2007

Level 3 Qualifications in First Line Management

Unit M3.01 - Solving Problems and Making Decisions

Kent Learning Resources

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Introduction

This workbook provides information covering the topic of 'Solving Problems and Making Decisions'.

As you work through the material, you will find there are questions for you to answer. You should answer these questions in the space provided or in a separate record.

You should also start a 'log' in which you keep any other information that you feel may be useful to you as your course progresses, or in the future. For example, you may find an article in a newspaper which is both interesting and relevant, in which case keep it in your log.

If you have particular difficulty answering any of the questions, speak to your tutor. We appreciate that your ability to answer some of the questions will depend on the context of your current role.

Disclaimer

Whilst every effort has been made to ensure the accuracy of the information provided, nothing in the materials should be relied on as a statement of absolute fact. This is especially true of any legal information. In the latter case only an overview is provided and, of course, the law is constantly changing.

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Problem Solving and Decision Making

A key feature in any manager's job will always be making decisions. This can arise from deciding what to do following the identification of a problem or could be more proactive where the decision is to take some form of action to deal with something 'new' such as the introduction of a new product or service. This can often arise from some form of creativity or innovation – an important aspect of any business activity.

Whilst we would all like to think we are good decision makers, many of us often fall into the trap of thinking good decision making is quick decision making. In reality good decision making is based around sound research and analysis of data, the identification of a range of options, good evaluation of the options open to us and good planning for the implementation of the decision.

Sometimes decisions can follow from 'rational assumptions'. These decisions tend to be limited to situations where:

- You are faced with a simple problem where the desired outcome is clear
- Where the alternatives are limited
- Where time pressures are minimal
- Where the cost of identifying and evaluating alternatives is low
- Where the organisation supports innovation and risk taking
- Where the outcomes are relatively concrete and measurable.

If only most of the decisions fitted these criteria, life would be comparatively simple, but frequently they don't.

Activity 1

Reflect for a few minutes about the types of decisions you have to make. How many of them fit the criteria we listed and how many don't.

Honestly answer the question 'do I make decisions based on sound investigation and analysis of all the information that is available or do I make my decisions mainly on the basis of experience and 'gut feel'?

So how are most decisions in organisations actually made?

Types of Problems and Decisions

Well-Structured Problems and Programmed Decisions.

Some problems are straightforward. The goal of the decision maker is clear, the problem is familiar, and information about the problem is easily defined and complete.

Such situations are called 'well-structured' problems. In handling this problem situation, the manager uses a 'programmed decision'.

Decisions are programmed in as much that they are repetitive and routine and that a definite system exists for handling them. Because the problem is well structured, the manager does not have to go to the trouble and expense of working up an involved decision process. Programmed decision making is relatively simple and tends to rely heavily on previous methods of identifying solutions.

The only real difficulty is in identifying the real problem. Once the problem is clear, so is the procedure.

In these cases the manager is following rules and procedures that determine what he or she ought or ought not to do. Managers frequently use rules when they confront a well-structured problem because they are simple to follow and ensure consistency.

Ill Structured Problems and Non-programmed Decisions

Not all problems managers face will be well structured and solvable by a programmed decision.

There will always be problems that that are new or unusual. Information about such problems is ambiguous or incomplete. When problems are ill structured, managers must rely on non-programmed decision making in order to develop unique solutions. Non-programmed decisions are unique and nonrecurring. When a manager confronts an ill-structured problem, or one that is unique, there is no cut-and-dried solution. It requires a custom-made response through 'non-programmed' decision making.

Activity 2

Give an example of a decision that you have made which could be described as a 'programmed decision' and describe briefly the set procedure you used to make the decision.

Activity 3

Now give an example of a 'non-programmed' decision and briefly describe how you approached the task of making the decision.

Decision Making Conditions

There are three conditions that managers may face as they make decisions:

- certainty,
- risk, and
- uncertainty

Certainty

The ideal situation for making decisions is one of certainty; that is, the manager is able to make perfectly accurate decisions because the outcome of every option is known.

Risk

A far more common situation is one of risk. By risk, we mean those situations where you are able to estimate the likelihood of certain alternatives or outcomes, but cannot be certain, thus the element of risk.

Uncertainty

What happens if you have to make a decision when you are not certain about the outcomes and cannot even make reasonable estimate of the potential outcomes?

Many decision-making situations are ones of uncertainty. Under conditions of uncertainty, the choice of alternative is influenced by the limited amount of information available.

Decision Making Styles

One view of decision-making styles proposes that there are three ways managers approach problems in the workplace; they are problem avoiders, problem solvers, or problem seekers.

- A **problem avoider** ignores information that points to a problem. Avoiders are inactive and do not want to confront problems.
- A **problem solver** tries to solve problems when they come up. Solvers are reactive; they deal with problems after they occur.
- **Problem seekers** actively seek out problems to solve or new opportunities to pursue. They take a proactive approach by anticipating problems. Managers can, and do, use all three approaches.

Activity 4

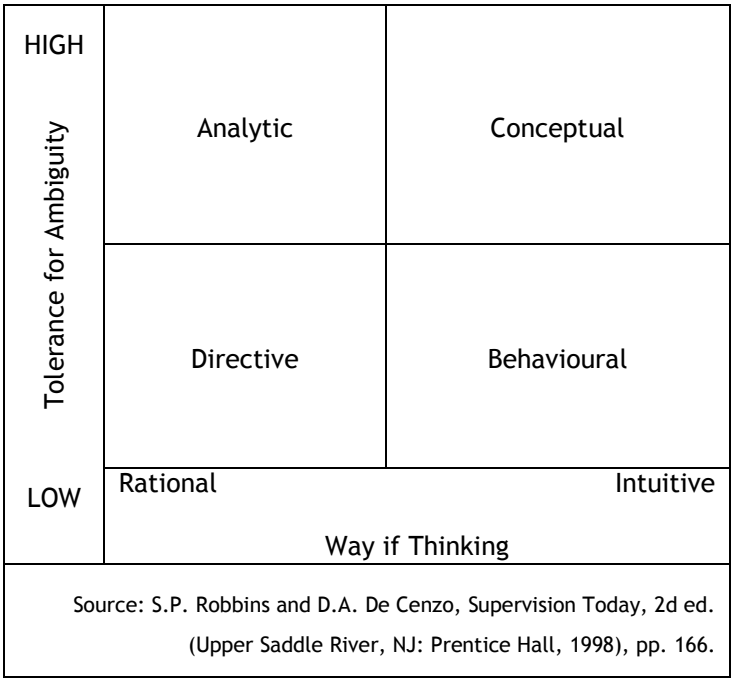
Which of the above is your predominant style? Be honest with yourself!

Gathering Information for Problem Solving and Decision Making

When you are gathering information to decide how to deal with problems or make decisions about future activities, the means of collecting data are the same as they are for a research project. However, you need to be aware of your own decision making style. These can be explained as an individual's tolerance for ambiguity.

Some of us have a low tolerance for ambiguity and must have consistency and order in the way we structure information so that ambiguity is minimised. On the other hand, some of us can tolerate high levels of ambiguity and are able to process many thoughts at the same time.

When these two dimensions are considered together, four styles of decision-making emerge:



Source: S.P. Robbins and D.A. De Cenzo, Supervision Today, 2d ed. (Upper Saddle River, NJ: Prentice Hall, 1998), pp. 166.

Directive style

People using the directive style have low tolerance for ambiguity and are rational in their way of thinking. They're efficient and logical. Directive types make fast decisions and focus on the short term. Their efficiency and speed in making decisions often result in their making decisions with minimal information and assessing few alternatives. This can, of course lead to some poor decisions.

The decision-maker may adopt this style due to a high need for power. Because of the use of little information and few alternatives, speed and unsatisfactory solutions are typical. The decision-makers tend to be focused and are frequently aggressive. Generally they prefer structure and specific information. Although they are efficient, these decision-makers have a high

need for security and status. They have the drive required to achieve results, but they also want to dominate others.

