were received by the closing deadline fixed on ….. (Date) …. at … (Time) - hrs and were publicly opened and read at …Time) … hrs on the same date

No.	Bidders, Name & address	Bid Security Amount	**Total Bid Amount**[1]				Remarks	Bidders' / representatives' Signatures
			Pkg1	Pkg2	Pkg3	ETC		

2. The following Bidders' representatives attended the public opening of bids and a copy of the attendance sheet is attached as an annexure of this record.

No.	Name	Designation	Bidding company represented
1			
2. Etc			

3. Matters transpiring during the opening of bids. (Any modifications, bid withdrawals, complaints received, and clarifications made or announced by the bid opening committee should be recorded)

4. Reading and signing of bids ended at ……hrs……

…… ……

(Name, Signature, and Designation) (Name, Signature, and Designation)

……

(Name, Signature, and Designation)

ATTENDANCE SHEET FOR OPENING OF BIDS

Name of Project: ---------- Loan/Credit/Grant No: ---------

Name of Contract: ……Contract Identification No: ……..

Place: ……Date: ……Time: ……

The following Bidders' representatives attended the public opening of bids.

No.	Bidders	Representatives	Designation	Signature
1				
2				
3				
4				
5				

- The office usually calls a meeting of concerned authorities to see and discuss the recommendation,
- makes a decision to award the contract of work,
- writes a letter to the winner offering the contract work and asking for a letter of acceptance.
- asks the bidder to produce performance security bond also,
- On a scheduled date, the bidder with a witness the chief of the office with a witness sign the contract document,
- After the contract signs the bidder becomes the contractor and the project manager employer.
- The PM issues a letter of instruction to start the work within stated days,
- The contractor inform the office the start date of the work with a schedule of the work, which is mandatory after the approval of the PM

Chapter-6
Construction Process 3

6.1	Site Surveying and Preparation
6.2	Arrangement of Facilities and Shops/Job Layout
6.3	Material Handling System
6.4	Financial Management and Cash flow Management

While executing design and drawing at first, the engineer has to lay out the designs and drawing on the ground to start physically building up the proposed design and plan. This is what is meant site surveying and preparation in the execution stage.

The site engineer has to mobilize a large numbers of craft people, heavy equipment, stack materials and set up an office to execute all of them. Therefore, during site surveying, the engineer has to allocate spaces, services and amenities to the people involved in the construction. At the same time safety during construction has to be paid attentions.

Temporary services are necessary to execute the construction work. Temporary services include temporary offices, electricity, telecommunication, roadways (access road), drinking water, sanitation system etc.

Also, heavy and costlier equipment and construction materials should also be allocated spaces in and around the site office so that no part of the equipment, materials or any other be stolen or broken by outsiders.

The engineer also needs to think about the disposal of the debris generated from the construction. In road construction, excavated earth has to be disposed properly without disturbing the environment.

While setting temporary office, the engineer should consider function ability within and around the site office to avoid delay in any work being carried out.

In site surveying the engineer lay out centerlines and sides of the proposed road, and searches reference points and bench marks set previously to carry out laying exactly as in the design and drawings.

Similarly, corner profiles are fixed for centerlines of walls in building sites. Benchmarks are also established for carrying out levels of the buildings so that relative levels of other structures and facilities can be determined. Those paints should be maintained throughout the construction period until the construction completes.

The equipment necessary for the construction is usually heavy and costlier. The project engineer need to decide whether equipment can be procured for the purpose of the site or has to hire for the requirement of time period. Without arranging equipment, the engineer cannot execute the works as stated in the specification.

The construction works employed with equipment results more quality than the works employed with manpower, and also it is quicker and more homogenous in the building of the work than the manpower and hence the application of equipment is inevitable for quality construction. Therefore, site engineer is expected to arrange equipment for the construction work. The equipment can be arranged in the following ways at site-

a. Procurement of the equipment,

b. Hiring of the equipment, and

c. Leasing of the equipment

Costlier equipment is not possible for small and medium size of project works. Some equipment are so costlier that the budget for the equipment assigned in the project work is so small that one can not just imagine of procuring equipment. Only those project works, which are large in size and have longer life, may be economical to procure certain equipment.

Most of the construction works are designed with the assumption of using equipment and hence equipment becomes inevitable.

The next option is by hiring equipment from certain companies that possess such construction equipment. Companies that provide equipment on hire now have been initiating to provide equipment on hire in Nepal too.

Usually the life of equipment is longer than the life of a project. So, it will be beneficial to acquire equipment on hire from such companies. Medium range project may require equipment longer than those of short-range project. Also, the construction firms have construction projects one after another. Such firms need equipment to have with them all the time.

The pre-qualifications for future projects are done on the possession of equipment. This leads the construction companies to possess more and efficient equipment. But because of shortage of capital, such companies can have equipment on lease. Equipment on lease requires paying its installment periodically. In this way, equipment in the construction site can be arranged either by procuring or by hiring or by leasing.

6.2 Arrangement of Facilities and Shops/Job Layout

Facilities required for the site may be the resources as required in the site. Those include manpower, machines, and materials. Among these, manpower is the first to consider, for humans work with their mind. Those humans are laid out according to their field of work. It is usually called an organization, in which the performers and the controller come face to face to solve the problems in time.

The main objective of construction management is to execute the construction project in an efficient manner to accomplish the work economically. Construction project involves from project inception to its accomplishment. Therefore, construction management work involves from project inception to completion and utility start up. The major objectives can be summarized as follows-

Continued--

- to complete the work in time,
- to execute the work within allocated budget economically,
- to execute the work at anticipated quality standard,
- to execute the work in a non-dispute environment, and
- To maintain the environment at par.

- Construction works consume various materials to build up facilities designed and planned for construction.
- Materials are not available at the spot where and when required, so, procurement of materials initiates in construction works.
- Too early or too late procurement from the requiring date causes unnecessary expenses like proper storage, supervision and maintenance or running for collection and collecting without quality choice render the construction works.
- Delay procurement may hinder the construction works by not being able to provide materials to the workers in the right time.

Thus, procurement becomes an important endeavor in construction works.

The quality and quantity of materials are drawn from design, plans and specification of the facility. The quality of materials is indicated by designers and the quantity is estimated from the detailed design and drawings.

From the schedule of the project, when what kind of materials for the construction is required are drawn whatsoever the variety of materials are. Various types of materials for a particular time point are calculated and accordingly procurement is processed.

Procurement is initiated from the needs initiated at the construction site. Construction itself is procured before it is built simply because it is contracted for the construction. As large sum of money involves in construction, and as one construction is not similar to another, its procurement becomes risky and hence complex.

Process of materials procurement-

The logical flow diagram of materials procurement can be as follows-

1. Needs of materials collection from different sites,
2. Group them according to their specification.
3. Cross check the type and quantity of each type of materials,
4. Check if they are available in stack.
5. Decide the time of delivery of each type of materials,
6. Decide either to tender, shopping, direct procurement from manufacturing company, or simply to put order for delivery,
7. For tender, prepare specification that include quality, testing, inspection and inventory entry,
8. Prepare tender document for the supply and delivery.

9. Introduce checking or inspecting of materials / sample before they are delivered at site in a total quantity ,
10. Make sure of quality for strength, color or pattern during order, inspection, checking or delivery points.
11. At delivery point, inspect and randomly examine the quality of materials to ensure the quality stated in specification,
12. Once accepted the delivered materials, immediately entered the ledger book showing balance of materials,
13. Each material type must have different ledger pages to keep a clear account,
14. Each ledger page must show consumption when and where,
15. The book must be closed at the end of each fiscal year by one level up officer with red ink,
16. Balanced and or deficit must be transferred to the next fiscal year.

Materials handling uses following terminologies-

Reserve limit of stock: Reserve limit is the quantity of materials of which financial cost is limited by the government to be kept in a division. The reserve limit however can be increased temporarily if required by a separate sanction of the government. The stock of material is limited because the investment in the purchase of the materials and lying without being used is wastage of investment for the period being stocked.

Issue rate: Issue rate indicates the cost per unit of material, fixed on the articles of stock for the purpose of calculating the amount creditable to the subhead concerned of the stock account when issued to it from the stock.

Indent: Indent means official requisition for stores. Materials are issued from the stock on demand in a proper format known as Indent form, prepared by official in-charge of different works as and when required.

Stocktaking: Stocktaking is the checking and verifying physically the stock by counting, measuring, and weighing once a year, for the period of fiscal year by the SDO or AE in-charge of the store.

Any surplus found after checking is credited to the government and if any shortage found, should be kept in suspense head as 'miscellaneous PW advance' and finally accounted as per decision by the competent authority.

Quantity and value account: Quantity account is the account in which the quantity of materials is accounted. Value account on the other hand is the account in which value of each material is accounted. The office in-charge or AE maintains the quantity account whereas the department or division maintains both quantity and value account.

Materials at Site (MAS): When materials are issued direct to the work or purchased directly, their costs are either charged direct to the work or debited to the suspense head "material" in the account of the work. When the cost is debited to suspense head 'material' it is then known as material at site account. MAS account is only maintained in the major works, where larger quantities of materials are likely to be issued.

MAS account is maintained month-wise in the form shown below under the head ‘detailed statement of materials compared with estimated requirements’ showing all issues of materials against the total estimated requirements.

The management of funding of an estimated amount at the required time of a project is in fact the Finance management. So, finance management indicates an arrangement of fund flows towards meeting funds that is required to be invested economically for the work to be undertaken.

Financing is thus understood as the raising of funds required to finance an economically separable capital investment proposal in which the lenders mainly rely on the estimated cash flow from the project to service their loans. Following are done in Finance management-

- In finance management, the repaying capacity of the project is assessed to recover the investment,
- Funds are released in stages as and when assets are created,

- Financers are keen to watch the performance of the enterprise and suggest / take remedial measures as and when required to ensure that the project repay the debt out of its cash generations.
- In construction, the construction project is designed and planned and estimated at its corresponding rates to get the total construction cost. The estimated cost becomes the total fund required to acquire for the work.

From the master construction schedule, various stages of the construction are worked out and the works included at every stages are separately worked out for its estimates. The funding of that estimate is made available at that stage by the construction management to pay to the contractor of the performance at that stage.

The management has to find sources of finance to acquire required funding for a project. The various source of finance can be-

1. Equity capital, and 2. Debt capital

The combined of equity and debt capital can be judiciously chosen according to the nature of the project.

Debt capital enforces upon the optimization an obligation for repayment of principal and payment of interest.

Equity capital does not impose any such obligation. Equity capital serves as a cushion at times when the business conditions are unfavorable to leading operational difficulties. Interest paid on debt capital (debenture, term loans etc) is a deductible item of expenditure from the profit earned by the organization for the purpose of arriving at the tax payable by the organization on its earnings.

Though equity capital does not impose any obligation for repayment principal and payment of interest like debt capital, equity capital has got a cost.

The contributions of equity capital anticipate a return on their investment by way of dividend. The following are the main sources of finance-

1. Ordinary share,
2. Preferred share,
3. Debentures,
4. Bonds,
5. Term loans,
6. Deferred credits,
7. Capital investment subsidy,
8. Lease financing,
9. Unsecured loans,
10. Internal accruals,
11. Bridge loans,
12. Public deposits.

Ordinary share: Also known as common share or equity share are the source of permanent capital. The share holders are the legal owners of the company, so they bear the risk of ownership also. For the capital contributed by the shareholders towards purchase of ordinary share, they are entitled for dividends. *They are entitled to dividends on their capital invested, only after interest obligations and dividends to preference shareholders are paid.*

Preference share: Preference share have priority of claim over equity share in the matter of payment of dividends. And also have a pre-determined rate of dividends.

Through dividends on preference share is payable out of profits, *if the company incurs loss in a particular year, the dividends not paid during that year is to be carried forward and is to be paid in subsequent year /years when the company earns profit.*

Dividends on non-cumulative preference shares do not add up for future payment.

