line of command, diagonal communication is also referred to as *cross-wise*, *radial*, or *circular* communication, depending upon the structure of the organization. For instance, a managing director could directly call a supervisor and give instructions.

VISUAL AIDS IN TECHNICAL COMMUNICATION

An illustration is a visual representation such as a drawing, painting, photograph, or other work of art that stresses subject more than form.

Visual aids are an important part of written technical communication. You might have observed that most technical reports, whether they are laboratory reports, project reports, or feasibility reports, include illustrations such as tables, graphs, maps, diagrams, charts, or photographs. In fact, text and illustrations are complementary in technical communication. Visual aids are also used extensively in presentations, to support the facts and figures being presented. Graphics can be used to represent the following elements in technical writing.

Concepts

This element depicts non-physical, conceptual things and their relationships. If you want to show how your company is organized, that is, the relationships between the different departments and officials, you could set up an organization chart—boxes and circles connected with lines that show how everything is hierarchically arranged and related. This is an example of a graphic depicting a concept.

Objects

Photographs, drawings, diagrams, and schematics are the types of graphics that show objects. If you are describing a fuel-injection system, you will probably need a drawing or diagram to explain the system properly. If you are explaining how to graft a fruit tree, you will need some illustrations of how it is done.

Numbers

Numbers are used while presenting data and statistics. If you are discussing the rising cost of housing in a particular city, you could use a table, with the columns showing the data for five-year periods since 1995. The rows could be for different types of housing. You could show the same data in the form of bar charts, pie charts, or line graphs.

Words

Graphics are also used to depict words. You have probably noticed how textbooks put key definitions and examples in boxes with words.

To further understand visual aids, let us answer the following questions:

- When to use?
- Why to use?
- How to use?
- What are the types?

When Illustrations are very effective when there is a mass of statistics and complex ideas to be represented. Statis-tical data is best explained through tables, graphs, charts, maps, diagrams, or photographs. As already mentioned, text and illustrations are complementary in technical communication. Hence, whenever the information to be communicated is too complicated or

technical to transmit just through words, we use visual aids. However, they should not be used just for the sake of using them.

Why Visual communication has more impact than verbal communication. Using illustra-tions has many advantages:

- Arouses interest and focuses on essentials
- Leads the reader to quicker comprehension
- Supports and reinforces words
- Saves much time and effort in explaining and interpreting complex ideas
- Explains the data in much lesser space but with greater accuracy
- Simplifies numerical data
- Emphasizes and clarifies certain facts and relationships
- Makes the descriptions vivid and eye-catching
- Renders a professional flavour to the communication

How The following are some guidelines to use illustrations effectively. The illustrations should be

- neat, accurate, and self-contained
- appropriate to the data
- labelled completely
- self-contained
- integrated with the text
- placed as close to the first reference as possible
- sized appropriately so that they are clear even upon reproduction
- such that they create a good balance between the verbal and the visual

Types Figure 1.3 classifies the various types of illustrations. It is clear from this figure that though there are various kinds of visual aids, they can be broadly classified into two main categories, namely tables and figures. All illustrations other than tables are usually categorized under figures.

In the process of selecting and designing illustrations, the question of which type to use always arises. Which type of illustration can be used most effectively to accomplish the desired objective? What type will present the facts more clearly? Before these questions can be answered, and before the actual work of selecting and designing the illustration can begin, the following preliminary steps must be taken. First the material must be arranged in some sort of systematic

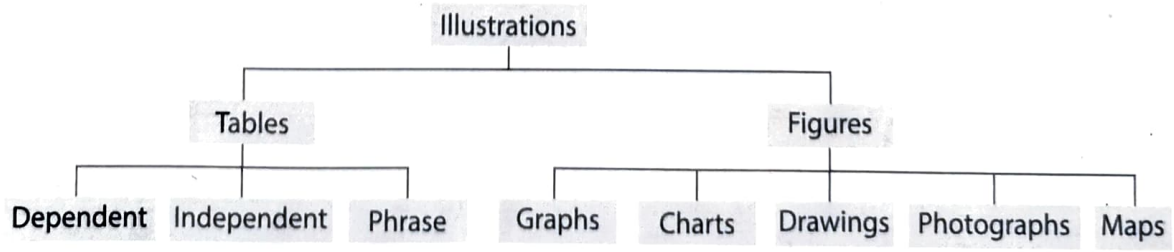


FIGURE 1.3 Types of illustrations

order: a series, a distribution, or some other logical arrangement. Next, we must be thoroughly familiar with the material and be aware of the implications of its use. The final step involves a decision about the type of illustration to be used. Several factors are considered for a decision of this kind, such as the nature of the data, the anticipated use, and the intended audience. These factors are usually interrelated.

The type of data will often aid in the selection of the appropriate type of media. For example, if the data were quantitative in nature, the selection might be from one group of charts; if the data were more qualitative in nature, the selection might be made from another group.

The following pages provide samples of various types of illustrations and also briefly explain the purpose for which each of these types is used.

Tables

A table is a systematic arrangement of numbers, words, or phrases in rows and columns, used to depict original numerical data as well as derived statistics. It permits rapid access to and relatively easy comparison of information. If the data is arranged chronologically (for example, sales figures over a ten-year period), the table can show trends—patterns of rising or falling activity. Of course, tables are not necessarily the most clear or vivid means of showing such trends or relationships between data—that is why we have charts and graphs (discussed later in this chapter).

The most important use of tables is for presenting numerical data. Imagine that you are comparing different models of laser printers in terms of physical characteristics such as height, depth, length, weight, and so on—you can use a table in this case.