Analytic style

Decision makers with an analytic style have much greater tolerance for ambiguity than do directive types. They want more information before making a decision and consider more alternatives than a directive style decision maker does. Analytic decision makers are best characterised as careful decision makers with the ability to adapt or cope with unique situations.

Conceptual style

Individuals with a conceptual style tend to be very broad in their outlook and will look at many alternatives. They focus on the long term and are very good at finding creative solutions to problems.

Behavioural style

Behavioural style decision makers work well with others. They are concerned about the achievements of their team members and are receptive to suggestions from others. They often use meetings to communicate, although they try to avoid conflict. Acceptance by other people is important to them.

Although these four decision-making styles are distinct, most managers have characteristics of more than one style. It's probably more realistic to think of a manager's dominant style and his or her alternate styles. Although some managers will rely almost exclusively on their dominant style, others are more flexible and can shift their style depending on the situation.

Solving Problems

So how should be approaching our problem solving?

The Problem Solving Cycle

There are six stages to solving a problem:

- Recognising the problem exists
- Defining what the problem really is
- Identifying likely causes
- Identifying the real cause
- Generating possible solutions
- Choosing the best solution

Of course information or data is required at each stage:

- You cannot recognise a problem exists if you do not have information to indicate its presence
- You cannot define the problem unless you have data to analyse that enables you to identify it
- Good analysis of the information will be required to identify the possible causes
- Further examination of the information should provide the answer to what is the real cause
- You need to obtain information – ideas for example, to provide a range of options to solve the problem
- Analysis of the information about each option will enable you to make a sound decision

When you come to making decisions, either to solve a problem or to determine a future course of action, you need to consider:

- Who is likely to be affected?
- What past experience is relevant?
- Who can give useful advice?
- What more do I need to know?
- What assumptions am I making which limit the choices?
- What are the logical options?
- What are the creative possibilities?

You cannot answer any of these questions without obtaining data and information.

Here we aim to provide some information on the approach to what we might call the more serious problem solving. They must be regarded as one typical in-depth approach and only one of numerous similar approaches. Ultimately it makes no difference what approach you adopt to problem solving, so long as it is sufficiently rigorous to root out the hidden data and relationships you are seeking.

"In practice most managers begin the process of problem solving with rational systems and only more reluctantly, move towards the creative mode" (Whetton 1996 p. 10)

Problems are time consuming and are frequently stressful. Many authorities recognise that, as a result, managers have a tendency to select the first reasonable solution that comes to mind.

Whetton sets out the model of the rational approach to problem solving as:

- Define problem
- Generate alternative solutions
- Evaluate and select an alternative
- Implement and follow up on the solution.

Conditions for good problem solving are:

- That factual information is differentiated from opinion or speculation
- That constraints within which the solution needs to be considered are recorded but put aside for possible brainstorming activity
- That everyone involved in the problem is consulted
- That comparison is made on a like for like basis
- That problem definition indicates whose problem it is
- That the definition of the problem is not simply a disguised solution

One problem associated with problem solving is well put by Broadwell:

"*The problem with evaluating...too early is that we may rule out some ideas by just not getting around to them*" (Broadwell 1972 p. 121)

Whetton suggests certain rules that should be considered in evaluations. These include postponing evaluation of alternatives until all alternatives

have been identified, adopting a positive approach, and learning from everyone who has something to say.

Attributes of good evaluation and selection

- Alternatives are evaluated relative to a optimal standard rather than satisfactory standard
- Evaluation of alternatives occurs systematically so that each is given full consideration
- Alternatives are evaluated in terms of goals of the organisation and the individuals involved
- Alternative standards suggested are stated explicitly

The rational model has limitations. These can be seen in terms of constraints on the model.

Constraints on the rational mode

In defining the problem constraints such as the failure to achieve consensus as to the definition of the problem is one such difficulty.

In the generating of alternatives we see constraints such as evaluating alternatives, one at a time, knowing few of the possible alternatives, adopting the first acceptable solution and adopting alternatives based on what is acceptable in the past

When we consider evaluating and selecting an alternative, the list of constraints grows. We may have limited information about each alternative; we may search for information too close too home - in easily accessible places. Also, gathering information may be expensive in terms of people and money. We frequently adopt satisfactory solutions, not optimal solutions. Solutions are often implemented before the problem is solved.

Stages in Critical Thinking

- Destruction of the set pattern in our thoughts
- An uncomfortable stage of insecurity while we establish new patterns
- Re establishment of new patterns. This is a version of the unfreezing refreezing approach more commonly associated with Kurt Lewin.

Whetton believes that in order to avoid or minimise discomfort we put up barriers which are termed conceptual blocks. Whetton quotes from Allen (1974) who defined a conceptual block as "mental obstacles that constrain the way the problem is defined and limits the number of alternative solutions thought to be relevant" (Whetton 1996 p. 23)

There is a frightening comment that:

...the more formal education individuals have, the more experience they have in a job, the less able they are to solve problems in creative ways. It has been estimated that most adults over 40 display less that 2 per cent of the creative problem solving ability of a child under the age of 5. That's because formal education is about teaching how to group information.... Individuals lose the ability to experiment, improvise or make mental detours. (Whetton 1996 p 23)

Theoretically we can see four types of conceptual blocks:

Consistency

Vertical thinking and one thinking language

Commitment

Stereotyping based on past experience - present problems are only variations on past problems

Compression

Artificial restraints from poor definition of problem. Failure to filter out irrelevant information or not finding needed information

Complacency

Not asking questions

Scoping the Problem

You will often find the phrase – 'scoping the problem'. This looks at the definition of the 'project' that is to deal with a problem. It generally involves the team that is set up to deal with the problem.

Scoping entails several stages:

- Defining the problem -The team members define the problem in specific terms and produce a problem statement. They present facts such as the product type and the error made.
- Identifying where the problem is appearing – The team identify where the problem is appearing, or manifesting itself, as specifically as possible. This helps the team focus its improvement efforts.
- Describing the size of the problem - The size of the problem is described in measurable terms.

- Describing the impact the problem is having on the organisation - The description of the problem's impact on the organisation should be as specific as possible.

The project scope is the definition of what the project is supposed to accomplish and the budget (in terms of time and/or money) that has been created to achieve these objectives.

It is absolutely essential that any change to the scope of the project has a matching change in budget, either time or resources. If the project scope is to build a building to house three Lorries with a budget of £100,000, the project manager is expected to do that. However, if the scope is changed to a building for four Lorries, the project manager must obtain an appropriate change in resources. If the budget cannot be adjusted, the project manager will need avoid the change in scope.

Usually, scope changes occur in the form of "scope creep". Scope creep is the piling up of small changes that, by themselves, are manageable, but in aggregate are significant.

Tools to Help Identify Causes of and Solutions to Problems

Brainstorming

Brainstorming is a method for developing creative solutions to problems. It works by focusing on a problem, and then deliberately coming up with as many deliberately unusual solutions as possible and by pushing the ideas as far as possible.

During the brainstorming session there is no criticism of ideas - the idea is to open up as many possibilities as possible, and break down preconceptions about the limits of the problem.

Once this has been done the results of the brainstorming session can be analysed and the best solutions can be explored either using further brainstorming or more conventional solutions.

How to Brainstorm

The following rules are important to brainstorming successfully:

- A leader should take control of the session, initially defining the problem to be solved with any criteria that must be met, and then keeping the session on course. He or she should encourage an enthusiastic, uncritical attitude amongst the brainstormers and encourage participation by all members of the team. The session should be announced as lasting a fixed length of time, and the leader should ensure that no train of thought is followed for too

long. The leader should try to keep the brainstorming on subject, and should try to steer it towards the development of some practical solutions.