When the company earns profit, it has to pay arrears of dividends to preference share holders before declaring any dividends on equity shares. The dividend rate is fixed in the case of preference shares and the dividends paid on preference share are not tax deductible.

Preference shares are of two types- redeemable preference shares and irredeemable preference shares. The redeemable preference share redeem after the stipulated period, whereas irredeemable preference share do not have any maturity date.

Debenture: Debentures are instruments for raising long term debt capital. Debenture holders are the creditors of the company. The company that has borrowed money by way of debenture has the obligation to repay interest and debt on specified period.

Debentures are secured by a charge on the present and future immovable properties. Interest on debentures has to be paid irrespective of financial situation of the issuing firm since payment of interest to debenture holders is a statutory obligation. A company can issue convertible debenture also.

Convertible debentures are those that are convertible into equity shares at the option of the debenture holders. The following are advantages of debentures as a source of long term finance-

1. The cost of debenture is less than the cost of equity share hence investor considers debenture relatively less risky as compared to equity share. So, debenture shareholders are prepared to accept a low / moderate return on their investment.

2. The interest payments to debenture holders are tax deductible and this has an indirect effect of further reducing the cost of debenture,
3. Since debenture holders do not have voting rights, there is no dilution of ownership,
4. Even if the project earns extraordinary profit, the debenture holders are entitled to receive only interest at the stipulated rate, and this in turn improves the earning on equity.

Disadvantages-

1. Debenture impose a legal obligation for the payment of interest and the principal and in the event of not being able to repay there is a danger of the company being forced into being liquidation,
2. Projects that have fluctuating sales and earnings will find it difficult to meet the repayment obligation which are not related to the earnings.

Bonds: A bond is similar to debenture and these two are used interchangeably.

Term Loans: This denotes long term loans offered for project financing. The period of principal repayment of such loans vary from 5-10 years depending upon the nature of project. For infrastructure project it may be 20 to 25 years. Initial moratorium (holiday period) for the repayment of the principal of one to two years is normally provided.

Repayment of principal and interest on term loan is obligatory on the part of the borrowing company as in the case of Debenture. The term loaning institutions are vested with statutory powers to seize the assets of the defaulted units. They have a developmental out-look and their objective is to stipulate and support the industrial growth.

Deferred credits: Some machinery suppliers provide the facility of deferred credit, provided the credit-taker provides a bank guarantee. It is like bank guarantee of a contract performance.

Capital investment Subsidy: Government provides subsidy for setting up of industries. The subsidy offered is of two types-

a. Area subsidy, and b. Product subsidy.

Area subsidy: The government notifies backward areas from time to time based on the industrial activity prevailing in different parts of the country. The quantum of capital investment subsidy is in the range of 15% to 20% on the fixed asset.

Product subsidy: It is available for products that manufacture specified products. The products that are eligible for subsidy are identified by the government by keeping in view the potential for the economic development of the country in such sectors of industries and notified by the government.

Lease Financing: Lease is a contract whereby the lessor gives to the lesse the right to use the asset, usually for an agreed period of time, in return for the consideration of periodical payments by the lesse to the lessor called lease rentals.

Unsecured loans: If there is shortfall in the means-of-finance, the promoters/directors can mobilize funds from their friends, relatives and well-wishers in the form of loans to make good the shortfall. Such loans are always unsecured. Unsecured loans can be mobilized only when the director / promoters have good rapport with the loaners (relatives or friends).

Banks and financial institutions also stipulate the maximum limit for unsecured loan. Normally unsecured loan component is expected not to exceed 50% of the equity capital.

Internal Accruals: Internal accruals form part of the means of finance in respect of expansion projects. As existing company may go for an expansion (diversification or modernization) project may opt to finance a portion of the capital investment out of internal cash accruals. Depreciation which is not a cash expenditure and profit retained after payment of dividends are the main source of internally generated funds.

Bridge finance (Loans): It is a temporary loan for tying up the capital cost of a project. Bridge loans are sanctioned by Banks and financial institutions in order to help speedy implementation of the project. In the absence of bridge loan, a project may get delayed. The necessity for bridge loan arises when finance from a particular source is getting delayed.

Public deposit: Public deposit can also be used as loan for financing a project if such opportunities are made available. It may be available for a period of six month to 36 months on certain interest.

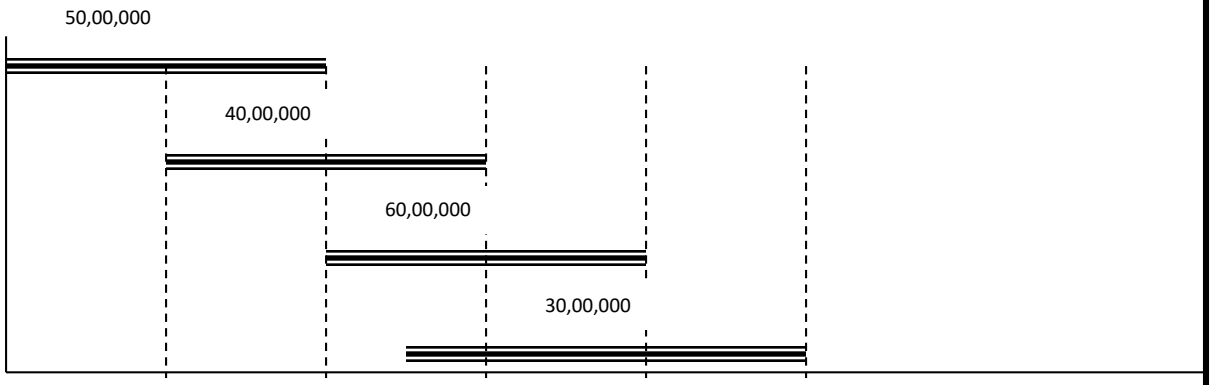
For the larger project, they are financed by the combination of equity and debt, because the arrangement of equity fund for the entire project may not be feasible. Often the equity finance is made use of during the initial stage of project implementation, because financial institutions insist the project promoters to mobilize equity capital before releasing their loan component.

Whatever may be the approach to lending , the lending decision is primarily governed by three considerations-

1. The capacity of the project to repay the loan along with the interest obligations, out of its own cash generations,
2. The value of security offered for the loan,
3. The integrity and willingness of the borrowers to pay the loans in time.

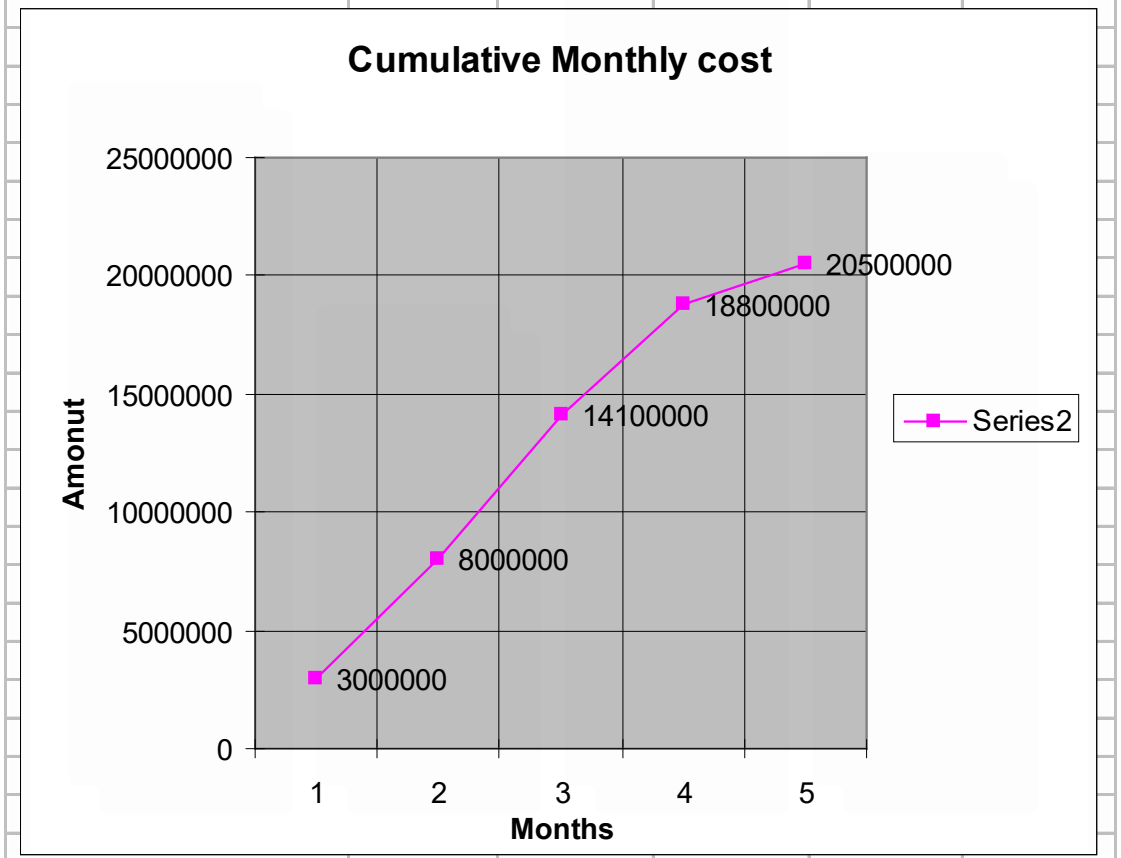
The first and foremost criterion is that that the project should be self-sustaining.

Cash flow projection: In many contracts contractor provides an S-curve of estimated progress and costs across the life of the project. The contract develops it by constructing a simple “bar-chart” of the project, assigning costs of the bars and and indirect cost thaqt incur due to other expenses including staff salary, smoothly connecting the projected amounts of expenditures over time.



Monthly direct cost	25,00,000	45,00,000	56,00,000	42,00,000	12,00,000
Monthly indirect cost	5,00,000	5,00,000	5,00,000	5,00,000	5,00,000

Monthly direct cost	2500000	4500000	5600000	4200000	1200000
Monthly indirect cost	500000	500000	500000	500000	500000
Total monthly cost	3000000	5000000	6100000	4700000	1700000
Cumulative monthly cost	3000000	8000000	14100000	18800000	20500000



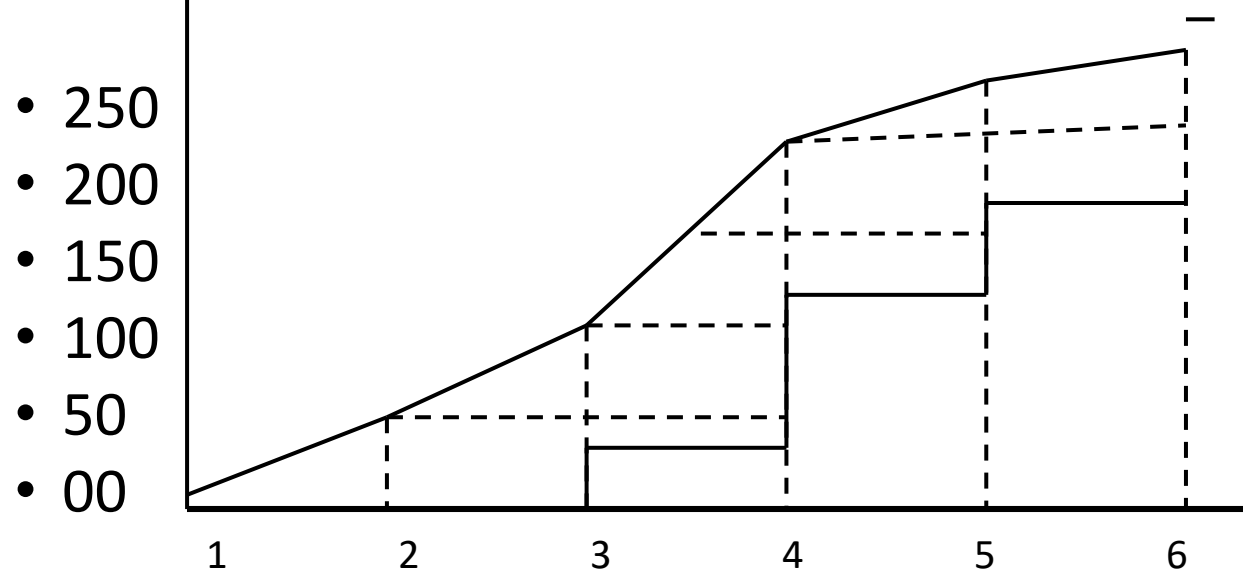
The flow of money from the owner to the contractor is in the form of progress payment. As already noted, estimates of work completed are made by the contractor periodically and are verified by the owner's representative. Depending upon the type of contracts (lump sum, unit price etc.) the estimates are based on evaluation of the percentage of the total contract completion or actual field measurements of quantities placed.

