Chapter -4

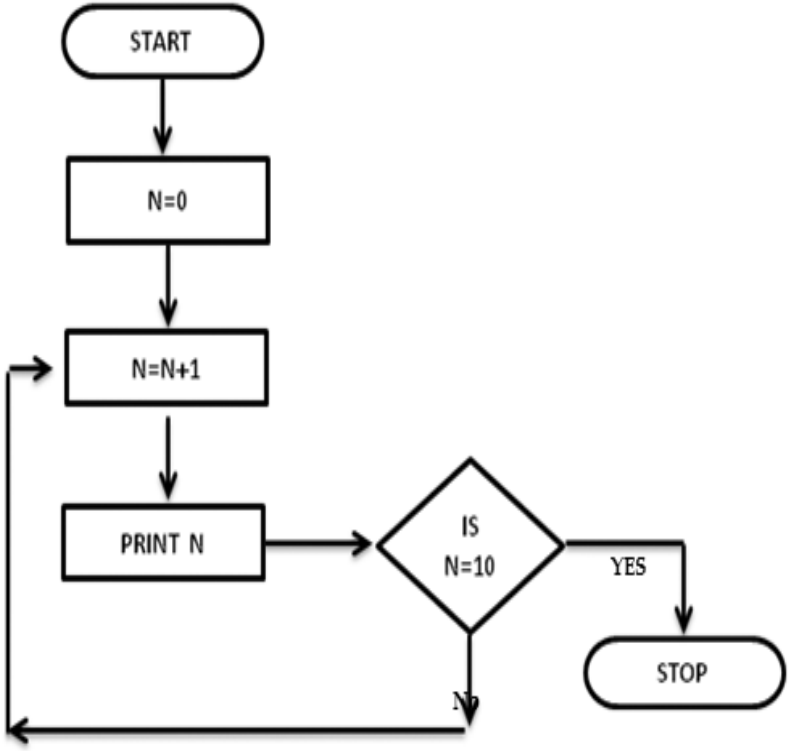
Flow Diagram

Flow Diagram

Flow diagram is a graphic or pictorial representation of the sequence of steps that are performed to produce some output. Flow diagram applies for a product, service, information etc. It is a systematic method of writing the sequences of activities with arrows indicating the direction of flow of the process sequence. In fact, it is known as the **"Armchair journey of a process"** without actually visiting the place.

Flow charts were popular among computer programmers in the 1960s. They used it to write the sequence of the steps the computer has to perform.

Given below is a flow chart for a programme to print numbers from 1 to 10.



Flow Charts can also be used to dissect a process for better understanding and analysing.

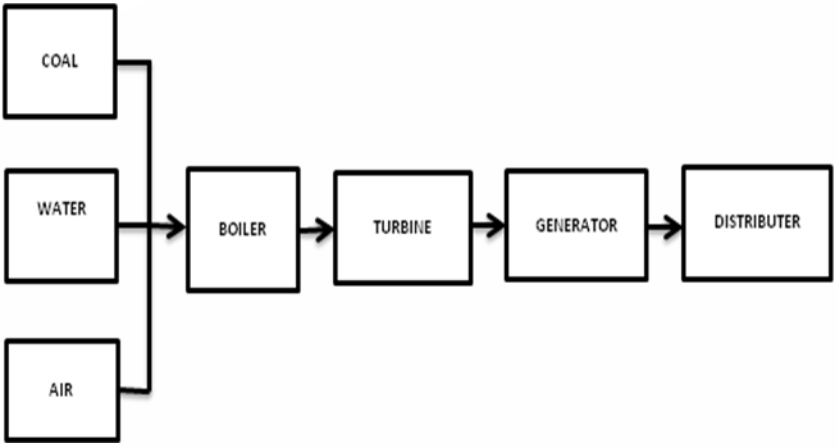
It can also be used for re-planning or making a change. Without really going through the physical sequence of operations, we can envisage where there is a problem, what actions need to be taken to mitigate the problem etc. The flow chart helps in analysing whether a particular action is adding value to the process or redundant. Quality Circles, QIT & SGA teams use flow charts during "Identification of problem" stage.