Traditionally, the title of a table is placed on top of the table or in the first row of the table. If the contents of the table are obvious and there is no need to cross-reference the table from anywhere else in the communication, the title can be omitted. To avoid complications, tables can be considered as figures (the same as other graphics), and numbered within the same sequence.

As shown in Figure 1.3, there are three types of tables:

- Dependent
- Independent
- Phrase

Dependent tables are those whose contents cannot be understood without going through the text. This type is used for presenting less data (Figure 1.4). Independent tables are the most commonly used ones. Though the text should explain each table, readers need not go through the text to understand the contents of these tables (Figure 1.5). Phrase tables are used when the data is in words or phrases instead of numerical figures (Figure 1.6).

Advantages and disadvantages

The tabular form of presentation, while simple for the communicator, has both advantages and disadvantages. A lot of numerical figures can be depicted through a table. A number of

TABLE I Details of inpatients admitted on 14.11.15

General ward	35
Special ward	15
Maternity ward	10

FIGURE 1.4 Dependent table

Style and Formatting Guidelines for Tables

- In the text just preceding the table, refer to the table. Explain the general significance of the data in the table; do not expect readers to figure it out entirely for themselves.
- Do not overwhelm readers with monster 11-column, 30-row tables. Simplify the table data down to just that amount of data that illustrates your point—without, of course, distorting that data.
- Do not put the word or abbreviation for the unit of measurement in every cell of a column. For example, in a column of measurements all in millimetres, do not put 'mm' after every number. Put the common abbreviation in parentheses along with the column or row heading.
- Right- or decimal-align numbers in columns. If the two entries in a column are 123 and 4, 4 should be right below 3, not below 1.
- When there is some special point you need to make about one or more of the items in the table, use a footnote instead of clogging up the table with the information.
- Most of the advanced word-processing software packages, such as Word and WordPerfect, now have table-generating tools. You do not have to draw the lines and other formatting details.

TABLE II Fatal road accidents 2011–15 (% wise)

Year	Pedestrians	Cyclists	Others	Total	%
2011	2380	830	1310	4520	19.7
2012	2315	850	1615	4780	20.8
2013	2255	805	1750	4810	20.9
2014	2460	750	2060	5270	22.9
2015	2050	735	800	3585	15.7
Total	11460t	3970	7535	22965	100
Percentage	50%	17%	33%	100%	

FIGURE 1.5 Independent table

TABLE III

Goods	Durability	Nature/metal	Availability
Wires	Long lasting	Copper	Freely
Utensils	Long lasting	Steel	Scarce

FIGURE 1.6 Phrase table

combinations are possible in the tabular form; for example, numeric and non-numeric data can be depicted together. However, it also has certain disadvantages: while it is a part of visual depiction, yet, visually, the details are not evident at a glance. Occasionally, the writer might, in

TABLE 1 Sales data for 2000–10

Year	Product A	Product B
2000–01	20000	7000
2001–02	19899	7500
2002–03	20100	11000
2003–04	18500	13000
2004–05	15000	13500
2005–06	15500	13250
2006–07	12000	15000
2007–08	10500	16500
2008–09	8000	19258
2009–10	8500	20136

FIGURE 1.7 (a) Table presenting sales data for a ten-year period

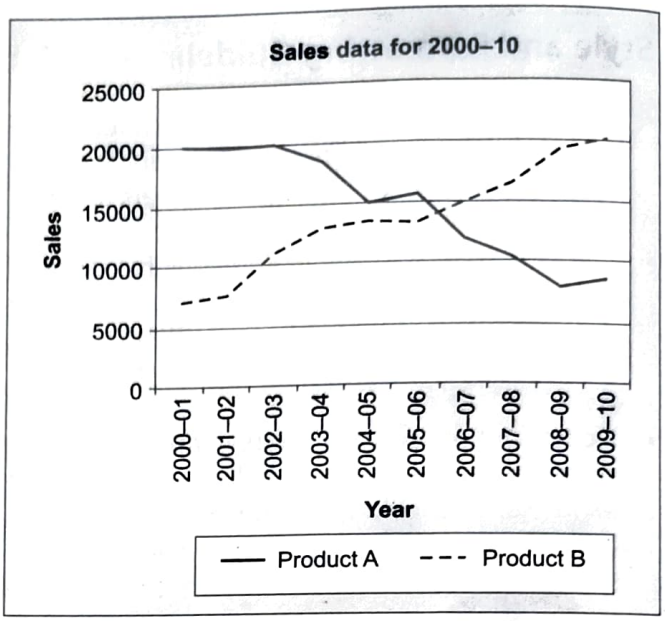


FIGURE 1.7 (b) Line graph showing the same data

the process of putting in too much data, make it too detailed and complicated. Finally, there is very little visual appeal in tables.

Graphs

Graphs are actually just another way of presenting the same data that is presented in tables—in a more impressive and interesting way. At the same time, however, a chart or diagram offers less detail or precision than tables. Figure 1.7 shows the difference between a table [Figure. 1.7(a)] of sales figures for a 10-year period and a *line graph* [Figure. 1.7(b)] for the same data. The graph presents a better sense of the overall trend but not the precise sales figure.

Producing graphs

As with illustrations, the following options are available for creating graphs: photocopying from other sources, generating graphics using special software, and manually drawing original graphics. Many spreadsheet application software packages (such as MS Excel) have fancy features for generating graphs—once the data is fed and the format specified, the application generates the required graph. Several types of graphs can be used. The various types are rectilinear or line graph, bar graph, pie graph, scatter graph, pictorial graph, and surface graph.