The owner retains 10% of all validated progress payment claims until one half (1/2) of the contract value has been built and approved as an incentive for the contractor to complete the contract.

The minus term for retainage drops out when 50% of the contract is completed. Because of the delay in payment of billings by the owner and the retainage withheld, the revenue profile lags behind the expense s-curve as shown below-

The revenue profile makes a stair-step appearance since the progress payments are transferred in discrete amount based on preceding equation.

Pay=1.25 (indirect expense + direct expense) – 0.10 [1.25 indirect expense + direct expense]



Chapter-7
Controlling Project Integration and Work 5

7.1	Work Scope Control
7.2	Product Quality Control
7.3	Labor Productivity Control
7.4	Equipment Productivity Control
7.5	Material Productivity Control
7.6	Work Schedule Control
7.7	Performance Control Using Earned Value Analysis

Chapter-8
Site Management 3

8.1 Responsibility of Site Engineer

Site engineer is the sole person at site to interpret the design and drawing, condition of contract and to change them into reality. Site engineer is the judge in the construction work at site. Site engineer is supposed to be fair to all stakeholders. The contractor has the notion of making profit from the work, whereas the employer has the notion of making the most quality out of the contract terms and condition. With this tug of war the site engineer has to play a bridging person to convert the design and drawing and term and condition into a reality.

Therefore, site engineer plays a sincere role being fair to all parties on the basis of design and drawing and condition of contract.

Continued--

As the conditions of contract has been sectioned in four, accordingly the responsibility of site engineer can also be described on the same four sections as follows-

a. Quality concerns-

- The site engineer has the responsibility to accurately lay out the designs and drawings as required at the site,
- Has the responsibility of controlling the quality of work,
- Has to verity the quality of materials by testing and by ensuring through test certificates,
- To identify the essential variation and its causes, cost, alternatives and approval from the authority,
- To examine the storage or stock of materials at site,

Continued--

- To interpret the terms and conditions of contract to the contractor or other involved parties when necessary,
- To approve source of materials if asked by the contractor,
- to collect test certificates of the materials issued from authorized institution,
- to approve the method of construction that comply the statement in the specification,

b. Time or progress concerns-

- to ask programs of order, delivery, test and samples of materials that the contractor intend to employ them in the construction,

Continued--

- to verify the progress as per the programs submitted and approved by the authority at site.
- To control variations orders to control time or progress,
- To calculate the speed of work and the time available for the completion of the work based on the available resources at site with the contractor and notify the likely delay to occur in future,
- To give instruction to speed up the construction works to meet the target,
- To timely certify the bills by examining it that was submitted by the contractors for payment,
- To make quick right decision so that the work does not progress because of delay in decision making,

Continued--

- ❖ To check the works, materials, sample or equipment when and where the contractor ask to do so at site,
- ❖ To hold meeting with the contractor and technicians for quality and timely construction as per plans,

c. Cost concerns-

- ✓ to minimize variations orders as far as possible,
- ✓ to ensure that the compensatory events occur minimum,
- ✓ to minimize changes,
- ✓ to control quantity so that their quantities do not exceed given in BoQ,
- ✓ to make payment in time,
- ✓ to reduce disputes as far as possible among the parties to enhance works and thereby maintaining cost level,

Continued--

- ✓ to check bills and produce to the authority as soon as possible not to disturb the payment to all labor by the contractors,
- ✓ to keep records of all issued instructions, inquiries, or letters received from authorities so that they can be produced when and where needed to resolve disputes,
- ✓ to find defects and to instruct the contractor to correct them as soon as possible,

Above all, the site engineer has the responsibility of maintaining hygiene and environment at their normal level at site so that the large number of labor working there shall not be affected and the environmental condition is maintained.

Supervision works of contractor means to get the work executed through contractor as per design and drawing and plan.

In supervision, all the projects aspects- quality, time or progress and cost are focused to keep in control as in program.

While supervising works of contractor, the supervisor must supervise the works as per conditions of contract and specification designed for.

Supervisors should study and be familiar with the conditions of contract and detailed specification of the works.

The conditions give the areas for supervising whereas the specification gives the degree of checking the works for quality, progress and cost

While supervising works of contractors, the following steps are undergone-

1. study the conditions of contract prior to starting supervising the works,
2. design and drawing and plan give way outs for engineers for supervising,
3. consult program, which gives the schedule of parts of work against dates, submitted by the contractor,
4. study technical specification for examining quality of work, materials and process,
5. assist the contractor by coordinating to record measurements of the completed works, examining the bill for making timely payment,

6. Ask the contractor to produce daily report of site condition- climatic conditions, labor employed at different works, materials stock and consumption at site etc.,
7. hold meetings with the contractor to review the progress of work. to draw attentions of all the participants to acquire progress and quality.

8.4 Site order book

At site, it is necessary to immediately instruct the contractor to do or not to do, and that is made easier by setting a Site Order. Authentic person can issue instruction at his/her visit and the instruction become a basis for payment.

The book usually has triplicates- one is taken by the instruction giver, another is sent to site engineer or supervisor and the last is kept with the contractor.

Bills are the claims for payment of the works performed. A systematic process of claiming the bills is adopted, because the works done may not be the exact as what is in the BoQ.

Most of the time, quantities vary. Also, if the bills are intermittent, all the quantities are not done by that time of claiming of the bill. Also bills play a kind of record and the record should be exact and true to what is actually done. The following steps are followed to make bills for payments-

1. The work completed is measured jointly and recorded in a duplicate book and duly signed by both representatives. One copy is taken by the contractor and the other by the consultant

- 2. The contractor will prepare a detailed measurement sheet of the work done. From it, an abstract of quantity of work done is prepared.
- 3. A comparative sheet of the work done up to date is prepared, in which the total work to be done as per contract, rate of the item of work, work done to date, work done and paid previously and the balance to be paid is prepared.
- 4. A bill of the unpaid quantity is then prepared and worked out the total amount of the bill of the work done,
- 5.Tax, retention money and advance if any taken are deducted to make payment of the bill

6 A letter along with all those documents is submitted to the consultant for making recommendation for the payment of the bill.

7. The consultant will check the submitted bill within certain time period, which is usually mentioned in the condition of contract, and forward for the payment to be made to the owner. Also, the owner will make payment within the stipulated time period

Page no. ------

Job No.: ---------- Date of Measurement: --------

Item No.	Item of work	No	Length	Breadth	H/D	Qntty.	Rmks

---------- ---------- ----------

Measurement taken by | Checked by | Approved by

Project: ---------- Job No.:----------

Date of commencement: ----------Date of completion: --------

Item No.	Item of works	Page no.	Preparing officer		Checking officer		Approving officer		Remarks
			Name and signature	Date	Name and signature	Date	Name and signature	Date	

Date: ----------

Item No	Item of works	Unit	Quantity	Rate	Amount	Remark

In words. NRs. ----------only.

---------- ---------- ----------

Prepared by Checked by Approved by

Sample of a Comparative sheet

Item no	Item of works	Contract			Work done to date		Work paid previously		Claim		Rmks
		Rate	quantity	amount	quantity	amount	quantity	Amount	quantity	amount	

---------- ---------- ----------

Prepared by checked by Approved by

8.7 Muster Roll

Muster Roll: Muster roll is prepared when department executes construction works by employing labors and artisans etc. the materials and equipment and tools are issued from the office. The disbursing authority makes payment to the labor on temporary imprest amount, which is approved by the SDO. Muster roll has two parts-

Part-I: Nominal roll where daily attendance is recorded. In this part, names of labors, designation, labor's father's name, dates of attendance, rates, total amount due for each, total amount for whole labor, signature of the attendance taking person, signature of the officer who make payments etc are provided. Fines are also recorded if any in this part. Muster roll is never made duplicate

Continued--

Part-II: Details of quantity of work done by the labor and the program of work are recorded in this part. Details of measurements are taken and entered in MB and an abstract of quantity is prepared sub head wise. The abstract of quantity is recorded in here with reference to MB

Part -1 of Muster Roll

Work Description: ---------- File No.: ----------

Place of work: ---------- Date: From -------- to -------

S N	Type Labor	Names	Father's Names	Days of work done 5			Total days	Rates	Total amount	Sgn of recipient	Disbursing officer
				2	3	4					
1	2	3	4				6	7	8	9	10

Recorder: ----------Checking officer:----------Approving Officer----------

Approved amount Rs……In words……..only.

Place: ----------

Date: ----------

Total amount to be paid----------

Amount paid:----------

Date: ----------

Disbursing officer----------

Signature:----------

Signature of officer----------

Post: ----------

Signature of Submitter_----------

Post:----------

Part-II

SN as per Muster Roll	Names of labors that were not paid	Father's names	Remainder	Remarks

Signature :----------Project ----------
Post: ----------Nos. Of Labors:----------
Date :----------to----------
Muster Roll No.:----------
Authorized Person:----------
Signature: ----------

Continued--

S N	Description of works	Estimated amount	Quantity		Quantity from previous muster roll		Total work to date	Balance as per estimate
			labor	material	Labor amount	Material amount		

Measurement Book No. and Page No.----------Signature==========

Date: ----------Designation:----------

Chapter-9
Project Maintenance 4

9.1	Maintenance Basics
9.2	Types of Maintenance
9.3	Planning and Scheduling of Maintenance
9.4	Estimating Maintenance Cost
9.5	Management of Maintenance and Financing

Maintenance management is an activity to acquire full life utilization of a facility or equipment at its normally running condition. Maintenance management for a facility or equipment is required to prolong its life at running condition. The maintenance at the beginning may be less required but as the utilization goes on it requires frequent maintenance to complete its service life.

The following are the importance of maintenance management-

1. Preserving company's investment and prolonging the lives of aspects to increase the time over which investment provides service.
2. To minimize the loss of productive time and the cost because of malfunctioning of equipment
3. Minimizing the loss of productive time and cost because of maintenance effects Efficient use of maintenance personnel and equipment, and
4. Preserving company's investment and prolonging the lives of aspects to increase the time over which investment provides service

There are two types of maintenance management-

a. Preventive maintenance, and

b. Remedial maintenance

a. **Preventive maintenance management**

Any maintenance performed before breakdown of any structure or equipment to keep at its normal running condition is known as preventive maintenance. Preventive maintenance seeks the following considerations-

1. The reliability of design, selection of materials and technology and construction,
2. Periodic inspection and record keeping to assess the condition of facilities and equipment so that breakdown can be avoided,
3. Adequate lubricating, painting, cleaning and adjusting to maintain operative conditions.
4. Periodic and repetitive servicing, repair or overhauls even through no breakdown has occurred,

A branch of preventive maintenance, called predictive maintenance, applies sensor and analysis of technical data to determine when the performance of a part of equipment is about to degrade too far or when it is about to break down. The problems are corrected at a scheduled and organized manner before the costly damages or breakdown occurs.

b. Remedial maintenance management

Remedial maintenance aims at restoring the facilities and equipment to acceptable conditions after a break down has occurred. Tune up, lubrication and waxing of a car are preventive maintenance whereas replacement and repairs of damaged parts occurred in the car are remedial maintenance. With the repairs and replacements of damaged parts of the car, the cars can start and give services substantially

The planning and control in the maintenance management is carried out as per the type of maintenance management. If the type of maintenance is preventive, the planning and control aspects should also be preventive. The approach for planning and control in maintenance management should be accordingly done in the same aspects.