- Participants in the brainstorming process should come from as wide a range of disciplines with as broad a range of experience as possible. This brings many more creative ideas to the session.
- Brainstormers should be encouraged to have fun brainstorming, coming up with as many ideas as possible, from solidly practical ones to wildly impractical ones in an environment where creativity is welcomed.
- Ideas must not be criticised or evaluated during the brainstorming session. Criticism introduces an element of risk for a group member in putting forward an idea. This stifles creativity and cripples the free running nature of a good brainstorming session.
- Brainstormers should not only come up with new ideas in a brainstorming session, but should also 'spark off' from associations with other people's ideas and develop other people's ideas.
- A record should be kept of the session either as notes or a tape recording. This should be studied subsequently for evaluation. It can also be helpful to jot down ideas on a board which can be seen by all brainstormers.

Individual vs. group brainstorming

Brainstorming can either be carried out by individuals, groups or both:

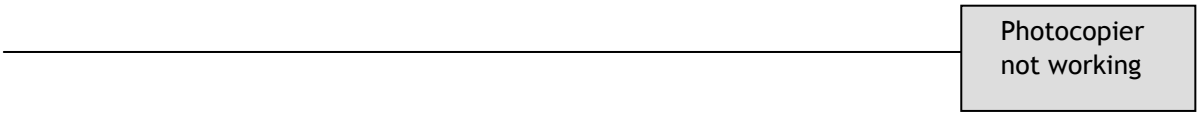
- Individual brainstorming tends to produce a wider range of ideas than group brainstorming, but tends not to develop the ideas as effectively, perhaps as individuals on their own run up against problems they cannot solve. Individuals are free to explore ideas in their own time without any fear of criticism, and without being dominated by other group members.
- Group brainstorming develops ideas more deeply and effectively, as when difficulties in the development of an idea by one person are reached, another person's creativity and experience can be used to break them down. Group brainstorming tends to produce fewer ideas (as time is spent developing ideas in depth) and can lead to the suppression of creative but quiet people by loud and uncreative ones.
- Individual and group brainstorming can be mixed, perhaps by defining a problem, and then letting team members initially come up with a wide range of possibly shallow solutions. These solutions could then be enhanced and developed by group brainstorming.

Cause and Effect Diagrams

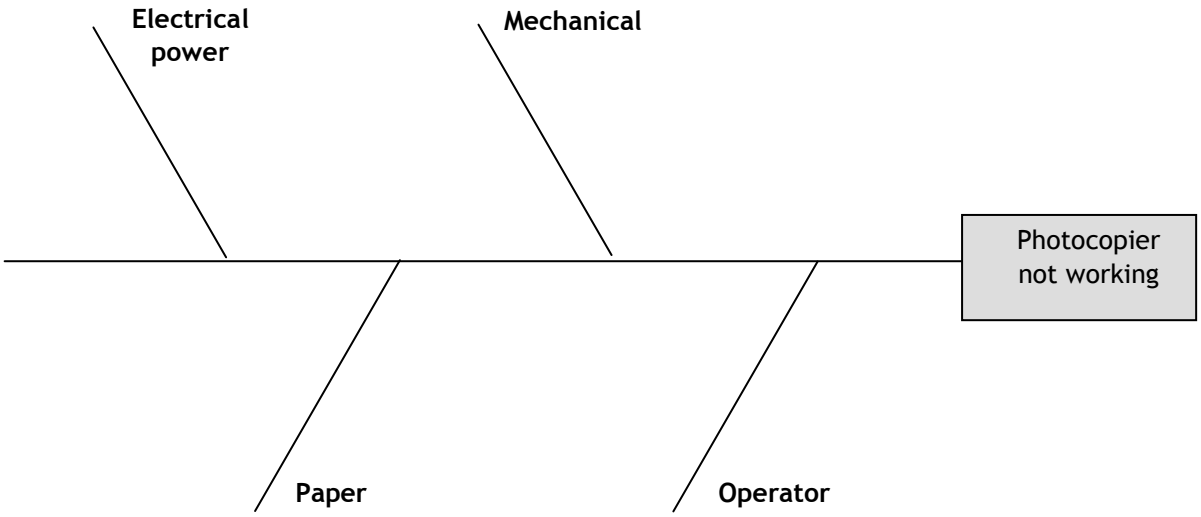
These are sometimes referred to as fishbone diagrams, for reasons which will become evident. You can do this on your own, but again there is power in numbers and involving others in the process will increase the likelihood of finding the real problem.

The cause and effect diagram identifies the main components of a task and then, for each main component, subdivides them into subcomponents. These may be again subdivided…

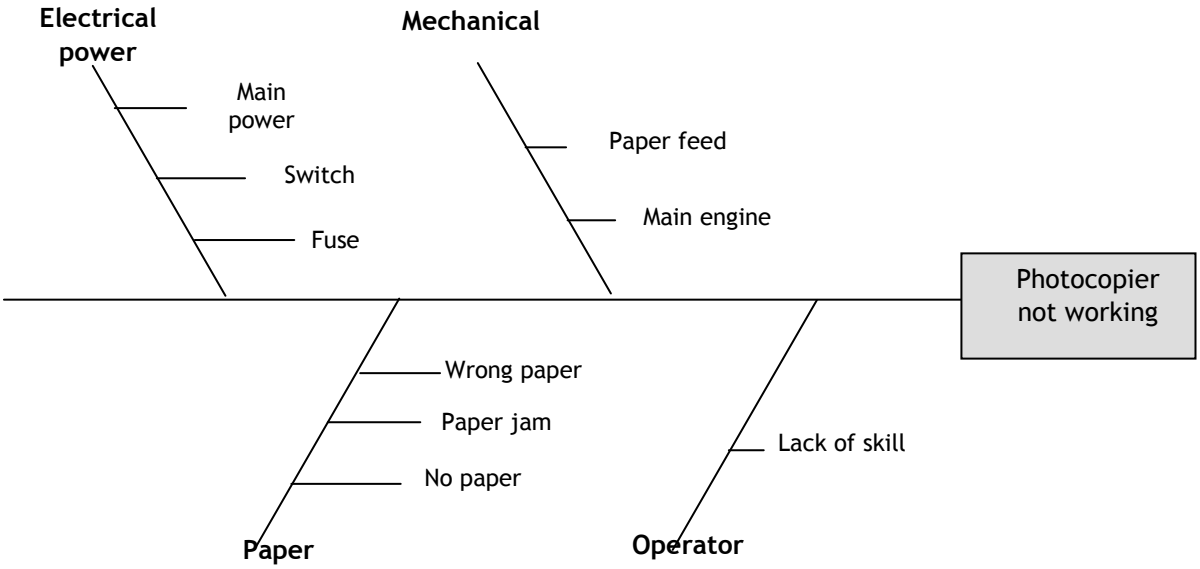
It is probably easier to think of an example. We will consider the problem that the photocopier is not functioning. We start with a straight line indicating the problem:



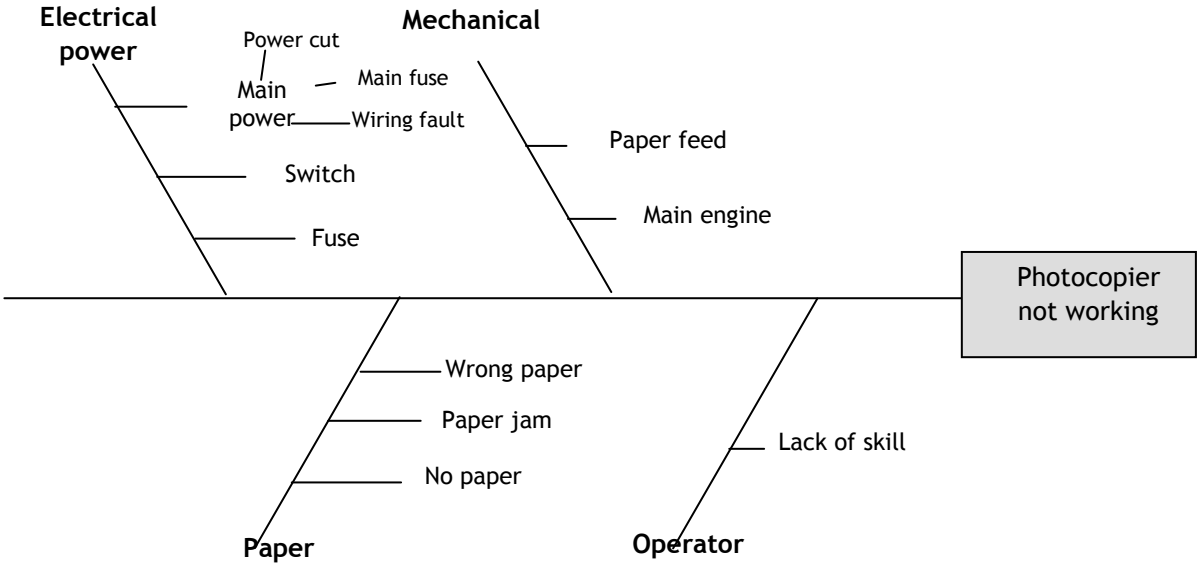
Next we add the main component factors that make it work:



Next we add factors associated with each spur:



Then we can explore each factor further:



By this method you are identifying all the possible sources of the ***real*** problem.

You then have to gain as much information as you can about each factor you have identified to enable you to isolate the real cause so you can then decide what action to take.

Evaluating Potential Solutions

Of course, before you can evaluate options you need to have set criteria against which to judge each objectively.

Ideally, you should have done this before you generate the options, ensuring, of course, that you do not interrupt you option generation by trying to evaluate your ideas as you go – this can inhibit the creativity.

Your criteria should fall into two headings:

- Essential – those factors that must be resolved through the option chosen
- Desirable – those factors that it would be good to achieve at the same time. It can help further if each of the desirable options is given a 'weighting' to help during the evaluation stage.

There are two techniques that can help.

Decision Making Grid

The grid will be designed to meet your own personal preference, but the following is one possible format.

OPTION	MEETS ESSENTIAL CRITERIA	MEETS DESIRABLE CRITERIA			FINANCIAL COST	OTHER COST	RISKS	LIKELIHOOD OF SUCCESS (%)
		1	2	3				

By completing a chart similar to this, you can objectively score each factor of each option and gain a clearer picture of the potential of each possible solution.

Another issue that can make life difficult is where there are several options to compare. It is the straight forward fact that, however clever our brain is, it still has difficulties in dealing with complexity.

To make life simpler you can use a grid to structure a process whereby you only compare one option with another.

If we assume you have 5 options, you construct a grid as follows:

	Option 5	Option 4	Option 3	Option 2
Option 1				
Option 2				
Option 3				
Option 4				

You then compare option 1 against option 5, entering in the first square the number which wins. Then you evaluate option 1 against option 4, and so forth until you have completed all the unshaded squares. Once you have completed this exercise, you add up how many times each option appears in the squares. The highest number is the best option.

If you have two options with the same score, then they are equally viable – so toss a coin!

An added advantage of using this method is that you automatically identify your plan B in case plan A fails for some unforeseen reason.

Activity 5

Problem-solving questionnaire

Below are 18 statements to do with problem solving. Look at each statement and decide whether or not you agree that this represents your view; then tick the appropriate response.

		Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	I can usually understand a problem from other people's viewpoints.					
2	I try not to come up with stupid suggestions or ideas.					
3	Time spent daydreaming can often help in solving a problem.					
4	Most people want pretty much the same out of life.					
5	Sometimes I have to 'sleep' on a problem before I can make any headway with it					
6	My organisation tolerates wild ducks as long as they all fly in formation.					
7	It's worth spending quite a bit of time defining a problem before starting to solve it.					
8	I can always spot a winning idea right away.					
9	I believe that rules are often made to be broken.					
10	I can usually sum-up people and situations pretty quickly.					
11	I don't mind taking a gamble by trying out or working on way-out solutions.					
12	Problem solving is a serious business, really.					
13	I often find it useful to visualise the situation in my mind when trying to solve a problem.					
14	Some problem-solving techniques just seem to leave you with dozens of half-baked ideas.					
15	I am constructive when people criticise my ideas and solutions.					
16	I think most people approach problem solving in much the same way as I do.					
17	Every problem can be solved by a combination of cash and commonsense.					
18	Most teams should leave solving problems to the talented ones who do it best.					

Scoring Key

Score odd-numbered and even-numbered questions separately; for example, for numbers 1, 3, 5, etc. a 'Strongly agree' response scores 5, whilst for numbers 2, 4, 6, etc. such a response scores 1.

Odd-numbered questions

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
5	4	3	2	1

Even-numbered questions

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

Answer Sheet

The questionnaire addresses three areas where blocks to your creative thinking can exist:

A - Perceptual blocks

B - Emotional blocks

C - Cultural/Environmental blocks

Add the scores for the appropriate questions to give your score for each of the three areas, and also add the three to give a grand total:

A Questions 1 7 13 4 10 16 > A score –

B Questions 5 11 17 2 8 14 > B score –

C Questions 3 9 15 6 12 18 > C score –

Total score :

The maximum score per area is 30, and the maximum total score is 90. The minimum score per area (assuming all questions have been answered) is 6, and the minimum total score is 18.

Perceptual Blocks

A low score in this area indicates that your perception, your way of seeing a problem, is not developed sufficiently to enable you to make full use of your creative ability. It may be that you tend to define problems too rigidly or specifically, or that you are not able to see an issue from any other viewpoint other than your own.

When working with people you may tend to make assumptions about them, their abilities, and their motives without really understanding what it is that they are capable of. People who have strong perceptual blocks to their thinking tend to categorise or label people and are unable to exploit their creativity to the full.

Often our education has emphasised analytical problem-solving methods (for example, scientific methods) and fostered belief that for any problem there is one right answer. Also our minds are constantly bombarded by stimuli and communications of all kinds, and so it is natural for our brains to filter out what is unnecessary so that we can focus only on what is important.

We can reduce the perceptual blocks to our creative thinking by considering the following points:

- Try to understand a problem from other people's viewpoints.
- Other people may have very different beliefs and values from yours; be aware that there may be a variety of goals and objectives governing what is considered to be an acceptable solution.
- Time spent defining a problem before attempting to solve it is useful time. Once you have stated a problem clearly, try to restate it in at least three different ways. This process alone can give rise to totally unexpected avenues of thought.
- When working with others give them room to show what they are capable of - don't assume you know; you may be surprised.
- Don't assume that there is a right way to solve a problem. There are many theories and techniques that are said to help in the creative thinking process: some may work on a particular problem, some may not. You may develop a method that suits you, but make sure that you are also open to different approaches.
- Develop the use of visualisation in your problem solving: imagine the problem from every viewpoint and try to see what would be happening if a solution was found.

Emotional Blocks

A low score in this area indicates a number of internal blocks that fall under a general heading 'emotional blocks'. It may be that our education or upbringing has reinforced the belief that not only is there one answer, but that there is only one right answer; hence a fear of being thought stupid or foolish for not producing complete or ideal solutions immediately. In fact, we may often be guilty of killing our own fragile and newly-formed solutions prematurely.

Creative thinking can sometimes be a sloppy process - there is often no fixed agenda governing how ideas are formed. It may be that your sense of good order needs to be relaxed somewhat, or you may need to be aware that 'sleeping on a problem' is not really evading the issues but is actually a very productive method.