Line graphs Line graphs [Figure 1.8(a) and (b)] are used to show continuous change with respect to time. For example, the increase, decrease, or no change in temperature along with time can be depicted through a line graph. If two or three experiments have been conducted, the three different readings can be depicted using three lines.

Several trends (indicated by lines) over a specific period of time can be depicted by the line graph, indicating trends over time and allowing easy comparisons. However, a little caution should be exercised if the lines cross each other at points, as this can confuse the reader. Preferably, if there are criss-crossing lines, only three variables should be plotted, as too many variables would prevent the fine distinctions from being noticed, leading to erroneous conclusions.

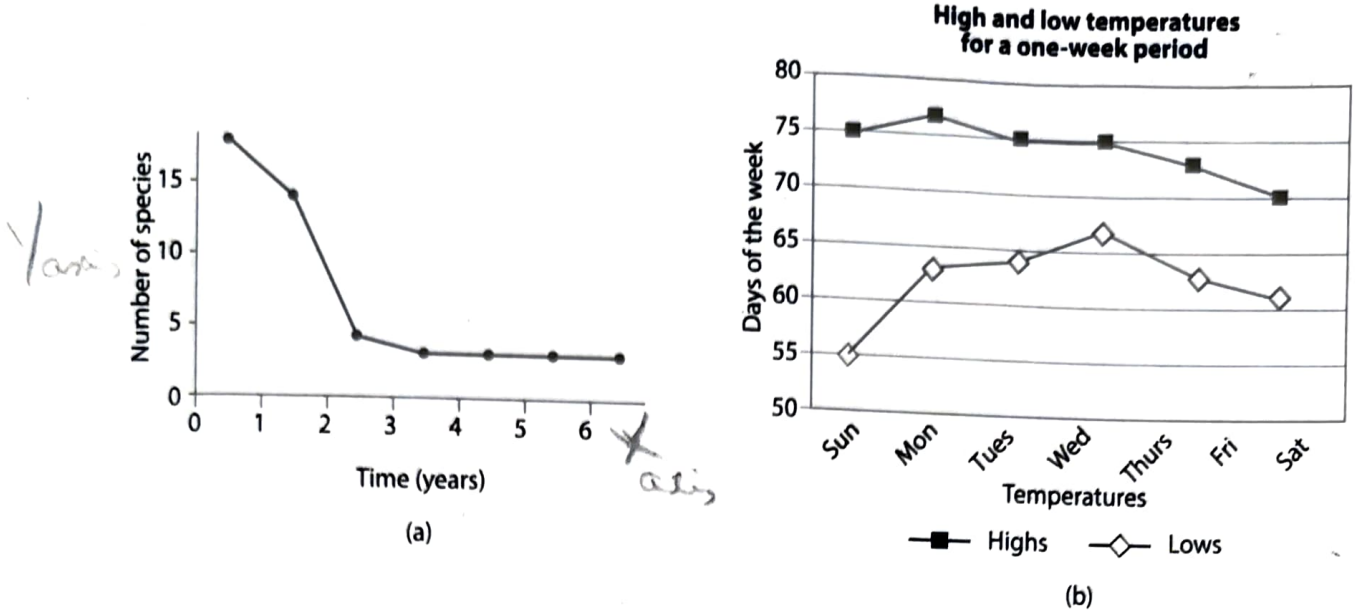


FIGURE 1.8 Line graphs

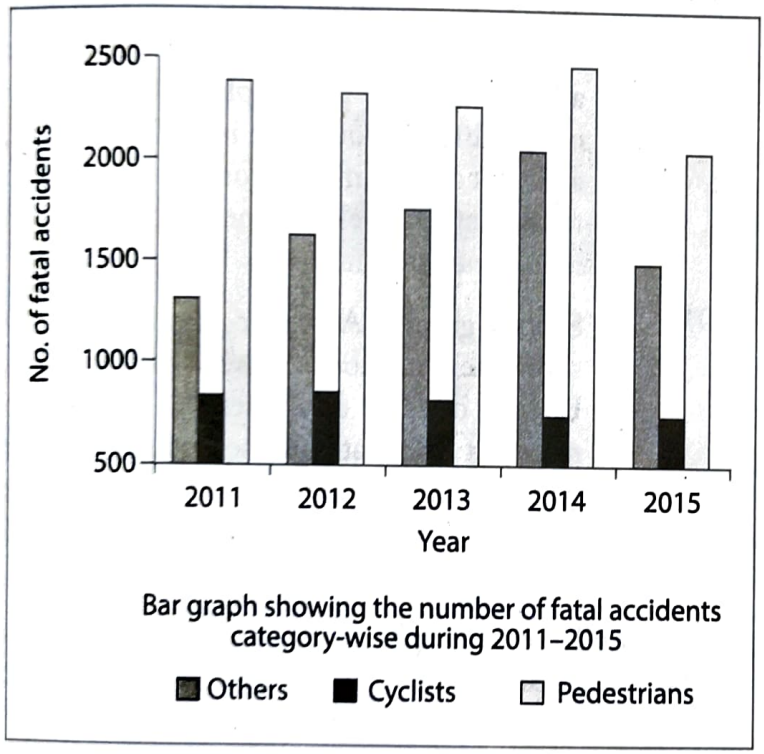


FIGURE 1.9 Bar graph with three variables

Bar graphs Bar graphs are effective in emphasizing the comparison of various data items. They can be used to depict the quantity of different items during the same period or the same item during different periods.

These are the simplest to construct and very easy to understand. They could be of various types: vertical with singular or multiple bars stacked (Figure 1.9) or comparative and horizontal. If these graphs depict more than one variable, two colours or designs are used to highlight the difference between the two variables. These graphs are comparative and if more than two variables in terms of the same time frame are used, a stacked vertical or horizontal bar graph is used. The greatest advantage of these bar diagrams is that they can also be used with a three-dimensional effect.