Preventive maintenance is the nature of recurring-one. So, it has to be performed at a pre-established times. Preventive maintenance is scheduled to prolong life. It can be pre-planned when and how preventive maintenance be carried out. Also the manufacturing factory recommends preventive maintenance for the equipment. Buildings and other facilities are provided with maintenance works before and after rainy season. Some other facilities need biyearly or every five yearly maintenance as the case may be. Preventive maintenance also depends upon the intense utility of the facility or equipment. Therefore, preventive management should be accordingly arranged

Continued--

In preventive maintenance, plan and control is done in the following bases-

a. identify activities that require maintenance,
b. prioritize them in sequence,
c. see predictive maintenance,
d. integrate predictive maintenance with preventive maintenance,
e. outdoor maintenance has to be adjusted with the seasons,
f. Indoor maintenance started any time.

The priorities of the parts or activities requiring maintenance help in planning and controlling the effective use of the maintenance labors. It is very mush similar to job shop scheduling. When the maintenance work has a long work cycle and is non-repetitive, it is more like a project than a job shop operation

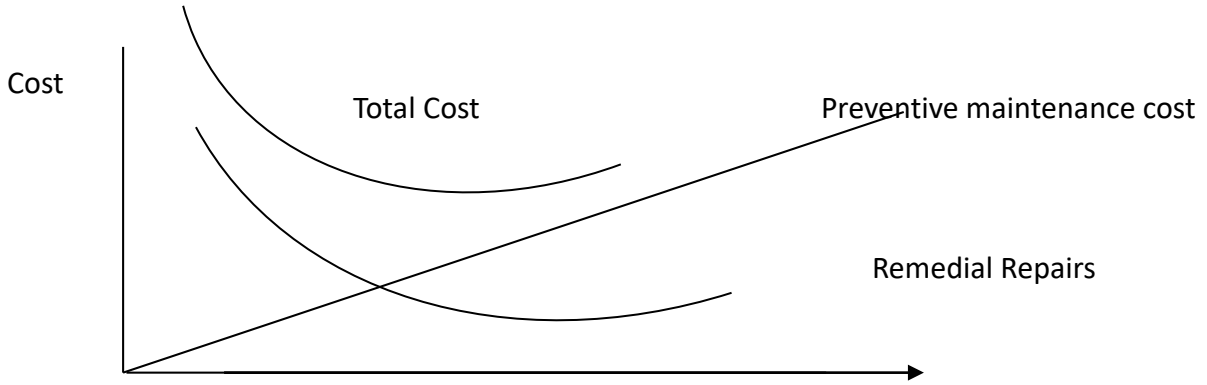
An inventory for repair parts may be maintained to reduce the lead-time before repair can begin. Information from equipment vendors and form past records may be used to help forecast the reliability of various components and equipment in the operation cycle.

Spare parts inventories are subject to costs for obsolescence, taxes and insurance costs of invested capital and other costs The following basic maintenance decisions are executed for monitoring and control of maintenance management-

1. Centralized versus decentralized maintenance,
2. Contract versus in house maintenance,
3. Standby equipment,
4. Repair versus replacement,
5. Individual versus group maintenance, and
6. The amount of maintenance capital

Should a company spend more of its time on minor tune-ups and preventive works, or should it just wait until something breaks down and then fix it? The answer to this question depends upon several factors, including the relative cost of prevention versus the cost of repair.

Probably some trade-off between the two extremes is advisable, because the costs may follow the pattern shown if figure below-



9.1 Maintenance Basics

Maintenance Basics is dedicated to providing exceptional high quality service to Orange County. Whether you need a general contractor or professional handyman, our goal is to always exceed your expectations while respecting your valuable time.

By providing outstanding service, we hope to provide you the peace of mind in knowing that your residence is being properly maintained by a professional, while allowing you the time to do those things you would much rather be doing.

- **Don't have time to perform property maintenance, general repair, home improvement or renovation**
-
- **Would rather spend your time on something other than these general contracting or handyman tasks**
-
- **Plan to perform home or property repair but never seem to get around to it**
-
- **Need help maintaining an investment property whether long term rental or vacation rental by owner**
- **WE CAN HELP**

Continued--

The Maintenance Planning and Scheduling function has four basic objectives:

- To provide the right information for the technician to more easily to perform the job
- Have identified the right parts and materials, having them staged and kitted
- Interface with the Operations partner to ensure the equipment is available for Maintenance at the specified time
- To ensure the right priority Maintenance work is accomplished based on business needs.

In the end, the function is all about doing the right work while addressing avoidable delays i.e. driving technician wrench time up. To do this, there are a number of tasks that the Planner Scheduler performs.

Continued--

1. Avoids getting involved with this week's emergency work as planning must be focused on the future
2. Reviews work orders requiring planning to understand the requested work
3. Evaluates and understands planned work priorities
4. Job scoping/ research – spends 1/3 of the day in the field
5. Prepares job plans based on level of detail required
6. Maintains a job plan library for reuse
7. Identifies and requisitions/ reserves parts and materials
8. Prepares the job package

Continued--

10. Interfaces with the Operations group to validate work priority and equipment availability
11. Collaborates with Maintenance Supervisors on next week's available labor hours to build the weekly schedule from
12 Develops the next week's maintenance schedule based on priority
13 Provides a level of coordination in the planning and scheduling phases, not during the execution of the work which the responsibility of maintenance supervision
14 Leads the weekly maintenance scheduling meeting
15 Ensures the preventive maintenance program is scheduled and work-leveled

Continued--

16 Maintains the asset hierarchy if so required

17 Develops and improving the asset bill of materials

18 Reports on the Key performance indicators (KPI) if required

19 Performs other administration tasks of the CMMS/ EAM if required

20 Reviews completed job feedback to improve job plan content and estimates

21 Integrates key words on work order closure to assist the data mining for reliability engineering purpos

Chapter – 10
Personnel Management

10.1	Management Principles: Administration and Organization Principles
10.2	Centralization and Decentralization
10.3	Supervisory and Leadership Styles
10.4	Importance of Communication
10.5	Information System for decisions
10.6	Motivating and Directing: human elements, evaluation and merit ranking
10.7	Personnel selection, testing and training
10.8	Trade unions and relation with management

10.1 Management principles: administration and organization principles

Organizations are human association for achieving goals. In every moment, human have goals to achieve and for achieving those goals, they need to have an association. Larger associations can be distinctly seen and realized which are established to satisfy human needs. Some of the examples are as follows of organizations

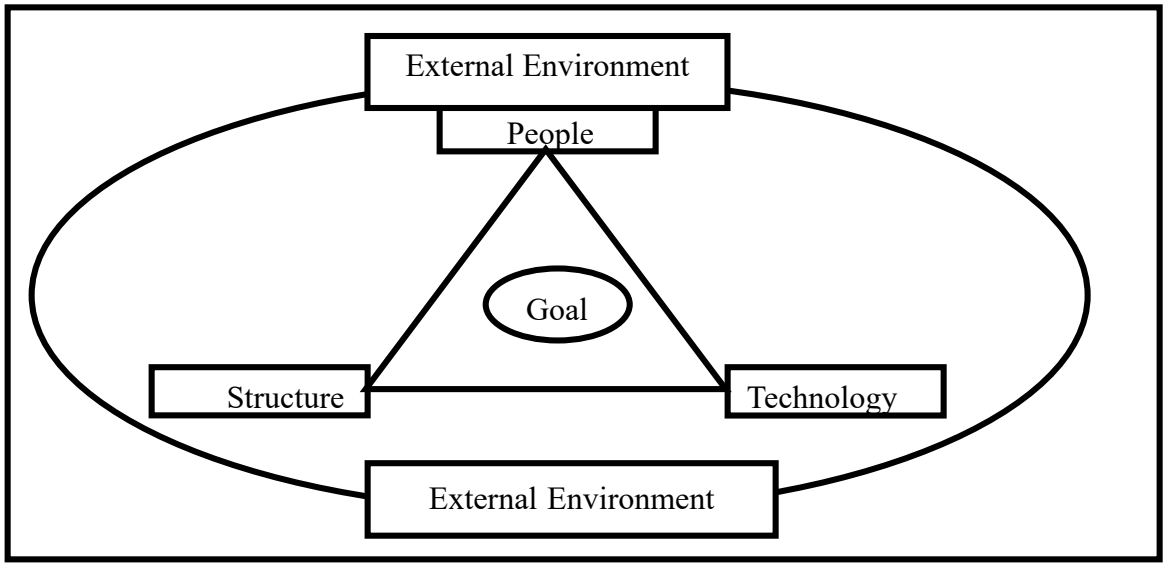
"An organization is a systematic arrangement of people to accomplish some specific purpose."-Stephen P. Robbins (1996).

Organization is a goal oriented technical, structural, psycho-social and managerial sub system of its broader environment"-Kast and Rosenzweig (1985).

Continued--

Characteristics of an organization-

1. Organization is an open system,
2. Organization is a goal oriented,
3. Organization is an association of people,



4. Organization consists of structure
5. Organization consists of technology ,
6. Organization has continuity

Continued--

Goals form a network of “means-end chain”-

“Management achieves goals by getting the jobs done efficiently and effectively through and with people by using the means of planning, organizing, staffing, directing and controlling in a dynamic environment.”

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Continued--

There are various principles of management but all principles swing along the following 14 points propounded by **Henry Foyal**, which is known as Administrative principle of Management.

1. Division of work: Specialization of workers, Departments emerged,
2. Authority and Responsibility: Authority is legitimate power to give order and responsibility is an obligation to perform the job,
3. Discipline: Obedience and respect for agreements,
4. Unit of Command: One employee one boss,
5. Unit of direction: One plan and one head for group of activities having one objection
6. Subordination of individual interest to general interest: Interests of organization should be above the interest of individual,
7. Remuneration: Fair and equitable wages to employees,
8. Centralization: Centralized power structure, decentralization with centralized control

Continued--

9. Scalar chain:Hierarchy of superior subordinate relationship for all employees,
10. Equity: Sense of kindness and justice at all levels of scalar chain,
11. Order: A place for everything and everything in its place,
12. Stability and employee tenure: Job security to decrease turnover,
13. Initiative: Encourage subordinates' initiative,
14. Espirit-de corps: Union is strength, cohesive and team spirit

10.2 Centralization and Leadership

Leadership is guiding and influencing people to achieve goals willingly and enthusiastically in a given situation.-Kootz and Weirich.

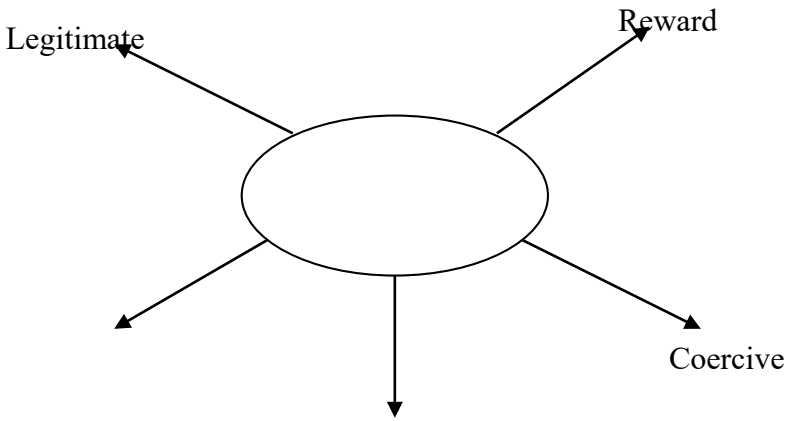
Leading is the influencing function of management. Managers as leaders establish organizational goals, decide what is to be done and motivate people to do it. In practice, effective managers are also good leader.