Similarly, it may mean that you should, from time to time, relax your mind and allow your heart to determine in what direction your problem-solving should go. Try leaving the evaluation of your ideas until you have a number of them.

Emotional blocks can be reduced by considering the following:

- Allow yourself to consider seemingly stupid ideas. You may find that they turn out to be not so stupid when combined with other ideas, or when seen in a different light.
- When stuck on a problem, literally 'sleep on it' or go and have a break. Your subconscious will continue to work on it and may find that new ideas present themselves when you return to the problem.
- Try to look beyond the first obvious idea that appears to be a winner. Spend time examining alternative solutions.
- Give house-room to new or unusual solutions. Work on the basis that there is a part of every idea that can be used, either by itself, or in combination with other ideas.
- Don't worry about the quantity of ideas that techniques such as brainstorming provide. They stimulate the brain to produce yet more ideas and increase the likelihood that a new solution can be found.
- Some people report that their best ideas come out when the pressure of a deadline creates a climate of necessity. However, use with caution!

Cultural/environmental blocks

If you have a low score in this area, it may mean that you have been susceptible to cultural and educational influences on the way you tackle problem-solving, or that there is something in your present environment that is not conducive to creative thinking.

Unfortunately for some people, school reinforces a belief that humour, fantasy and play have little place in either learning or problem-solving. In addition a high value is placed on so-called left brain thinking (reason, logic, analytical thinking) to the detriment of right brain thinking (feeling, intuition, qualitative judgement). These factors can have a strong influence on our creative thinking capability.

The influence of our environment may affect us in many ways. It may make us resistant to change, to see or do things differently. Our organizations may be autocratic or merely locked-in to traditional methods.

We can reduce the impact of the cultural/environmental blocks by looking at the following factors:

- Use fantasy and day-dreaming in your creative thinking process. Imagine what different solutions would look like implemented and envisage how they could be improved.
- Does your organisation foster innovation and initiative in both thinking and action? If the organisation or your superiors are unsympathetic, create your own innovative 'cell' within your own area of responsibility. Use creative thinking to devise ways of implementing thinking techniques and solutions in an acceptable way. If all else fails you can always leave!
- Challenge rules and procedures inasmuch as they affect your thinking process. Ask why these rules were set up. Are they still valid, and what is their purpose? Have you set up rules or routines that hinder you from getting a fresh viewpoint when you need one?
- Bring humour into your problem-solving - it will add a new dimension.
- Try not to be defensive when others criticise your ideas or solutions. Respond positively in a way that stimulates further creative thinking ('OK, if I can think of a way of eliminating that aspect, will you find the idea acceptable?')
- Common sense and money are useful things to have, usually when you are implementing a solution. However, creative thinking sometimes means throwing away common sense and being open to irrational or previously unacceptable viewpoints. Sometimes you need to be outrageous.

Decision Making Checklist

Some form of checklist may assist in the full decision making process. For each of the areas, ask some questions:

Aim/Objective

- Why is the decision necessary?
- Why is it needed now?
- What were the results of previous similar decisions?
- What happens if we do not make a decision?
- Who should take the decision?
- What broad aims should guide the process?
- What would the most successful outcome be in terms of essential factors and desirable factors?

Data

- Who is likely to be affected?
- What past experience is relevant?
- Who can give useful advice?
- What more do I need to know?
- What assumptions am I making which limit the choices?
- What are the logical options?
- What are the creative possibilities?

Courses

- What options are impossible?
- Why is each impossible option rejected?
- What are the possible options?
- Can any more possible options be devised?

Decision

- What are the likely short-term benefits of each option?
- What are the likely long-term benefits of each option?
- What are the likely costs of each?
- What are the likely risks of each option?
- Does each option meet the criteria defined?
- Which option meets all the essential elements and highest numbers of desirable elements?
- Why should this not be the decision?

Action

- What is the decision?
- What needs to be done?
- Who is involved?
- How should the implementation be managed?
- How can the risks be minimised?
- How can you monitor the effectiveness of the decision?

Analytical Statistics and Presenting Information

Statistics is a body of methods and theory that you apply to quantitative data so assist in making decisions in the face of uncertainty.

Whenever you have quantitative data you will normally need to analyse it to make some sense of what it means.

There is often a distinction drawn between:

'Descriptive statistics', called *exploratory data analysis*, which is used to summarise or display the data; and

'*Inferential statistics'*, called *confirmatory data analysis* which involves using the data to draw conclusions. Often there is a distinction made between data which has a normal distribution (which we will look at later) and that which is not distributed, i.e. where the data is *skewed.*

These days there are a number of computer software packages that can be used to help in the analysis process.

When thinking about the technique you intend to use, you will need to take into account:

- Whether you wish to conduct exploratory data analysis to summarise, describe or display your data, or confirmatory data analysis to make inferences from the data
- Whether your data has a normal distribution
- The number of variables you wish to analyse at the same time
- The measurement scale of your data

The analysis of a single variable is known as *univariate* data analysis; two variables, *bivariate* analysis; and more than two variable *multivariate* analysis.

We are going to focus on univariate and bivariate analysis because this can be conducted on all research where quantitative data has been obtained.

Exploratory Data Analysis

There are four main groups of techniques that can be used for:

- Presenting frequencies
- Measuring location
- Measuring dispersion
- Measuring change

Types of Data

Data can be described as ‘qualitative’ or ‘quantitative’.

Activity 6

How would you describe the two terms qualitative data and quantitative data?

Qualitative data is concerned with non numerical information whilst quantitative data is data that is collected in numerical form.

Quantitative data can also be classified as discrete, which can take only one range of distinct values, such as number of employees or continuous which can take any value in a given range, such as time or length.

Presenting Frequencies

Even when you have collected small sets of data you will probably need to rearrange it to enable you to make full sense of it.

A frequency is a numerical value representing the number of observations of the variable you are studying. Typically the resulting distribution is a list in size order which can then be presented through the use of a table, chart, graph or some other diagram.

Where there is a small amount of data, you can probably rearranged it quite simply yourself. If, however, there is a substantial amount, then it is much easier to use a computer programme, such as a spreadsheet, to do the work for you.

You can add other useful information by summarising the average and/or percentage frequencies.

The average describes the data set by the use of single value. It involves calculating the arithmetic 'mean'.

The formula is:

$$\text{Mean} = \Sigma x/n$$

Where x = each observation

N = the total number of observations

Σ = the sum of

The percentage summarises the data by describing the proportion or part in every 100. You calculate the percentage relative frequency using this formula:

$$\text{Percentage relative frequency} = f/\Sigma f \times 100$$

Where f = frequency

Σ = the sum of

It might help us to try this out.

Activity 7

Assume that you have asked a number of your customers how many times they sold a particular item.

The data you collected shows the following:

1 customer sold the item once

3 customers sold the item twice

2 customers sold the item three times

3 customers sold the item four times

3 customers sold the item five times

Your first decision is to determine whether to order your data by frequency or variable. For the exercise we will order by variable (the number of items sold).

Produce your frequency table:

No of items sold	Number of Customers

On the next page we have our table.

No of items sold (x)	Number of Customers (f)
1	1
2	3
3	2
4	3
5	3
Total	12

Now work out the percentage relative frequency:

No of items sold (x)	Number of Customers (f)	% of Customers (f%)
1	1	
2	3	
3	2	
4	3	
5	3	
Total	12	

You should have a table that looks like this:

No of items sold (x)	Number of Customers (f)	% of Customers (f%)
1	1	8.5
2	3	25
3	2	16.5
4	3	25
5	3	25
Total	12	100

From this we can see that 16.5% of the customers sold 3 items and 25% sold 2 items and so on.

This frequency distribution table is a simple, but effective way of showing data and displaying it. In our examples we have used univariate data.

Where you have two variables (bivariate data), you can still use a table, but now it is called cross tabulation.