Presentations in this form are advantageous as they have a convincing impact, and two or more variables can be stacked without leading to difficulties in grasping the details. The colour and schematic designs added to the bars lend visual appeal to these graphs. However, there could be a lack of precision in the presentation of details, as the variables may become too cluttered and the lettering too small.

Pie graphs Alternatively known as a *percentage graph* or *circle graph*, a pie graph is a circular chart divided into sectors, illustrating proportion (Figure 1.10). In such type of graph, the arc length of each sector (and consequently its central angle and area) is proportional to the quantity

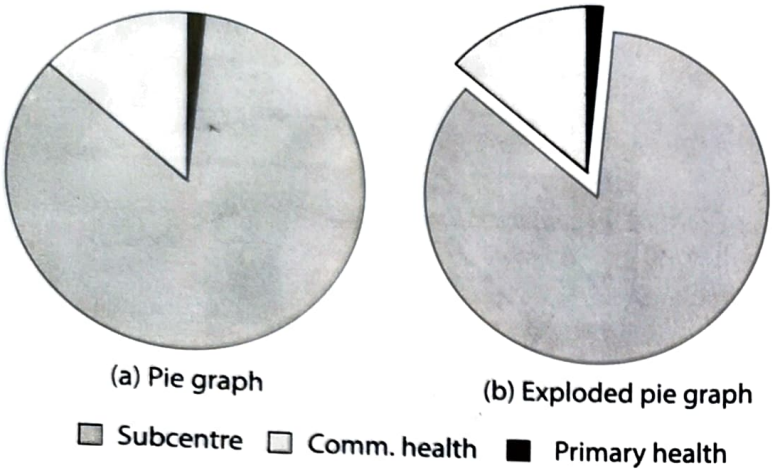


FIGURE 1.10 Pie graph

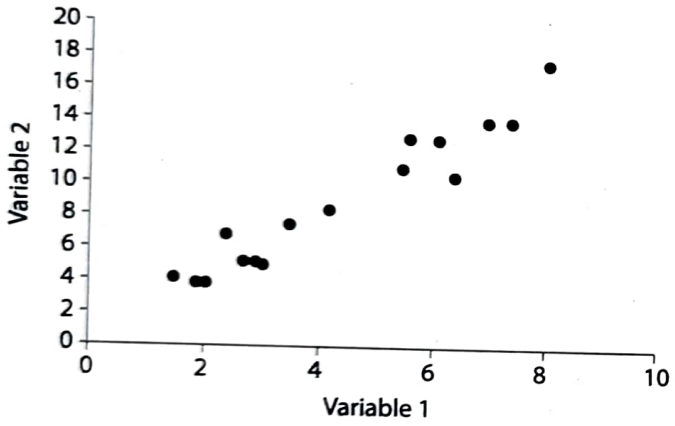


FIGURE 1.11 Scatter graph

it represents. This is one of the most popular forms used to depict the share of various categories making up a certain quantity and their correlations to the whole as a percentage. If there is a need to emphasize a particular segment, it is detached from the pie and referred to as the *floating wedge*. Such a pie is referred to as an *exploded pie*.

The pie graph captures the attention of the reader more effectively than probably any other presentation would. Within one graph itself, the various segments can be highlighted. In addition to the colour pattern used, the categorization of the segments can be given within, outside, or alongside the graph. However, there could be occasions when the difference is very minor and it might get blurred; for example, a segment depicting 0.5% may become too small to notice. Hence, it is not advisable to use pie graphs if the number of variables in your data is more than five, as it becomes difficult for the human eye to detect the relative percentage of too many cluttered items.

Scatter graph A scatter graph is used to show the correlation between two variables. Usually, dots (•) or crosses (×) are used to represent the data. In scatter graphs, the plotted data must lead to clusters. The absence of clustering refers to the absence of correlation between the two items represented on the horizontal and vertical axes. Notice the clustering at various places in the scatter graph given in Figure 1.11.

Pictograms/pictorial graph Pictograms are similar to bar graphs, with figures or small pictures plotted instead of bars. The pictures are chosen in accordance with the variables represented. This graph is self-explanatory; for example, if a graph were to indicate the population boom in the last five years, human figures could be used, thus illustrating the point being made by the writer. In such an example, a cluster of the figures or pictures would indicate an excessive number during that period. This type of graph is not used extensively for business reports.

The advantage of pictograms is that large numbers can be presented by a single cluster of figures. Much time and effort goes into the design of this graph so as to make it truly representative of the situation it seeks to address. However, it is not very useful for business reports, which contain more concrete data that cannot be represented pictorially. As pictograms are eye-catching, they are suitable for magazines (Figure 1.12).