Leaders decide where the organization should go and managers decide how to get there. Leader does the right things and the managers do things right.

Power: power is the potential ability to influence others' attitude or behavior, whereas power refers to potential, leadership refers to actual use of that power to influence others. In most organized settings we are interested in the ability to influence behavior

Continued--

In most organized settings managers are interested in the ability to influence behavior. **Leadership powers** are-



Besides power, leadership should possess the following **influencing nature**.

1. Assertive, 2. Friendliness, 3. Bargaining,
4. Inspiration, 5. Motivation

Continued--

Leadership also possesses the following characteristics –

- Common goals
- Leader, follower, situation
- Unidirectional authority
- Influencing: power, bargaining, etc. as above.

A leader **centralizes** its power and exercises when and where s/he thinks suitable.The following are the leadership functions that centralize authority.

Goal determination: Leadership is concerned with goal formation showing where the organization should go.

Environmental Adaptation: Leadership is innovation and change oriented, because people want change, once again she or he determines the form and shape of change.

Task-oriented (problem centered): leadership pays attention to the problems of the people or followers,.

People-oriented (social function): Leaders are friends, philosophers, guides for the followers.

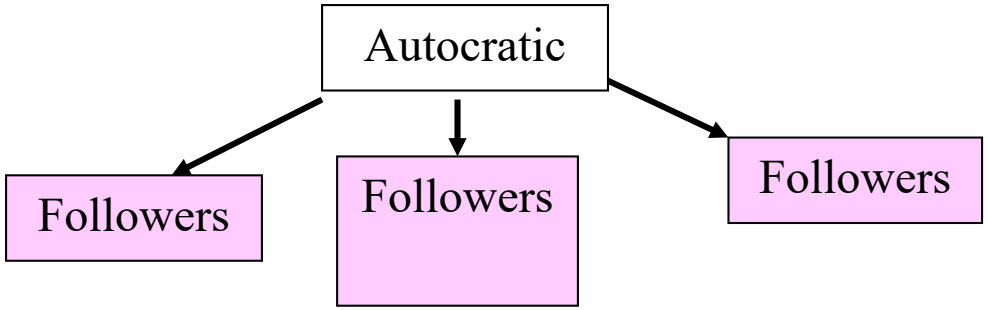
Representation: Leadership represents the organization to outside the world.

10.3 Supervising and leadership style

As management has to get work done through people, it must follow a suitable leadership style to fit to the organization. While executing leadership by leaders, the following three ways have been found-

1. **Autocratic Leadership style-**

   The leader centralizes the power and decision making authority with him.



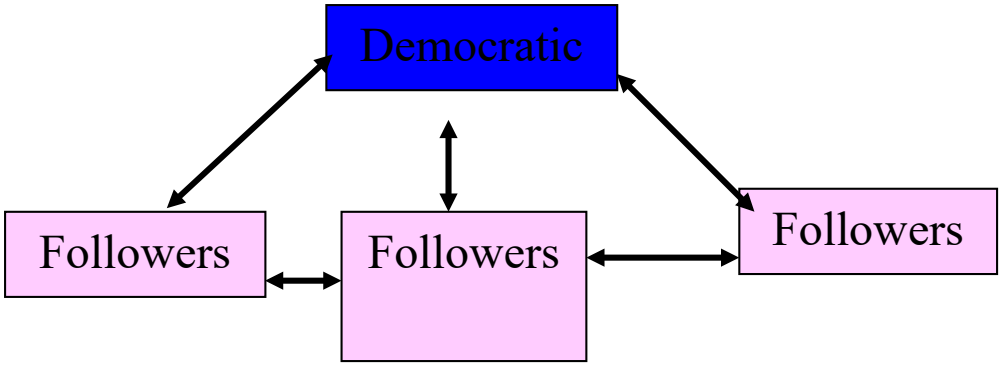
Leaders make decisions. Leaders have position-based authority. Leaders give rewards and punishment as they like. The leader controls information

2. **Democratic leadership style-**

Certain power is decentralized to subordinates. Subordinates are believed to be capable. So, discussions, consultation and participation are encouraged in this style of leadership

Continued--

Subordinates are consulted. Authority and responsibility are delegated. Influence follows both ways. Performance based reward is exercised. Information is shared between leader and followers.



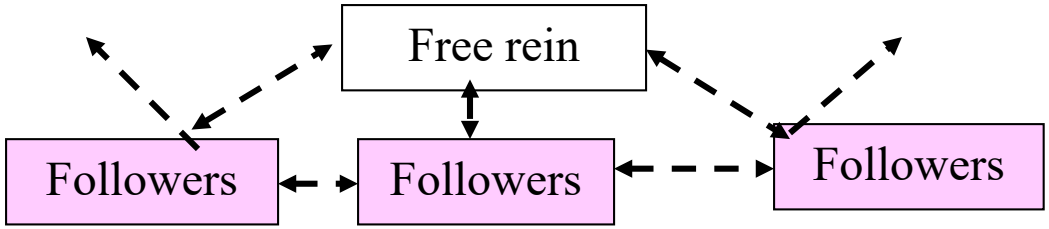
3. Free rein (laissez-faire) leadership style-

Subordinates are entrusted power and authority in making decisions. Leaders use little power and decision making. They are central only. Subordinates have high degree of freedom to make decisions. Influences follow all directions. Subordinates set their own goal. Their potentialities are utilized.

This type of leadership is effective in research-oriented jobs. It leads to high morale.

Continued--

This type of leadership is effective in research-oriented jobs. It leads to high morale.

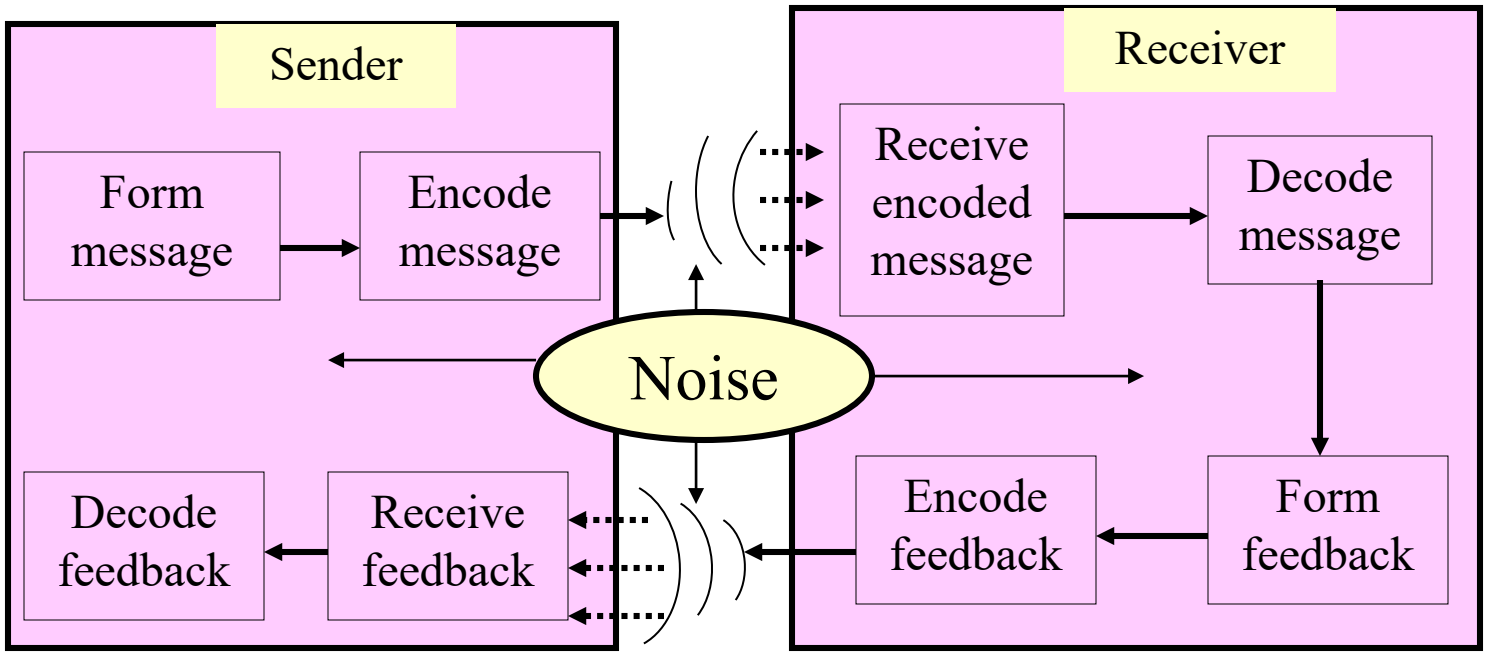


Manager (supervisor) plays the following major roles.

Interpersonal roles	**Informational roles**	**Decision making roles**
➢1. Figure head,	Information center	Entrepreneur
➢2. Leader,	Dissemination	Disturbance handling
➢3. Liaison	Spokesman	Resource allocation
		Negotiation

10.4 Importance of Communication

Communication is a process by which information is transmitted and **understood** between two or more people. Understood has been emphasized because transmitting the sender's intended meaning is the essence of good communication.



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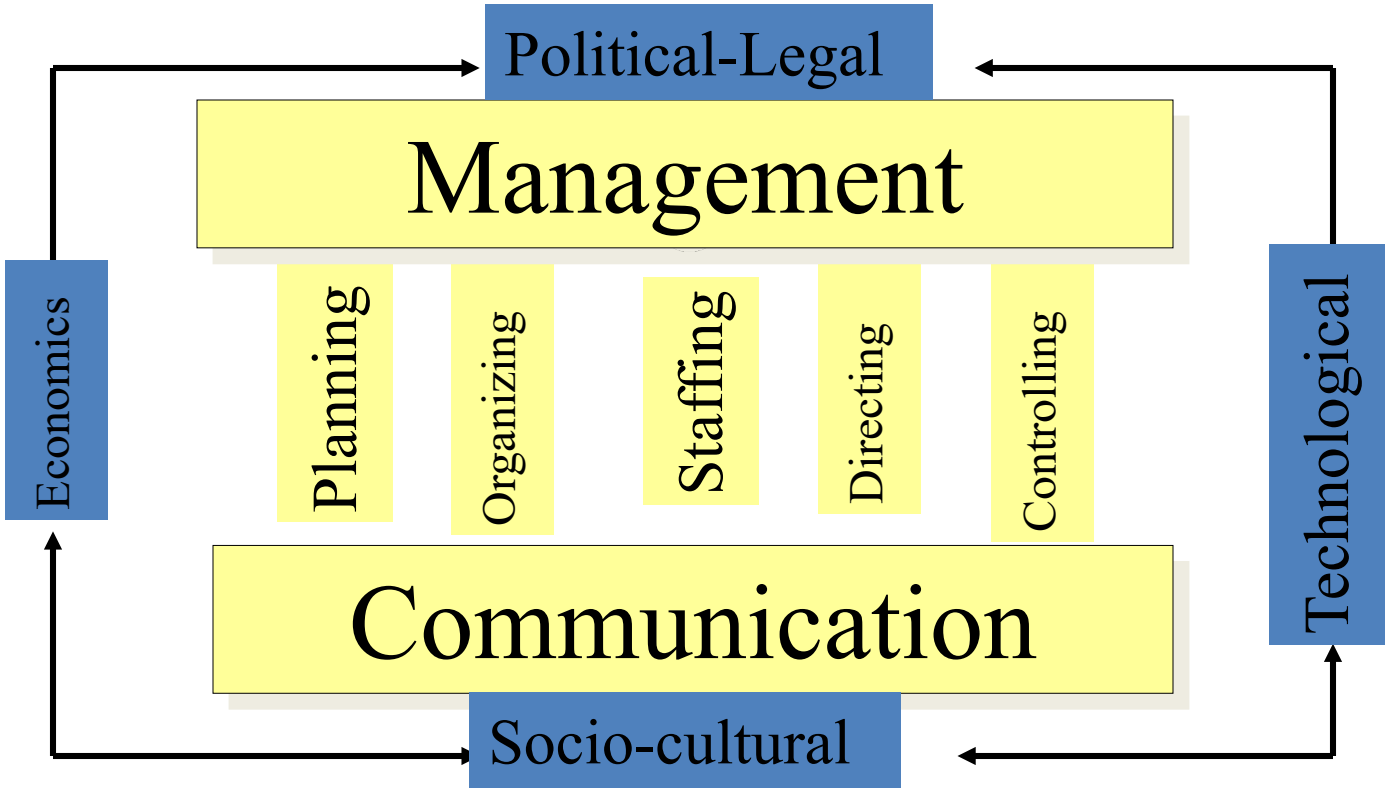
The management functions are rested upon the information obtained through communication. The external environment of the management includes economics, political-legal, technology and socio culture within which communication exists and thereby management functions take place



10.5 Information system of decisions

Decision-making involves making a choice among alternative courses of actions. Decision-making is choosing one among two or more alternatives by following the steps of problem recognition, development, and analysis of alternatives courses of action; and obtaining feedback to determine the effectiveness of the decision-making .