There are basically three types of flow diagrams:

1) High Level Flow Diagram
2) Matrix Flow Diagram
3) Detailed Flow Diagram

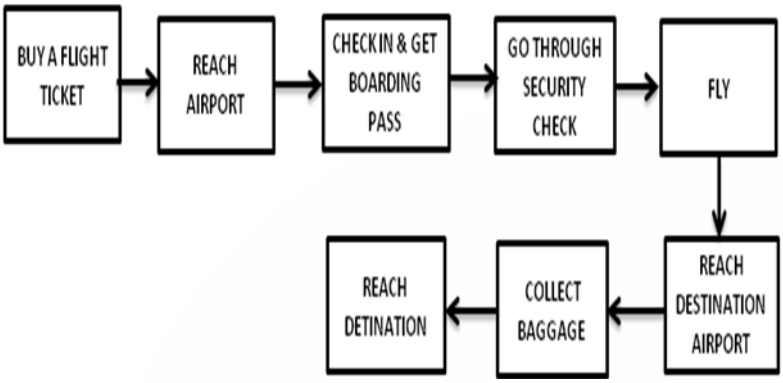
High Level Flow Diagram

The high level flow diagrams are very broad and less detailed flow diagrams giving a very quick overview of the process. For example, the high level flow diagram of a thermal power station can be as simple as shown below.



The major activities involved are arranging coal, water and air to the boiler, generate steam to run a turbine which runs a generator which produces electricity which in turn is distributed.

Similarly, if you want to reach another city by flight, the broad activities involved are:

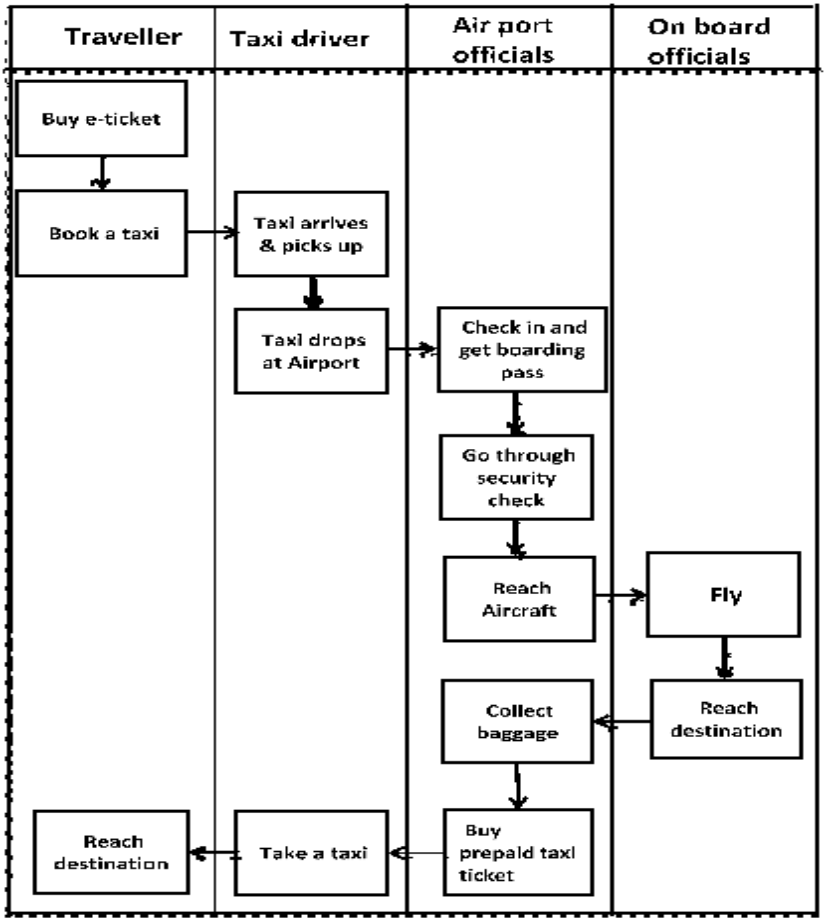


Here a traveler wants to reach from one city to another. The broad steps involved are :

a) Buying an e-ticket
b) Reaching the airport
c) Checking-in the luggage and getting boarding pass
d) Reaching the aircraft & flying
e) Reaching the destination airport
f) Collecting the baggage
g) Reaching destination

Matrix Flow Diagram

Now let us take the same example and try to redraw it as a Matrix Flow diagram.



In the matrix flow diagram, some additional information is provided. In the above case, there are four groups of people namely, the traveler, taxi driver / transporter, airport officials and on board officials. More than one activity takes place in each of the domains. These activities are represented in a matrix form as shown in the diagram below.