Area graphs Area graphs can be used to show how something changes over time. Usually, the x axis represents the time period and the y axis represents the variable being measured. Area

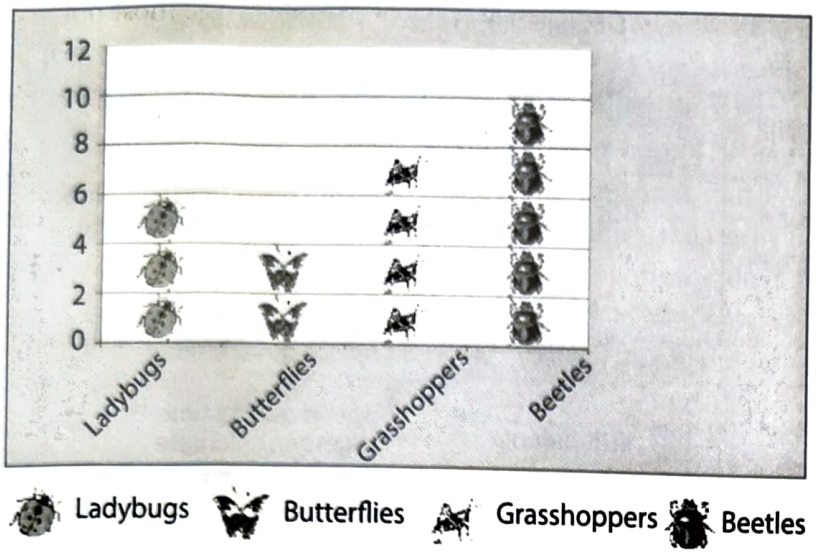


FIGURE 1.12 Pictorial graph

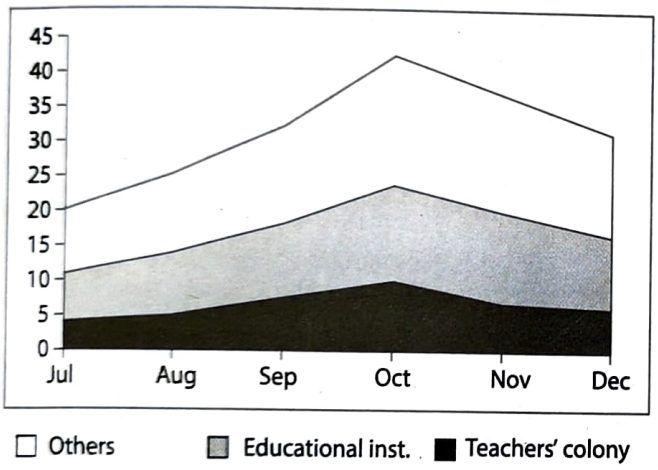


FIGURE 1.13 Area graph

graphs can be used to plot data that has peaks (ups) and valleys (downs), or data that was collected in a short time period.

These graphs also help to compare trends over a period of time. For example, when an area graph is plotted to show the water consumption in a particular educational campus, the total consumption of water in that campus as well as the consumption in individual areas can be shown (see Figure 1.13).

While index lines are predominant in line graphs, the area between the lines is highlighted in an area graph. In addition, shades of colours are also used. A darker shade is used at the bottom, and as the plot goes higher and higher, the shades become lighter. In Figure 1.13, the peak shows the total water consumption in the campus.

Charts

There are two types of charts: organization charts and flow charts.

Organization charts

Organization charts are generally used to illustrate the various positions or functions of an organization. Most of the communication channels in an organization are described through such charts. These charts can also be used to depict the organization of various other ideas such as the different sets of instructions given to subordinates or the different decisions taken for a particular project. Figure 1.14 shows how different options can be organized in the form of an organization chart.

Flow charts

Flow charts present a sequence of activities from start to finish. They are normally used to illustrate processes, procedures, and relationships. The various elements in the chart are generally depicted through geometrical figures (Figure 1.15). Circular or oval boxes are used to indicate the start or stop of the procedure, diamond-shaped boxes represent decision-making steps, and rectangular boxes indicate processing steps. Arrows indicate the process flow.

Charts are often used to make it easier to understand large quantities of data and the relationships between different parts of the data.

Drawings and Diagrams

In technical documents, drawings and diagrams are used to depict the objects, processes, circuits, etc. that are being described. Diagrams can be used to show the normal, sectional, or cut-away view of an object.