1. Problem situation – identify & define problem,
2. Decision maker – should be problem faced decision maker,
3. Decision environment – alternatives are known and consequences are also assumed. Following are the elements for decision environment-

- Certainty – there should be certainty of the consequence,
- Risk – decision maker is not aware of the alternatives,
- Uncertainty – decision maker is not aware of what will be consequences of the decision with all those available alternatives,
- Ambiguity – when alternatives and the goals are not clear, there exists ambiguity

Continued--

Nature of decision making –

- Decision is pervasive,
- It is a dynamic process,
- It is a continuum process,
- It is a selective process,
- It is goal oriented,

It gains commitments,

Types of decisions-

There are following types of decisions –

1. Programmed decisions,

-repetitive and routine problems,

-policies, rules and standard procedures,

-middle and lower level managers,

Continued--

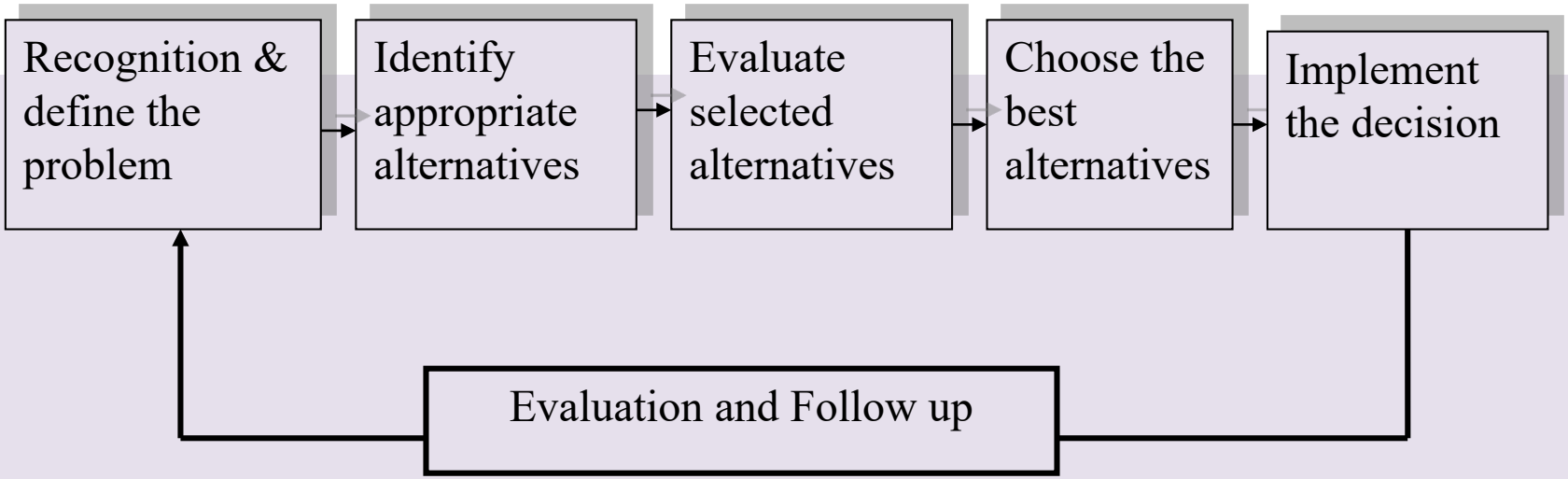
2. Non-programmed decisions-

- -Complex and novel and non-routine,
- - Judgmental, intuition & creativity,
- - Top level managers

3. Strategic, tactical and operational decision

4. Individual and group decision

Process of decision making-



10.6 Motivating and Directing: Human elements, elements evaluation and Merit rating

Motivation refers with how **Behavior** is energized, how it is directed and sustained. The management's challenge is then to channel the energy of the personnel and direct behaviors towards the organization's ends.

Lewich's equation stated as B=F (P, E), where B is behavior which is the function (F) of a person (P) and the environment (E).

Both persons and environment have an important contribution to management's understanding of employee behavior and motivation.

These are many Content and process theories of motivation, some of which have been discussed below-

Maslow's hierarchical needs

Abraham Maslow propounded hierarchical need theory. There are five hierarchical needs for all human beings starting from-

1. **Physiological needs** –Food, water, shelter etc,
2. **Safety needs** - Protection from physical and emotional harms,
3. **Social needs** – Social affection, belongingness, acceptance and friendships.
4. **Esteem needs** – self respect, autonomy, achievement are internal esteem. Status in the society, social recognition and attentions in the society are external esteems.
5. **Self actualization** – Growth, achieving one's potential and self-fulfillment.

Unless the first need does nor fulfill, the subsequent need cannot start.

Clasyton Alderfer of Yale University reworked on Abraham Maslow's need theory to align closely to the empirical research. He revised and called it **ERG theory**. ERG theory states only three core groups of needs- **Existence, Relatedness and Growth.**

Unlike in Maslow's need theory, any one or all of them can occur at a time

Herzberg's Motivation Hygiene theory

Frederick Herzberg propounded this theory. He developed dual factor theory of work Motivation. The theory identifies intrinsic factors, which are related to job situation and extrinsic factors that are associated with dissatisfaction.

a. **Maintenance or Hygiene factors**- These factors do not produce motivation, even if they are present in the work situation, but when they are absent, they cause dissatisfaction to the employees. They are as follows-

1. Company policy and administration,
2. Technical supervision,
3. Interpersonal relation with supervisors, peers and subordinates,
4. Salary,
5. Job Security,
6. Personal life,
7. Work condition
8. Status.

If these factors are absent in the work condition, there will occur more absenteeism, job quit, and grievances in the organization.

b. Motivational factors

The second part of this theory is Motivational factors. Motivational factors also called satisfiers or motivators. Motivational factors cause high level of motivation and when present in the work situation, satisfaction occurs.

Absence of motivational factors do not lead to dissatisfaction but to not satisfaction. These factors relate to job contents. Some motivators are as follows-

1. Achievement, 2. Recognition, 3. Advancement,
4. The work itself, 5. The possibility of personal growth,
6. Responsibility.

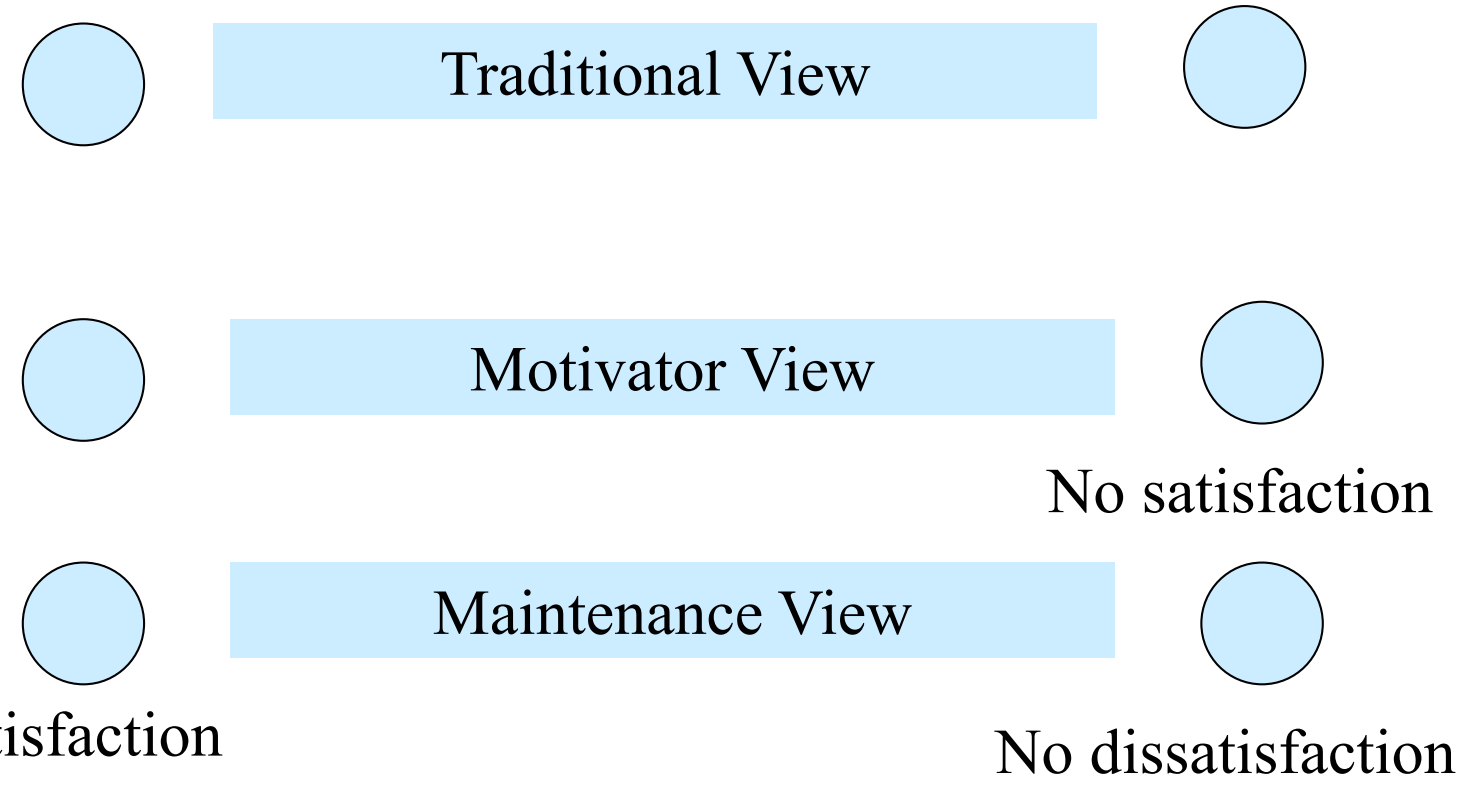
Herzberg has suggested two steps of application of this theory-

In the 1st step, the supervisor should eliminate maintenance or hygiene factors that cause dissatisfaction, and

In the 2nd step, the supervisor should motivate through motivating factors by enriching the jobs with motivators.