Detailed Flow Diagram

The detailed flow diagram is a listing down of all the activities in their natural sequence. For drawing this, a set of symbols are used. Now let us understand the symbols.

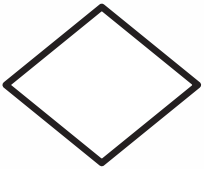
1. The Start / stop / end Symbol

It is also known as “terminal symbol”. It is a rounded rectangle. It is used at the beginning or end of an activity.

2. Activity Symbol

It is a rectangle in which a brief description of the activity at that step is indicated.

3. Decision Symbol

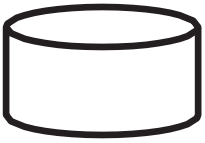


It is a diamond symbol. It is used to depict a decision. If the decision is ”YES”, the flow will go in one way. If the decision is“NO”, then the flow will go in another way. It is the decision signal which enhances the utility of the flow diagram. There are totally three possible options.

4. Document Symbol

This symbol is used to depict a document pertaining to a process.

5. Data Base Symbol



This indicates electronically stored information pertaining to the process.

6. Flow Lines

These are arrows which show the direction of flow of the sequence of action. When it comes to decision symbol, there is one input and three possible outputs. From the decision symbol, we often go through a process re-loop. Arrows help in identifying the process re-loop.

7. Connectivity Symbol or connector symbol

In large flow diagrams, it is difficult to completely show all the activities and loops in one page.

Whenever we have to continue on another page, we use the connectivity symbol which is just a small circle. The next page starts with a circle or connectivity symbol. If there are more than one connectivity symbol in one flow diagram, we can use, A,B,C to

indicate that the particular operation continues from wherever A, B, or C are marked . Instead of alphabets numbers can also be used inside the connector symbol.

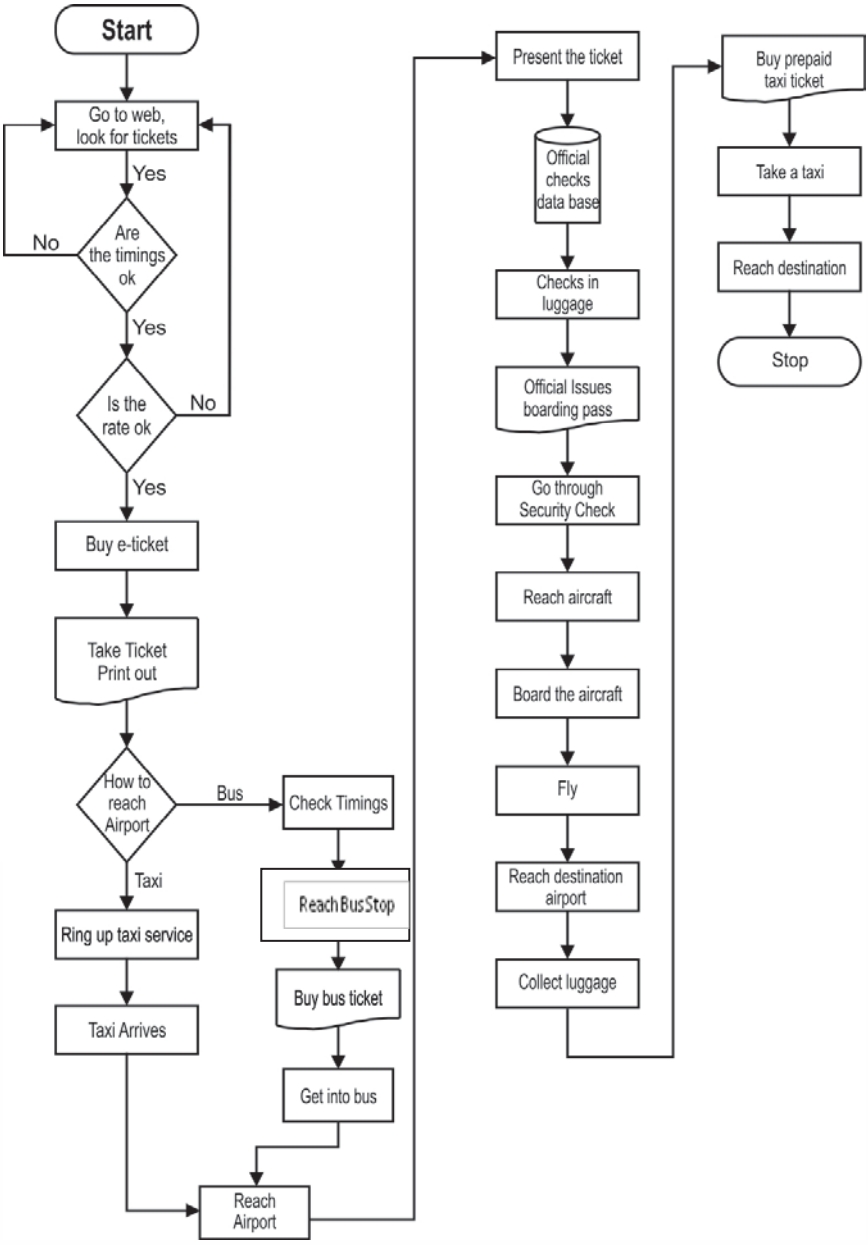
How to draw a Flow Diagram?