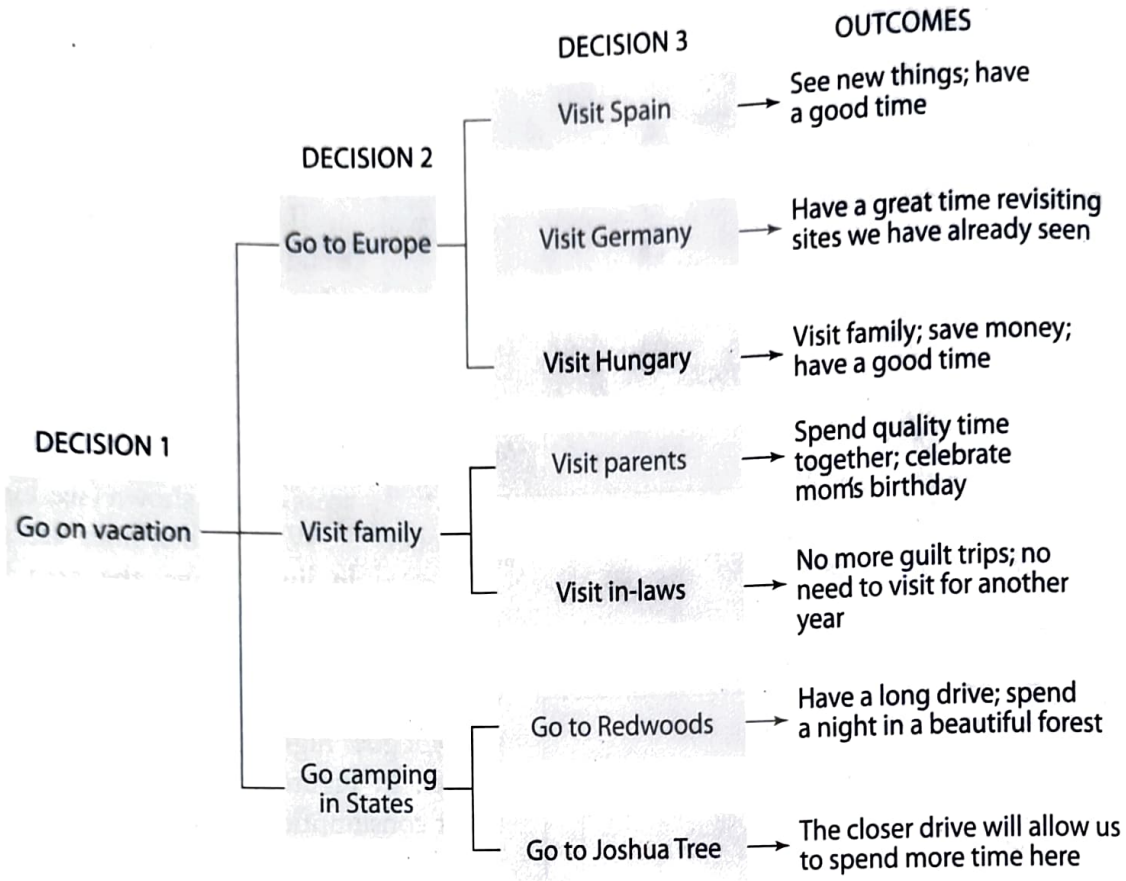


FIGURE 1.14 Organization chart

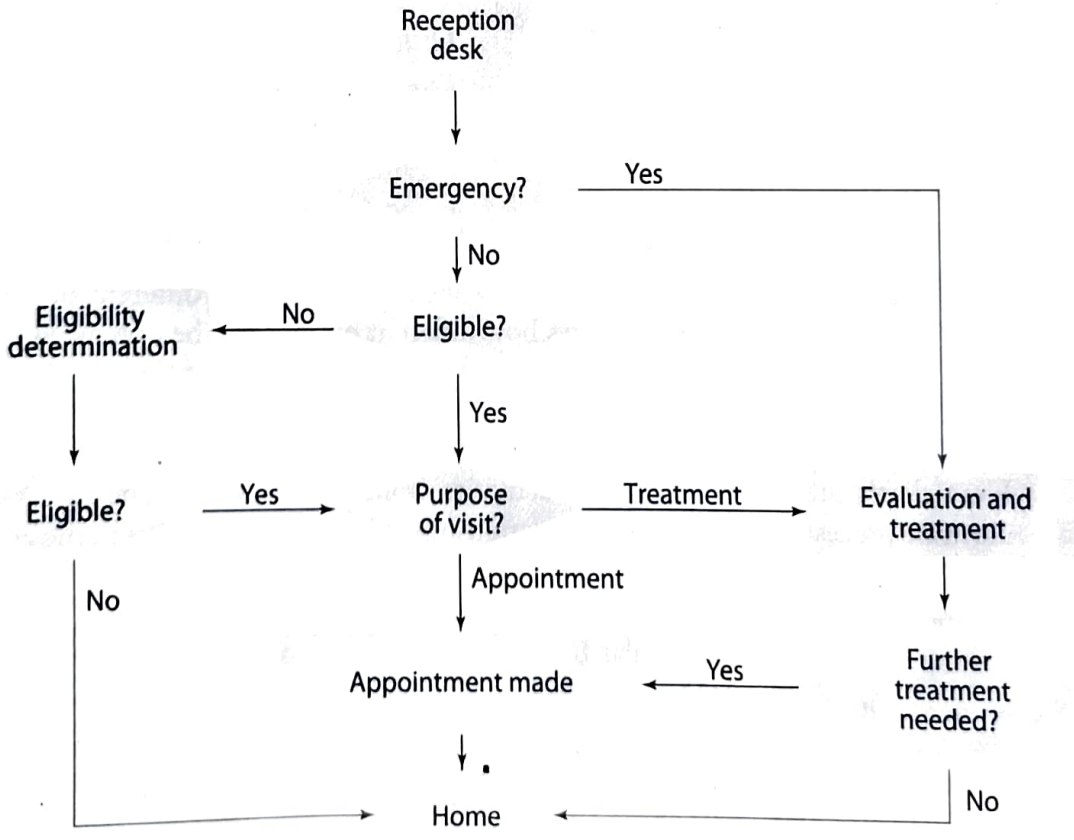


FIGURE 1.15 Flow chart

Drawings and photographs range from those showing minimal detail to those illustrating maximal and minute details. For example, a simple line drawing of how to graft a fruit tree reduces the detail to simple lines representing the hands, the tools, the graft stock, and the graft. On the other hand, there can be complex diagrams showing a schematic view of systems; for example, the wiring diagram of a clock radio, which hardly resembles the actual physical system at all. These graphics with their gradations of detail have varying uses.

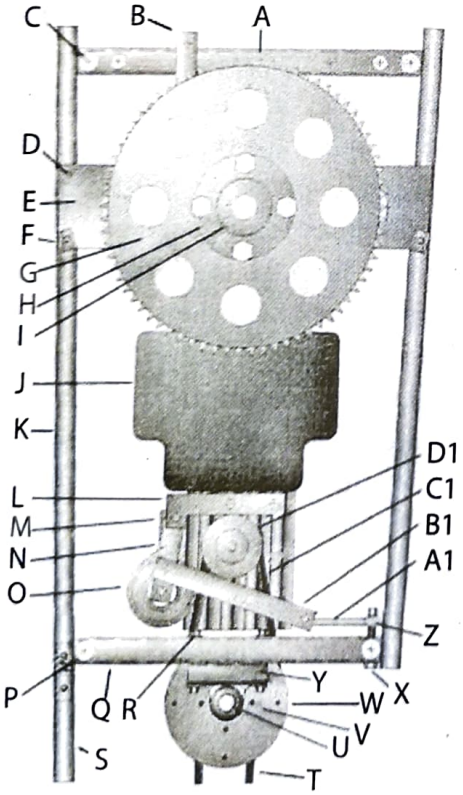
In instructions, simple drawings (often called *line drawings* because they use just lines, without other detail such as shading) are the most common. They simplify the explanations and the objects so that the reader can focus on the key details. In descriptions, detailed drawings are used, including those with shading and depth perspectives. Figures 1.16 and 1.17 show examples of technical drawings.