Continued--

Frederick Herzberg's Dual factors of Motivation



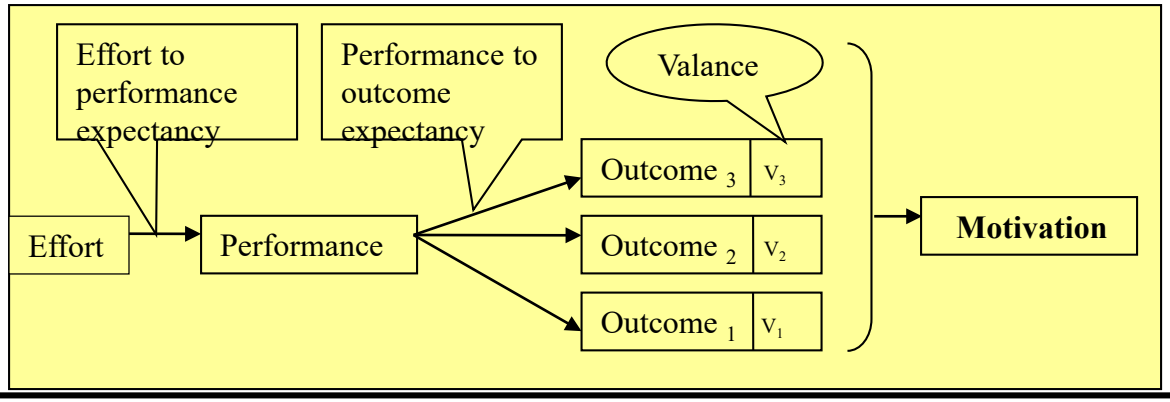
Expectancy theory of motivation

The concept was substantially revised and refined by Lyman Potter and Edward Lawler in 1968, and again by Edward Lawler in 1973.

Motivation will be greatest when-

- an individual believes that s/he can perform at the desired level when high Effort tends to Performance expectancy.
- an individual believes that good performance on his /her part will lead good performance. High performance tends to outcome expectancy.
- an individual values those outcomes, gives high valance.

$$M = (E \rightarrow P) \times \Sigma [(P \rightarrow O) \times V]$$



Equity theory

Equity theory explains how people develop perceptions of fairness in the distribution and exchange of resources.

Individuals compare their job inputs and outcomes with those of others and then respond so as to eliminate any inequities. The main four elements of equity are-

1. **Self-inside**: employees' experiences in a different position in the current organization,
2. **Self-outside**: employee's experiences in a situation outside the current organization,
3. **Other-inside**: Another employee or group of employees inside an organization,
4. **Other-outsides**: Another employee or groups outside the organization.

Continued--

Ratio comparison and Perceptions

$O/I_A < O/I_S$: inequity due to being under rewarded,

$O/I_A = O/I_S$: Equity,

$O/I_A > O/I_S$: inequity due to being over rewarded,

Where, O = Outputs, I_A = inputs by the employees in the organization, and

I_S = inputs put by employees in other organizations.

And O/I_A represents the employees and O/I_S represents relevant others.

The employees that preconceive inequity will have the following six choices-

1. Change their input, 2. Change their outcomes,
3. Distort perception of self, 4. Distort perception of other,
4. Choose different referent, and 6. Leave the field.

Result: Continually treat people fairly in the distribution of organizational rewards.

Goal setting theory

Goal setting theory is the idea that establishing goals motivates people to strive to achieve them. Edwin Locke, professor of management at the University of Maryland, proposed this theory.

This theory does not focus as much on the needs and beliefs of people as on the external situation that guides human performance. The genesis of goal setting theory was the discovery that people, who has goals, they strive to achieve, perform better than those who do not have such goals, and that people with more difficult goals perform better than those with easier goals

10.7 Personnel selection, testing and training

The recruitment and selection process is a systematic attempt to implement the human resource plan by recruiting, evaluating and selecting qualified candidates for the jobs. Job analysis, job description, and job specification are important tools in the selection process.

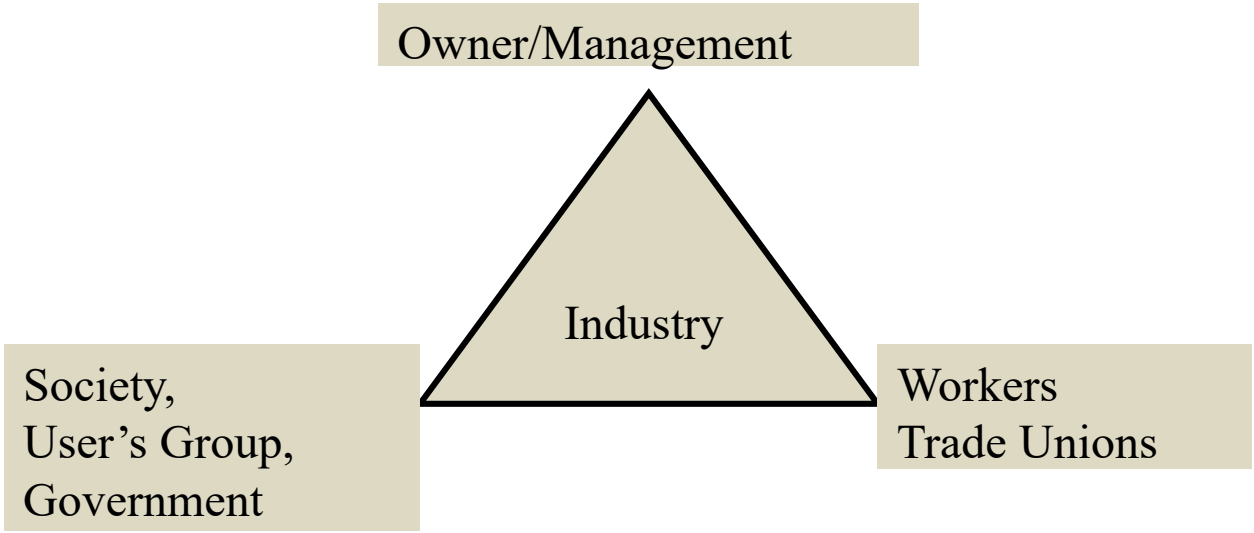
Recruitment is finding out the sources of competent people for the jobs identified from job analysis, job description and job specification.

Selection is the identifying appropriate candidates from among the sources of qualified candidates. Various methods are used to select right people for the right jobs.

Training and development is the process of utilizing the potential capabilities of the employees from which the employees also become motivated and put more extra effort for the attainment of the organizational goal.

10.8 Trade unions and relations with management

The outgrowth of industrialization results in industrial relations.. The workers make unions to safeguard their rights and duties against the management. Also the customers is safeguarded by the government. Thus there are three stakeholders in industry- the trade unions from workers, management from industrialists and government from the society.



Trade unions are the organization of workers acting collectively and seeking to protect and promote their mutual interests through collective bargaining..

Continued--

The main goals of trade unions are-

- Influence the Wage and Effort Bargain.
- Establish a Security System of members (Sub-security)
- Influence the administration of rules. Unions influence the condition of works.

  Obtain political power

Management fights with unions because they-

- Reduce the power of management.
- Increase the potential of strike.
- Increase costs and create threats to efficiency.
- Redirect employee commitment
- Pressurize for renewing HRM policies and decisions.

Continued--

Trade union in Nepal

Although there are many trade unions in Nepal, but registered and recognized are-

- GEFONT (General Federation of Nepalese Trade Unions) - It is affiliated to UML and has 304601 members.
- NTUC (Nepalese Trade Union Congress) - It is affiliated to Nepali Congress party and has members.
- DECONT (Democratic Congress of Nepalese Trade Union) – It is affiliated to Nepali Congress with members

Chapter-11
Regulatory Requirements

11.1	Safety Requirements
11.2	Workman's Compensation board
11.3	Fire Regulations and Insurance
11.4	Environment concern and protection
11.5	Building codes and quality control

11.1 Safety Requirements

Basically engineers works in the society for the fulfillment of the needs of the people. Nothing can be done singly and if it requires others to assist the work, it is not sure of his or her safety unless safety regulations has been provisioned.

Loss of lives, machines, property or any other that seek compensation raise the cost of construction. Engineers are bound to execute works within budget, time and quality standard as specified; without any loss of life, property and machines.

There is no other way except seeking help from other people for competition of the works, which is allocated budget. Remaining within the budget and time allocated, an engineer has to perform and accomplish the work without any harm or loss of life of any people either involved or noninvolved, property or violating the salutatory rules and regulations. So, safety requirements have been necessary for engineers.

In 1970 A.D., the Occupational Safety and Health Act (OSHA) changed dramatically the role of management that it must play a role in ensuring safety and health in the physical work conditions to meet adequate standards. What the Civil Rights Act did to alter the organization is the commitment to alternative action, OSHA has done to alter the organization in health and safety programs.

Labor Act 2048 (First revision in 2054 B.S.) has the following provisions regarding safety regulations-

Section 5, Article 27: Provision for Health and Safety-

The organizational management regulates the following-

a. In every organization, provisions shall be cleaning the workshop every day using chemicals to keep clean and safe work conditions.
b. Workspace will have sufficient air, light and adequate temperature.

c. Provision for managing debris, rubbishes and wastes in a safe place or demolish/burn safety.
d. Provide ear-protective devices to protect from noise pollution and reduce the noise pollution level as far as possible for safe working.
e. Provide sufficient watering space, usually 15mm for each workman. It will be counted only up to 4m from floor level.
f. Provide safe drinking water during working time and also manage fire extinguisher at every corner to protect from fire hazards.
g. Arrange separate and modern rest room in a convenient places.

Continued--

h. Acclaim “smoke- free zone” all or part of the working space as per the part nature of the work.

I, Examine/check health of every workman once in a year.

Article 28 -Eye protection

Clause 1. From glass, mirror, mercury, magnet plate, iron, concrete, cement, lime, stores and explosives dust or pieces may cause harm on eyes and hence protective measures should be arranged.

Clause 2. Harmful rays from wielding or gas-cutting or any thing similar can harm eyes of the workers, so, protective measures should be arranged for then.

Article 29- Safety from chemicals

Necessary protective personal measures should be provided to those, who work in chemical affected areas.

Article 30-Arrangement for fire hazards

Clause 1. The management of every organization should provide modern fire-control devices in the organization.

Clause 2. The management should arrange easy exit when necessary in fire-hazards.

Clause 3. Fire protective measures should be arranged in the organization. Article 31- Protection from dangerous machines

Clause 1. - Strong protection should be provided on those machines, which are power-run.

Clause 2- trained and experienced adult workers should be allowed to provide lubricants, inspectors or adjust the running machines.

Article 32 - Over-weight lifting

Clause1. None shall be allowed to lift or transfer loads, which can harm the worker.

Clause 2. Only limited weight shall be allowed to those who are adult, to load, lift or transfer weights.

Article 32.a. Without sufficient professional training/construction, no child shall be allowed to work-

Clause 1- without sufficient professional training and construction, no child shall be allowed to work.

Article 32 - Pressure plant

Clause 1. Necessary effective measures shall be required to arrange if the plants have to work is more than safe working pressure.

Article 34. Instructions to arrange safety

Clause 1. Labor office shall instruct the firm to have safety measures employed in a written order.

Clause 2. In case if not obeyed the order, labor office will order to close down the firm.

Article 35. To give notice

Clause 1. The firm will inform labor office if:

Any workman died because of accident.

Wounded and unable to work for the next 48 hours.

Within 3 days, and if any workman is found suffered from any disease from the profession, the firm will inform the labor office within 7 days.

Article 36. Authority to classify standards:

Safety arrangements and their classes can necessarily notify in the gazette paper by the government.

11.2 Workman's Compensation board

There will be a minimum salary (wage) fixing board and on the recommendation of the board, the wages of the employee of the organization shall be determined.

a. Minimum wage, disease allowance, benefits to be set by a min wage setting committee, which is constituted from equal numbers of representation from the workers/management and the government.
b. Minimum wage rate to be published in the gazette.
c. Provision for annual increment, usually wage of half a day only for permanent staff.
d. Its management's responsibility to make payment of salary in time, No payment except in the followings-
    i. imposed fine for being absent.
    ii. to cover the loss of the firm due to negligence
    iii. for the benefits provided

iv. excess payment,
v. medical benefit coverage during suspension
vi. payments from the order of the court, government office,
vii. tax deduction.