Activity 8

For this activity we will assume that you have carried out research to establish how many male and female managers there are in each of five departments.

Your findings show that production has 15 male and 5 female managers; sales has 11 male and 15 female managers; accounts has 6 male and 9 female mangers; HR has 7 male and 12 female managers; marketing has 2 male and 2 female mangers.

Create a table to show this data on the grid given. We also need to know the total number of managers in each department.

How you will have ordered your data will have been a matter of personal choice, but as the main objective is to show the distribution of male and female managers, it is probably appropriate to order the table by 'frequency'. In the example both male and female categories follow the same order.

If the data does not conveniently fit into this method, then you can use the category which contains the larger frequencies and let the other follow. You can always add other analysis, such as percentages, but we are not going to do so in this example.

Our table is on the next page.

Department	Male managers	Female managers	Total managers
Production	15	5	20
Sales	11	15	26
HR	7	12	19
Accounts	6	9	15
Marketing	2	2	4

Using Charts and Graphs

Charts and graphs are suitable for presenting and summarising frequency data and, like tables, can be constructed to convey information precisely.

Activity 9

List some advantages and disadvantages of using charts and graphs

Graphical Representation of Data

Graphical representation of data can often be useful, but there are some disadvantages:

Activity 10

What advantages and disadvantages can you think of in using graphical representation of data?

Here are some thoughts:

Advantages	Disadvantages
Good for communicating general points Attractive to look at Appeals to a more general audience Relationships can be seen more easily Easier to compare sets of data	Poor for communicating specific details Design may detract from the message Can be time consuming to prepare Can be misinterpreted Open to abuse

The reality is that some people prefer to see data in tabular form, others prefer graphical presentation. The important point is that any chart or graph should have some explanation.

If you have your data in some form of spreadsheet, or specialist statistical programme, it is easy to produce a variety of charts of graphs as they have this function built into them

Types of Data

Data can be categorised as:

Nominal – data that is in named categories, such as occupation, colour of eyes, age, etc

Ordinal – nominal data that has been ordered in some way, such as a person's first, second, third choice

Interval – data that has grouped at intervals, and can be measured on a scale

Ratio – which represents the highest level of precision as it is measured on a scale that starts at zero. This also permits both ratio and interval decisions to be made. For example you can say that 60 mph is twice as fast as 30 mph. 3 kg is half 6 kg.

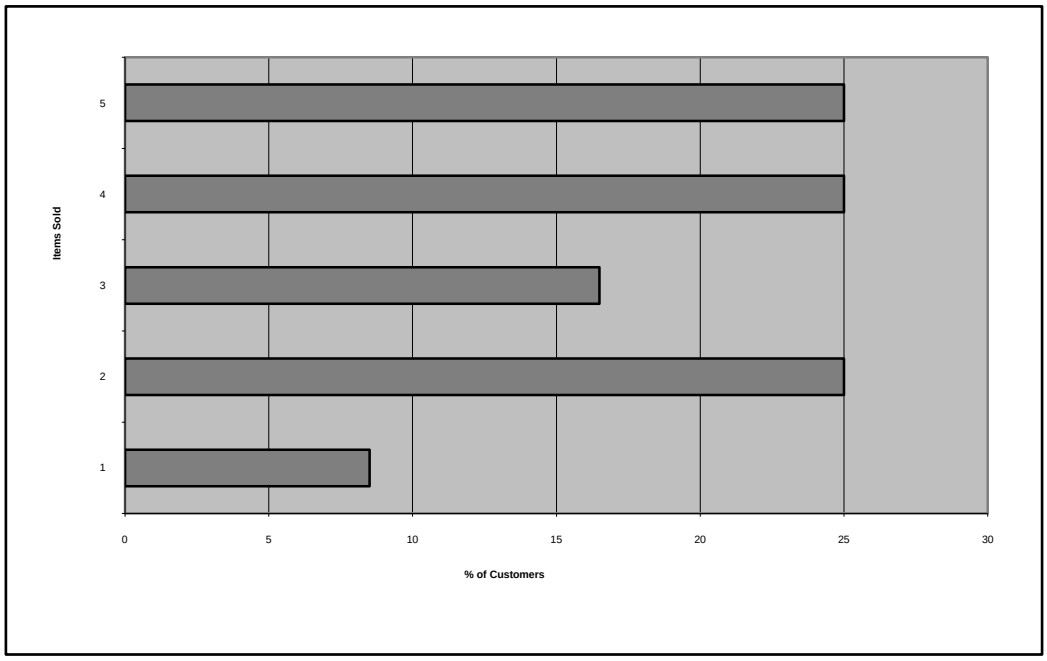
The sort of chart you use for each of the type of data will be a matter of choice, but in terms of suitability:

Type of chart	Bar chart	Pie chart	Histogram	Frequency polygon
Nominal	√	√		
Ordinal	√			
Interval			√	√
Ratio			√	√

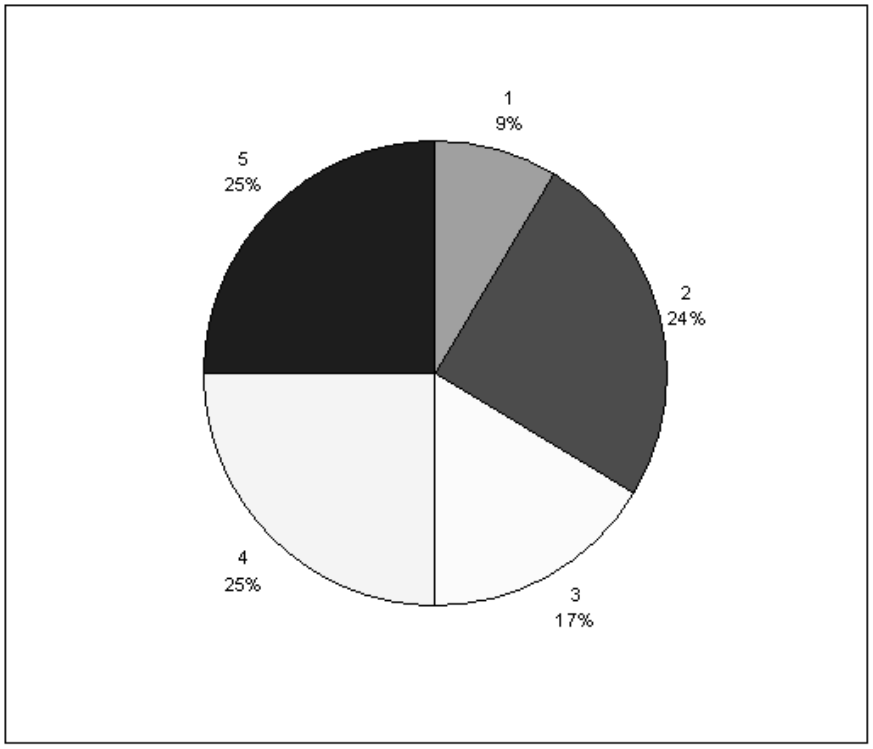
Activity 12

Using the data we had for Activity 7; create a bar chart plotting the percentage of customers against the number of items sold.