Several application software programs as well as the Internet provide clip arts, which are pre-made images of fairly common objects such as computers and telephones. These images can be used in technical documents along with suitable labels. Figure 1.18 shows some examples of clip art available in MS Word.

One difference between photography and other forms of graphics is that a photographer, in principle, just records a single moment in reality, with seemingly no interpretation.

Photographs

Photographs are often used in feasibility, recommendation, and evaluation reports. For example, if you are recommending a photocopier, or if you want to compare various cars, automated teller machines, etc., you might want to include photographs to support your report.



A	Upper crossmember front	O	Idler pulley
B	Control rod support	P	Rotor tower tubes
C	Rotor tower tubes	Q	Middle crossmember
D	AN 3 bolts	R	Motor mount spacers
E	Lower main rotor bearing crossmember	S	Tail boom tubes
F	Support tube bracket	T	Tail rotor belt B 210 gates
G	Main rotor sprocket to tooth	U	Jack shaft
H	Main rotor sprocket hub	V	3/4 Pillow block bearings
I	Main rotor shaft	W	Driven pulley
J	503 rotax or larger	X	AN4 bolts
K	Main frame long runs	Y	1 x 3 bolts
L	Idler pulley bracket	Z	Clutch lever
M	Idler pulley engine spacket	A1	MW 4 rod ends
N	Idler pulley swing arms	B1	Engagement arms
C1	Belts (5) super HC 3V280 gates	D1	Drive pulley

FIGURE 1.16 Sample drawing showing a belt drive

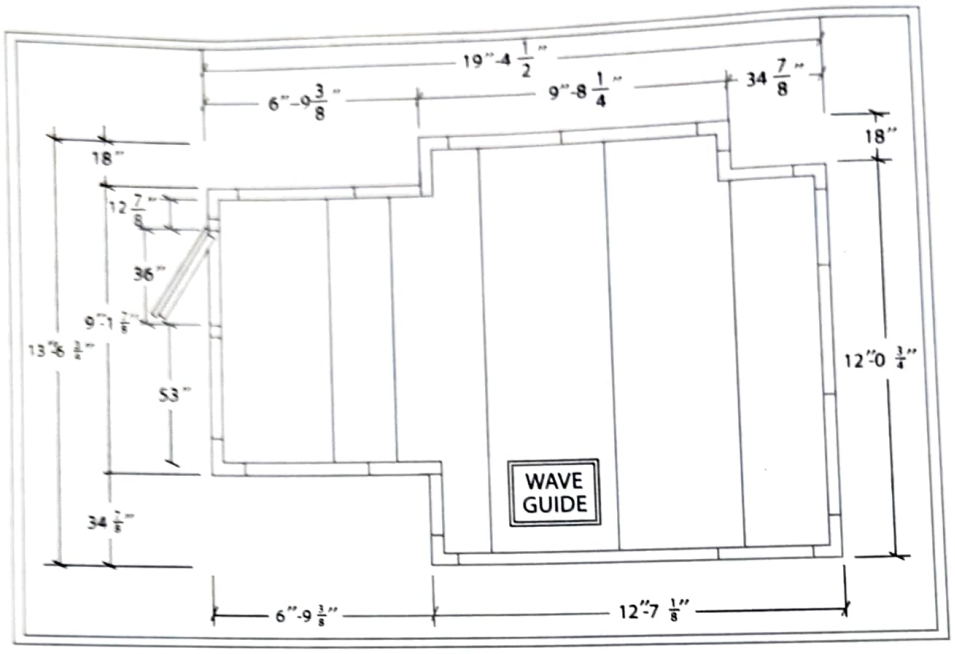


FIGURE 1.17 Sample diagram

Photographs give the reader a realistic view of the object. However, they should have a good enough resolution so that they are clear even upon reproduction. Irrelevant details can be removed from photographs by working on the negatives.

Maps

Maps graphically represent spatial relationships on plane surfaces. They are used to establish a frame of reference and to facilitate the understanding of spatial relationships that are difficult to describe in words, especially to serve as navigational aid. They may take different forms, such as the map of a political territory (town, state or country), the layout of a store or a manufacturing plant, or the market area of a business. They are appropriate when discussing or presenting statistical data through geographical indicators or expressing relationships between locations. Figure 1.19 shows the map of India's population density.

FIGURE 1.18 Example of clip art available with MS Word

The choice of scale for a map depends on its purpose and the amount of detail to be shown. It should be an accurate representation of the geographic details (places, buildings, streets, etc.). Cross-hatching or shading in maps is used to portray absolute amounts, rates, ratios, and percentages of data, such as health statistics, population, employment, traffic flow, and land usage. Colours, symbols, and pictograms may be used to make maps more appealing and attractive.