a) Always start the Flow diagram with a start symbol.
b) First note down all the activities.
c) Insert each activity inside a rectangle known as activity symbol.
d) Connect each activity (rectangle) with an arrow indicating the direction of flow of operation.
e) Whenever there is a change in the activity based on a decision, introduce a decision symbol (diamond). Follow the activities along each decision path and complete the loop.
f) Whenever a reference is made to a data base use the data base symbol.
g) If one page is not sufficient to complete the flow diagram and you have to continue on another page, use the connector symbol at the end of the first page and beginning of the next page.
h) When all the activities have been listed out and our goal for drawing the flow diagram has been achieved, complete the flow diagram with a terminal symbol again with “End” or “Stop” written in it.

Example of detailed flow diagram

We are now ready to draw a detailed Flow diagram. Let us now take the same case of a person wanting to reach one city from another city by flight.

Using all the above symbols, let us draw a detailed flow diagram incorporating all the activities involved in a person reaching from one city to another city in as much minute details as possible. The resulting detailed flow diagram will be as shown below.



Why should we prepare flow diagram?

There are two major reasons for drawing a flow diagram.

1) For understanding a process sequence with all its intricacies.

2) To make changes in the process for improvement.

Let us take up the first reason.
Flow diagram enables us:

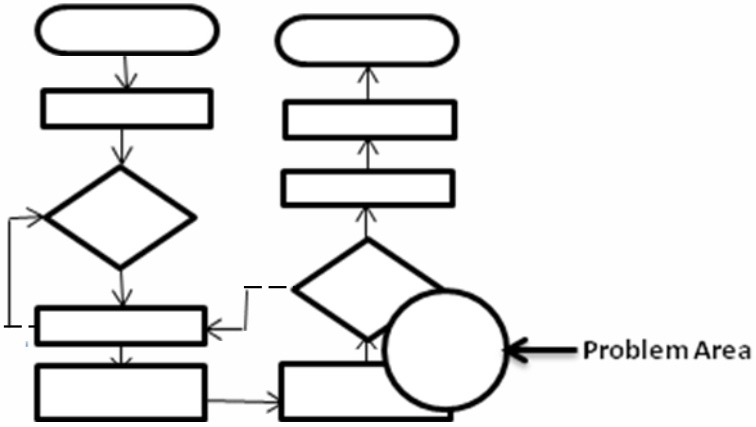
a) To see how smooth the flow of activities are.
b) If there are bottlenecks, where do they occur?
c) It helps us to estimate the time it requires to complete the process.
d) It helps us to locate redundant operations, if any.
e) To identify opportunities for changing the process.
Hence flow diagram has become popular as an "**arm chair journey**" of the process.

How to use flow diagrams effectively?

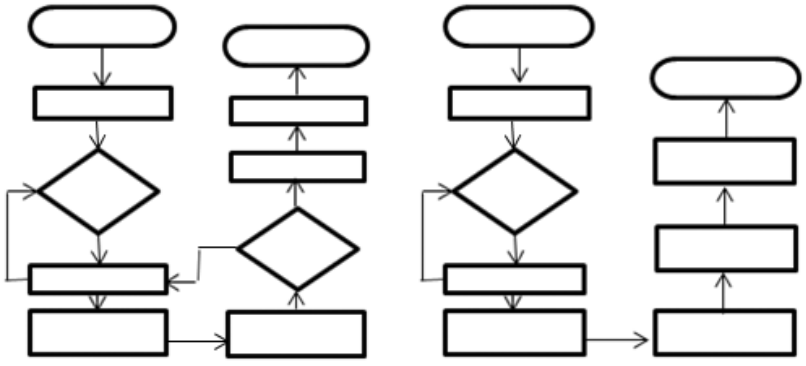
Flow diagrams can be used to explain others what is the sequence of operation in a pictorial way. In fact, this is useful for circle leader to explain the members what is the area, scope and sequence of the problem they have taken in hand.