6.3 Fire regulation and insurance

Labor Act 2050, under section 4, article 38 has spoken about fire protection management in Nepal.

Article 38: fire protection management- the management of the organization will do for the fire protection management as under-

- fire extinguisher equipment to be placed in right places for the fire protection purposes.
- In factories, sufficient water with pressure at hydrant point and hose pipes to be provided.
- For easy movement during fire hazards, emergency exit doors without any obstruction should be arranged.
- Arrange any system to alarm of fire hazards like siren during fire hazards.

- The equipments like fire extinguishers should be inspected at least once a year in the premises.
- Explosives like gun-powder, nitroglycerine, dynamite, gun cotton, blasting powder, mercury or others should be stored away from dense population and inspected and transported only by experts.

There is no separate section for insurance of the workers in Labor Act 2050, but under section 3, article 15 describes the conditions for obtaining the payment of the harms.

Article 15: Pay for harms:

a. any worker wounded while working should be examined by the doctor registered or recognized doctor by the government and all the expenses be borne by the organization in which the worker works.

b. the management will pay half salary to the physically wounded worker while working in the organization and has been obtaining treatment at home in addition to all medical expenses as explained in (1). But if s/he has been treating the wounds at hospital, s/he will get full salary of those days.

But if the treatment has been going for more than one year long, the organization will not pay for those extra times.

Article 1b: Loss of organs and payment:

- Accidentally, if the worker happens to lose any part of his body while working at the organization and if it happens to be 100% incapable, s/he will get a total amount of 5 years' salary from the organization.
- In case, loss of parts of body with incapability 100% as given in index-1, organization will have to pay the work accordingly.

Accident and Loss	Incapability fix results
Total Loss of sight	100
Full / complete paralysis	100
Both hands or palms with all fingers	100
Permanently bedded	100
One eye	100
Fully deaf	70
Any arm loss from elbow	70
Any loss from wrist	70

Article 17: death-

Any worker dies while working or dies during treatment period, his present salary of 3 years in total shall be provided to his/her nearest relative.

Article 18: determination of incapability percentage-

Accidentally if any worker loses his/her certain part of body, then a recognized doctor by the government will check and certify to fall in any of the incapability shall be determined. The victim will then obtain payment accordingly.

Article 19: “no pay of loss “condition

Any loss or damages due to natural calamities shall not be paid by the organization.

Article 20: dual benefits is not paid-

Any worker accidentally losing his/her organ will not be paid from both the organization of from his insurance company, if s/he has been insured by the organization. S/he will only get the bigger amount of the both only.

Article 21: Payment of loss and lay off with gratuity

Accidentally wounded or loss part of body while working in organization and if the treatment continued more than a year, the company may lay-off with gratuity and medical expenses for a year. But s/he should be declared by the government doctor.

Article 22: priority for employment

Any worker died while working in the firm and his/her descendent shall be appointed on an appropriate position.

Article 23: gratuity

- for the first 7 years, it will be ½ of the present salary for 7 months.
- For more than 7 and up to 15 years, the amount shall be 2/3 of the salary for the month nos. equal to total service years.
- For more than 15 years, 1 month's salary for the years of total services.

(*Refer: Labor Act 2048 and 2050, Nepal*)

Biosphere: a life support system

The biophysical environment includes plants and animals (biotic) that interact with the physical elements (abiotic) through the process of materials and energy cycling, involving the lithosphere (soil rocks) atmosphere (air and other vital gases) and hydrosphere (water), as well as radiation from the sun. This interaction of biotic components with abiotic elements of the natural environment constitutes the complex system of our biosphere: a system, which sustains life on earth.

Photosynthesis produces food for all life

As a primary component of the biophysical environment, plants produce all food materials with the help of sunlight (via photosynthesis) and maintain animal life. Green plants are eaten by one of the animal, called herbivores, and they, in turn, are eaten by another set of animals, called carnivores. The third set of organisms, which decomposes dead and decaying matter, is called detrivores. The process of eating and being eaten in a natural system is called food chain and involves energy cycling.

Ecosystem; a dynamic, self functioning, self perpetuating system:

The biotic and abiotic components of nature interact structurally and functionally, giving rise to a system called ecosystem. The biosphere contains many ecosystems such as forest, water, grassland, marine etc, each of which is able to perpetuate.

Environment; a system that includes human beings and their surroundings-

The biophysical systems interact with the social and economical aspects of man and this makes human being one of the entities of the environment. So, environment can be broadly defined as “the natural and social conditions that process all the organisms which include mankind and future generations.”

Natural environment, the sink for all wastes and source for all resources.

Human beings, a component of the environment, receive numerous services from ecosystem, which provide all vital life support elements such as oxygen water etc, provide material inputs, in term of natural capital to the economic system of man-producing man-made capital - and also provide “sink” functions to all the wastes produced through the economic activities.

Natural capital provides man made and human capital. Natural capital is defined as a stock of environmentally provided assets such as soil, atmosphere, forest, water, oil etc. that flows from ecosystem to the economic system; they are renewable or non-renewable, marketable or non-marketable. Sustainability means maintaining these resources without any insignificant depletion.

Human capital refers to people and their capacities, education, skills, cultures, technologies etc., while manmade capital includes houses, roads, factories etc. Man-made capital is a product of natural capital. Excessive use of natural capital has affected global eco-system

Ecosystems are capable of providing specific services to human beings. They provide limited amount of resources (perhaps into manmade capital) and absorb a limited amount of waste, without their functions being impaired and ultimately degraded. However, with population increase/growth and economic development, there is over-exploitation of certain resources, examples: global marine fish stock which has affected the productive capacity of the environment, especially at local and regional levels.

Similarly, disposal of increasing amount of waste has begun to "overload" the assimilative capacity of ecosystem (the "sink" function), causing additional degradation of the structural and functional integrity of the ecosystems.

E/A is a useful instrument for reducing adverse impact on the environment

These global trends have been apparent for the part 10-15 years and provide a context of increasing urgency in terms of applying quickly the environmental management instruments to the process of developing the geographic scales (local or international) one of these instruments continues to be E/A (Environment Impact Analysis), has its origin in a different context concerned, but different problems and difficulties were important.

(*EEIA training Manual IUCN, Nepal*)

Building codes are the norms set by the state to follow in construction. The codes provide guidance for design, drawing, construction and material selection as well. The codes confirm minimum level of quality of materials, construction and building. The codes also give guidance to methodology of the execution so that quality level can be maintained.

In execution of construction works, people of different background can use different method of doing works, but if the state confirms the guidelines for selecting materials to suit the local conditions, the nature of the materials available and the local methods of constructions, the codes examine, test and prescribe the suitable, safe and economical use of materials, methods of doing it, checks and tests to maintain quality.

The disasters occur due to low quality of construction create society, which the state does not want. Therefore, people wishing to build shelters using various materials-modern or traditional, will build safe and strong buildings/ constructions by following the norms set by the building codes.

Building codes-

1. Examines and tests materials and recommend for use
2. Samples are drawn from mass of the testing materials or population, examine in different adverse conditions and confirm the suitability of the same in the parts of the state for use.
3. The tested and examined samples ensure the guarantee of being strong, stable and non-dangerous.
4. As the state does not want any people to come across accidents or misfortunes, it regulates those tested and examined type of materials, processes and equipments for use.
5. The people also benefit by using tested, examined and recommended materials, methods and use. By any chance, failure occurs. It will be the case of the codes and it will again test in such climate and recommend a safe method.
6. By using the codes, the users ensure quality standards set recommended and regulated by the state.

Chapter-12 Specification

12.1	Purpose of Specifications
12.2	Types of Specifications: General and Detailed Specifications
12.3	Specification Writing: technique, use of international and local Standards, Codes of Practice
12.4	Importance of Specifications

12.1 Purpose of Specifications

- to describe the nature of works, materials, methodology of doing works to obtain anticipated quality level,
- to provide guidance to supervisors for collecting materials, systematic construction and maintenance of the works,
- to control the process of construction for quality control through method of execution.
- to give targets of the quality of work to the contractor, who, on the basis of it, collect materials, equipment and manpower to perform quality works,
- Because of gathering of materials, equipment, man power, their costs have to be ascertained, as a result, it helps in forecasting the fund for the works,

Continued--

- Because of gathering of materials, equipment, man power, their costs have to be ascertained, as a result, it helps in forecasting the fund for the works,
- as specification plays a role to bridge up the gap between the major stakeholders of the construction works, the same can be used as a basis for resolving disputes arisen among the stakeholders.
- Specification becomes a binding document for quality performance, it can be changed in the recommendation of the engineer with the support of the builder and approval by the owner and the performer,

12.2 Types of specifications

1. General specification / brief specification, and
2. Detailed specification,

1. General specification / brief specification,

- It gives the name and nature or class of items of works and materials in general,
- At the stage of designing and planning, the designer / planner use different items of works in short to distinguish one from other,
- It helps to obtain general ideas of the item of works,
- It is not used in conflict resolution. It does not make a basis for litigation

2. Detailed specification

- gives details of materials, methodology and maintenance regarding the quality level of a particular work,
- speaks out the quality of the input, process and outputs including maintenance required throughout its active life

It has the following three provisions in general-

a. General provision,

b. Technical provision, and

c. Standard specification provision

a. <u>General provision</u>: General limitations are described to eliminate dilemmas or to ensure ways of resolving the dilemmas.

Continued--

- department prepares it for general purposes
- describes the roles of contractors, owner and engineers in the construction.
- defines the time, dates, way out for defects and design and plans etc.
- describes the validity of roles of stakeholders, communication process, personnel requirements, governing law, decision-making process and other binding terms and conditions.
- Include the conditions of contracts,

Technical provisions

1. Materials-
   a. Chemical composition,
   b. Physical properties,
   c. Transportation and storage of materials,
   d. Nos. of tests and certifications
2. Workmanship-
   a. Construction methods,
   b. Protection of the finished products,
   c. Use of manpower or machines or both,
   d. Maintenance of the completed products

c. Standards specifications provisions-

- specifications are standardized for the most items of works occurring in the similar situation / works by the departments or any other authentic authority,
- standards are provided with code of practice numbers, where and when the code is quoted, the details of it gives its details specifications, which have already, been described by the authority,
- By quoting the standard specification numbers, the writing up of the specification can be minimized without creating confusion, ISI, NSI, BSI are some of the standards specifications that can be quoted.

12.3 Technique and Code of Practice of specification Writing

The paragraphs of specifications must clearly describe the anticipated quality standards of resources used in the construction.

Their physical state, processing and output stages, and maintenance techniques, are described when and where required

FIDIC guidelines are followed for writing specifications,

The World Bank's Standard Bidding Document (SBD) for large and small contracts is widely used as guidelines for systematic and detailed stages of writing specifications

Following points are recommended for writing specifications-

1. use concise, clearly worded and unambiguous word sentence,
2. syllabi and sentences should be grammatically correct,
3. accurate and complete information should be given in all respects,
4. use any suitable and desired words for exact meaning
5. practical limitations should be kept in mind
6. specifications should be fair to all stakeholders
7. it is a legal document, so, use only concise words to avoid confusion and ambiguity,
8. established and recognized parameters are described through its code numbers in the relevant context wholly of partly,

2.4 Importance of specifications

The following importance / necessities of specifications can be listed down –

1. It helps to bring up the expected and envisaged qualities in the design stage of all – materials, workmanship and products,
2. It helps to ensure the expected quality of materials, procedures, outputs by testing samples at different stages of constructions,
3. It helps all concerning stakeholders to guide in construction, inspections and obtaining the products,
4. It resolves disputes concerning the work if arise due to misunderstandings about the quality, process or maintenance of the work

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