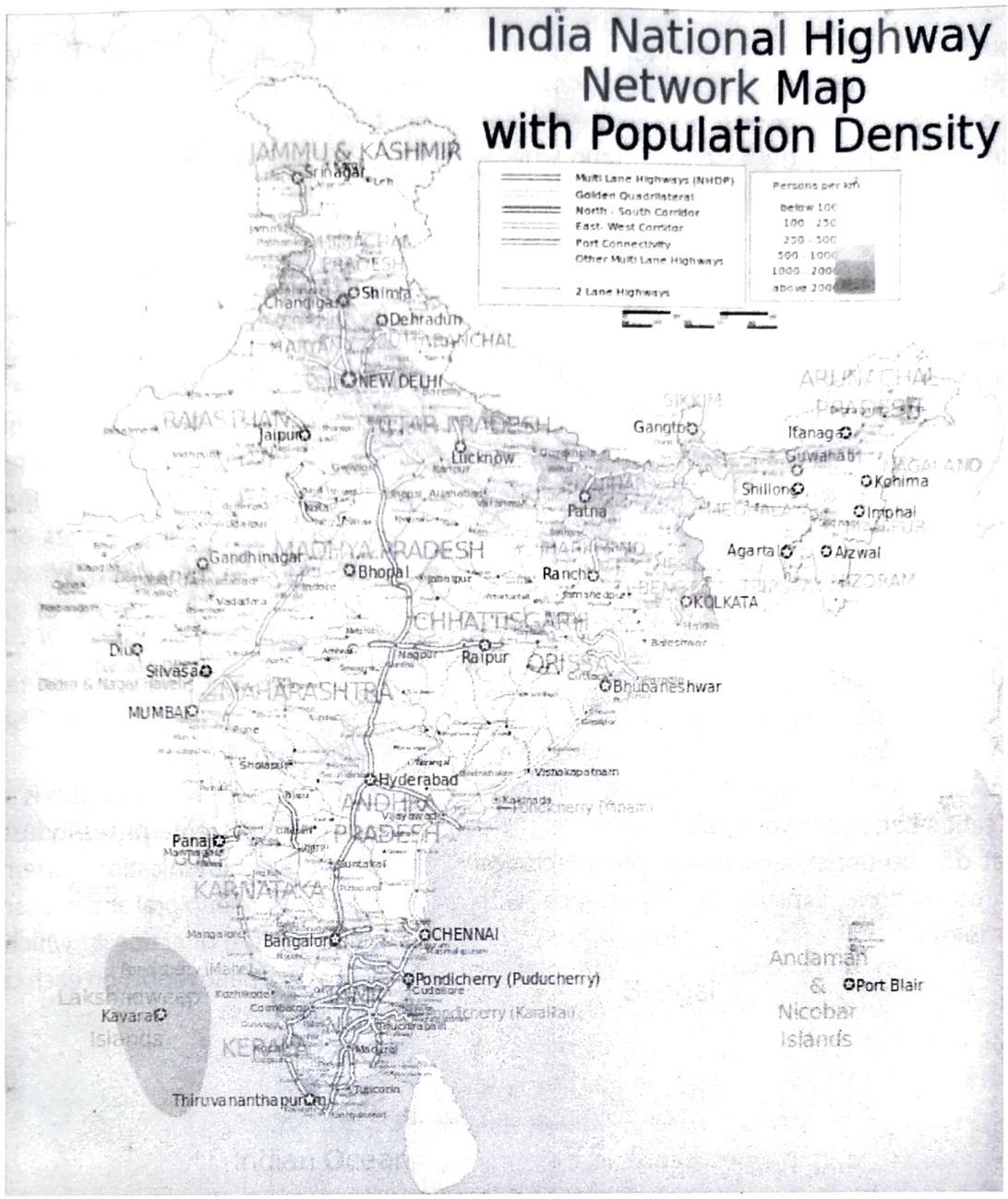


FIGURE 1.19 Sample map illustration

SUMMARY

Technical communication is process of sharing information through various modes with a specific audi-ence for a specific purpose. The process involves the transmission and interchange of ideas, facts, feelings, or courses of action. Technical communication is different from general communication. The objective of technical communication is to present correct, accurate, concise, clear, and appropriate information.

The communication process includes six main elements—sender, message, channel, receiver, response, and feedback. The success of communication lies in positive feedback. Sometimes the message received is not the same as the message intended by the sender; this is because of the presence of noise.

Communication takes place at different levels: extrap-ersonal, intrapersonal, interpersonal, organizational, and mass communication. In an organization the flow of communication can be vertical, horizontal, or diagonal.

Visual aids are a very important component of written technical communication. These are used extensively in reports, presentations, and proposals, to support the facts and figures being investigated and presented. The various types of visual aids that can be used in technical documents are tables, graphs, charts, drawings and diagrams, photographs, and maps.

EXERCISES

1. Answer the following questions in about 200 words each:
   (a) How is general-purpose communication different from technical communication?
   (b) Communication is the process of sending and receiving information. Explain the communication process in the light of this statement. Draw the communication cycle to support your answer.
   (c) How is feedback important in communication? Give two examples of delayed feedback.
   (d) Explain 'flow of communication'. Illustrate it with examples from the existing communication patterns in your college/institute.
2. What do you understand by the term technical communication? Explain its importance with examples.
3. Human communication takes place at different levels. How can you distinguish between intrapersonal and interpersonal communication?
4. What are the characteristics of mass communication? Explain the term gatekeeper.
5. What are the various modes of communication flow in an organization? What is upward flow and what is the purpose of this mode in an organization?
6. How can visual aids enhance technical communication? What points should be borne in mind while using visual aids?
7. Project: Visit a few organizations (academic institutions/business enterprises/industries) and determine the communication patterns existing there. Classify them into oral and written categories. Also figure out the direction in which these flow. Prepare a two-page report on each of your visits.