It can be used to pin point the problem area on the process sequence.

Most of the teams circle the area where their problem is located. This makes it easier to understand and helps in analysing the problem and finding a remedial solution



It can be used to present the current process sequence and the proposed sequence. This helps the circles as well the management to view the proposed changes more critically and enable them to see the benefits. Other departments such as safety, maintenance and costing can look at the changes critically from their points of views.



Current system Proposed system

The second reason for drawing a flow diagram is to make changes for **improvement in process.**

Dr. J.M. Juran had said that when you want to improve any process, examine the following symbols critically.

a) The decision symbol
b) The activity symbol
c) The rework loop
d) The document or data base symbol

a) The decision symbol

Every decision symbol should be examined critically. See if there are any redundant, unnecessary or incomplete loops. Change or elimination of any of the branches may result in productivity or cost reduction or waste reduction.

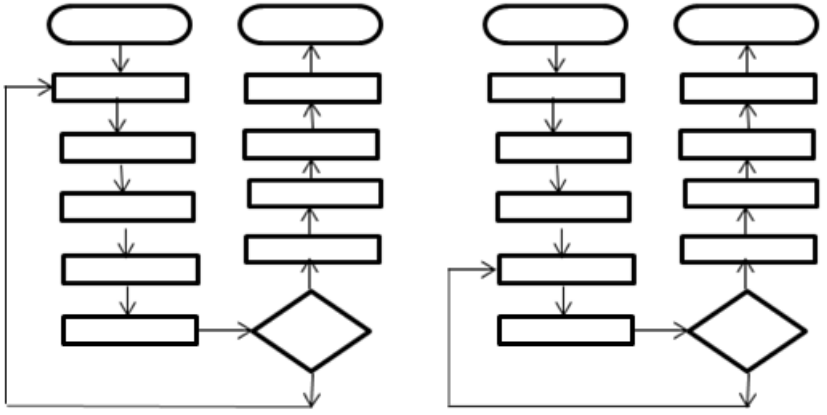
b) The activity symbol

Every activity symbol must be examined. We must examine whether the said activity is required at all for the process or not. Can we combine two activities together? Can we eliminate anyactivity? Can we simplify any activity? Does the activity add any value to the process? In fact, a whole new subject called "Value Engineering" is currently in vogue whose primary objective is to reduce or eliminate redundant activities.

c) The rework loop

The rework loop has to be examined very critically. Why should there be a rework loop in the first place? Something is not Ok first time and the rework loop is a check point to detect and correct the situation. In fact, every route has to be examined and should be eliminated if possible by design changes. Flow diagrams contribute quite a bit towards this end. If rework cannot be eliminated completely at least efforts should be made to shorten the loop.

Lesser number of elements in the loop indicates an improvement in the process.



Long rework loop

Reduced rework loop

d) The document or data base symbol.

In many companies, the same data is rewritten or reproduced at several stages in the process. This not only consumes more time,

but also delays the process. Further there could be errors introduced while rewriting the same information again, leading to confusion. Hence it is necessary to critically examine the activities involving the data base and remedial actions should be initiated if found necessary.

Documents and data bases are important sources of information. It should be ensured that these data bases are up to date and contain current and correct information. Very often data bases are not updated and taking decisions based on archaic data can be dangerous.

When do quality circles use flow diagrams?

Quality circles use flow diagrams:

a) While defining a process
b) While defining a problem.
c) While identifying the root causes
d) While devising a solution
e) While implementing the solution
f) While making a presentation to the management indicating the existing process and the changes proposed
g) While reviewing and following up

Pit falls in making flow diagrams

Flow diagrams should be made by people who know the process well.

Very often it is prepared by people who are not involved in the actual

activities. This may not reflect the real state of affairs.

The changes made to adopt the process might not have been updated.

Such un-updated flow diagram might not be of much use.

Quite often rework loops are not mentioned. For example testing-rejection-rework loop is not shown sometimes for fear of being

questioned. The higher authorities may not be knowing about such a thing. If this was brought to light, remedial actions could have been taken.