You chart should look something like this:



Alternatively you could produce the data as a pie chart, in which case it might look like:



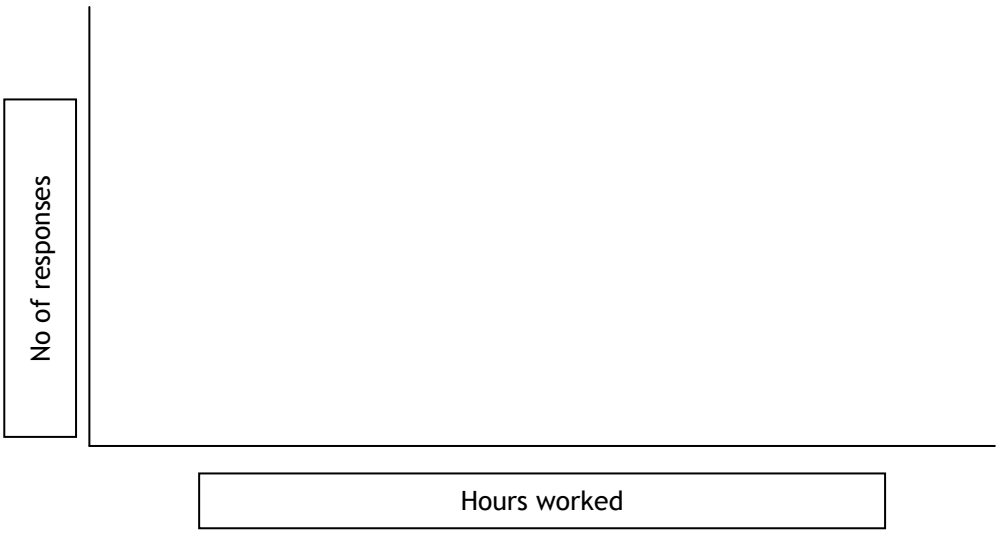
Pie charts should only be used to present proportional data as they are too indistinct to show detailed information.

Another form of graph is the 'line graph'. You can only use these where you are displaying continuous data. It is not appropriate for discrete data. The independent variable is shown on the horizontal axis and the dependent variable on the vertical axis.

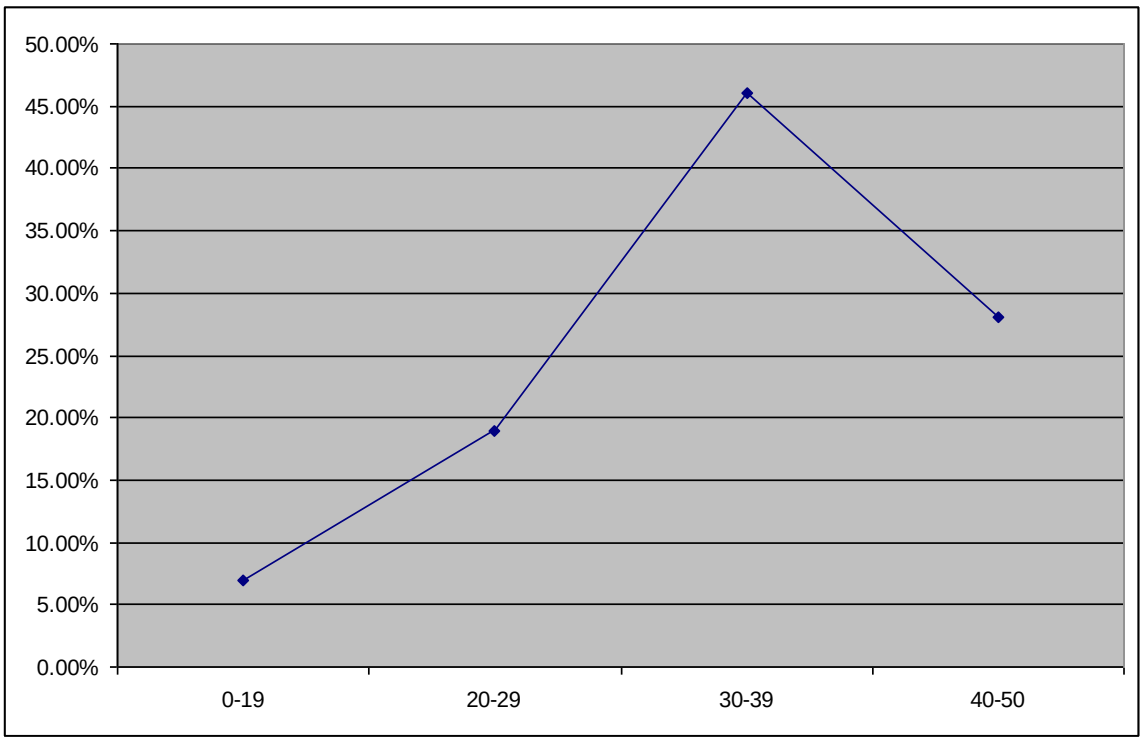
Activity 13

Using the following data where we have obtained information of the hours worked by the people questioned, create a line graph showing the percentage of people working in each band of hours worked (you need to work out the percentage first and enter your own scales on the axis):

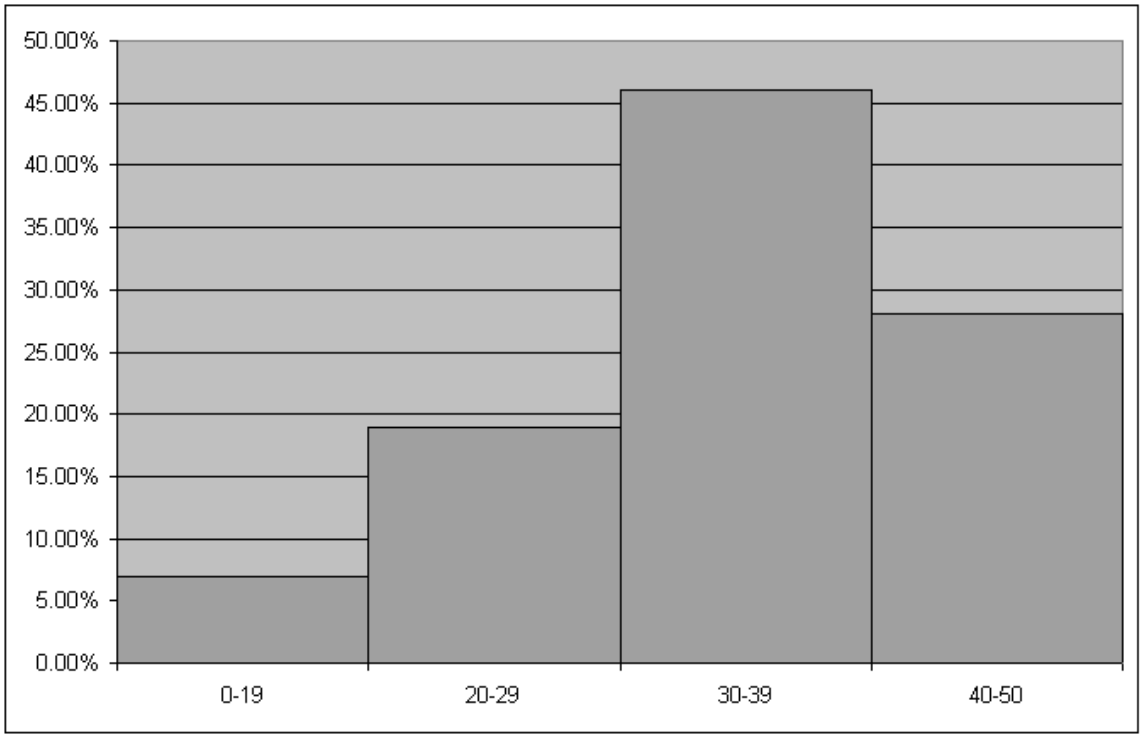
Hours worked	Number of responses	% response
10-19	7	
20-29	18	
30-39	43	
40-50	26	



Your line graph should look something like:

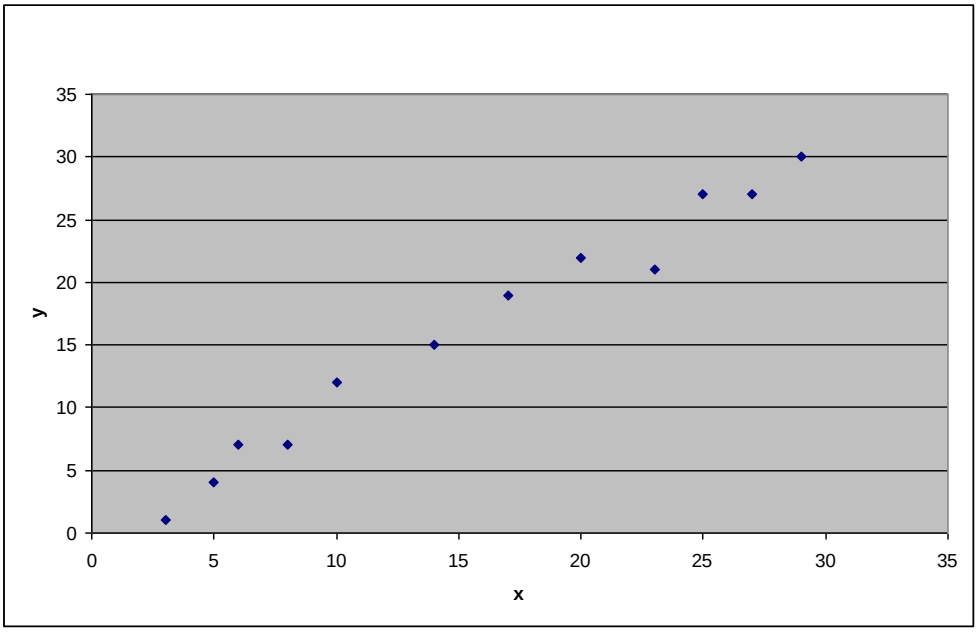


Another way of displaying the same data is by the use of a histogram. You will notice that this is similar to a bar chart, but the width of the bars span the frequency.

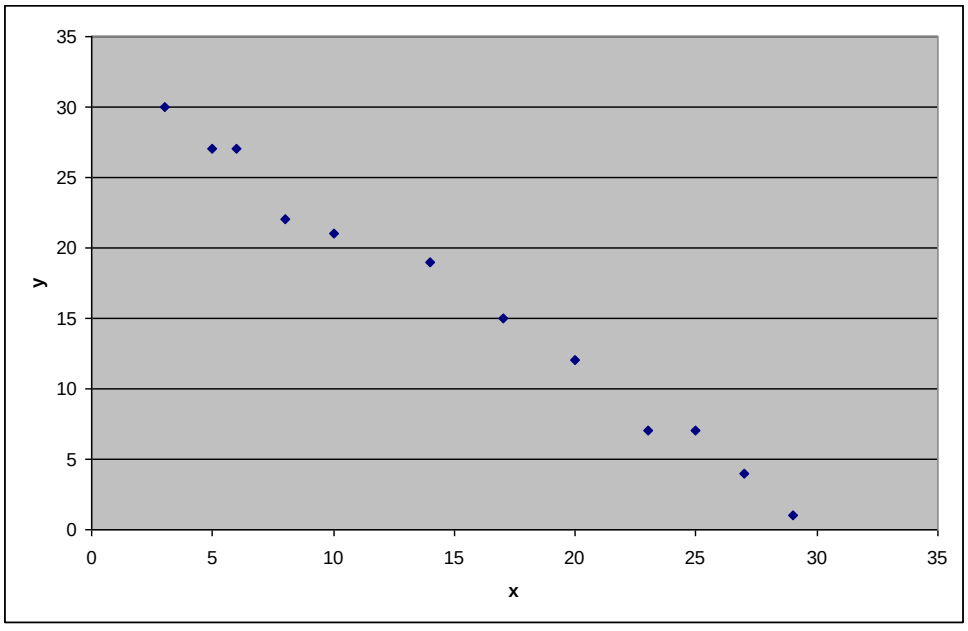


Scatter diagrams

Scatter diagrams are used to show the relationship between two variables. One variable is plotted against the other on a graph and this will display a pattern of points. By its very nature this is useful when analysing bivariate data. The pattern indicates the strength and direction of the correlation between the two variables. Correlation is concerned with measuring the strength of association between two variables. The more points tend to cluster around a straight line, the stronger and higher the correlation. So:



Shows a positive linear correlation, whilst the following shows a negative correlation.



Measuring Location

A measure of location or central tendency is a convenient way of describing a large frequency distribution by the use of a single value.

The main measures are:

- The mean
- The median
- The mode

The Mean

The formula for calculating the mean is:

Mean = $\Sigma x/n$

Where

Σ = the sum of

x = each observation

n = the total number of observations

Activity 14

Calculate the mean (average) weekly commission for the following data:

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
£58	£65	£42	£74	£33	£48	£52

You should have arrived at a figure of £53.14.

The advantages of the mean as a measurement are:

- It can be easily calculated
- It makes use of all the data
- It can be used in other forms of statistical work

But it has disadvantages:

- It can be affected by 'outliers' – data which is widely different from the norm and distorts the result
- It can give meaningless figures; for example to day that the average family as 2.4 children.

The Median

The median is the mid-value in a frequency distribution which has been arranged in size order.

Its calculation is very simple:

The median =(n+1)/2

Where n is the number of observations. Using the same data for activity 14, we first rearrange it in order:

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
£33	£42	£48	£52	£58	£65	£74

As we had 7 observations, the median is (7+1)/2 which is 4, so the median is shown in the 4 item of data, namely £52.

This works fine where there are an odd number of observations.

Where there is an even number, however the result would put us between two items and so you take the average of the two either side:

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
£33	£42	£48	£52	£58	£65	£74	£79

Our median calculation would be (8+1)/2 = 4.5, so our median is (£52+£58)/2 = £55.

The advantages of the median are:

- It not affected by 'outliers'
- It can be determined even if some of the values in the distribution are unknown
- It can represent an actual value in the data

Its disadvantages are:

- The value can only be a rough estimation for a grouped distribution
- It has no use in further statistical analysis
- Where the distribution is irregular, it may not be characteristic of the distribution

The Mode

Activity 15

The mode is the most frequently occurring value in a frequency distribution. So if we look at the figures in the following table, what is the mode?

3	7	5	4	3	7	8	7	9

You may have found it easier to actually sort the figures into order. What you should have found is that the mode is 7 – it appears more often than the other figures.

What does all this mean? All three methods of calculation give a way of estimating a mid point, they measure a central tendency. However their use in the real world can give some very different answers.

If you were researching the purchase of protective helmets and were going to rely on the straps to adjust the helmets to fit all and found the following data relating to 9 peoples' head size:

6"	6.5"	7"	7"	7"	7.5"	8"	8.5"	9"

Then the mode is 7". The median is also 7", but the mean is 7.38". If you purchased the nearest size to the mean, you would get the nearest size which would be 7 ½ . Of course if you used one of the first two, the helmets would fit 3 people perfectly, but if you used the mean figure, it would only fit one person perfectly!

In other words, you need to use the most appropriate figure for the purpose you have in mind.

Displaying Information

We have looked at a number of methods of displaying information in the preceding part on analysing data.

It will be useful to reconsider some of these to help us decide on the most appropriate means of displaying information.

We looked at **pie charts** as a means for displaying data.

Activity 16

What do you think are the advantages and disadvantages of the pie chart?

There are a number of advantages:

- They are easy to understand
- They make a strong impact and catch the eye
- They show comparisons easily

Amongst the disadvantages, you should have included:

- Where the proportions between two segments are close, they can be difficult to distinguish
- The don't give actual figures
- If there are many segments, they can be confusing.

Pie charts are good for showing how a total is divided. It can also help to include in each segment the size it represents.

You would probably use a pie chart when:

- You want to make an impact
- The details of the figures is not important
- You want to draw attention to broad divisions in the data

But you would probably not want to use this method where:

- There are a large number of divisions or segments
- You need to draw attention to small variations in the figures

Bar Charts were also used. These have the advantage of giving a visual impression with a scale against which the bars can be judged. AS such they give a reasonably accurate indication of the figures.

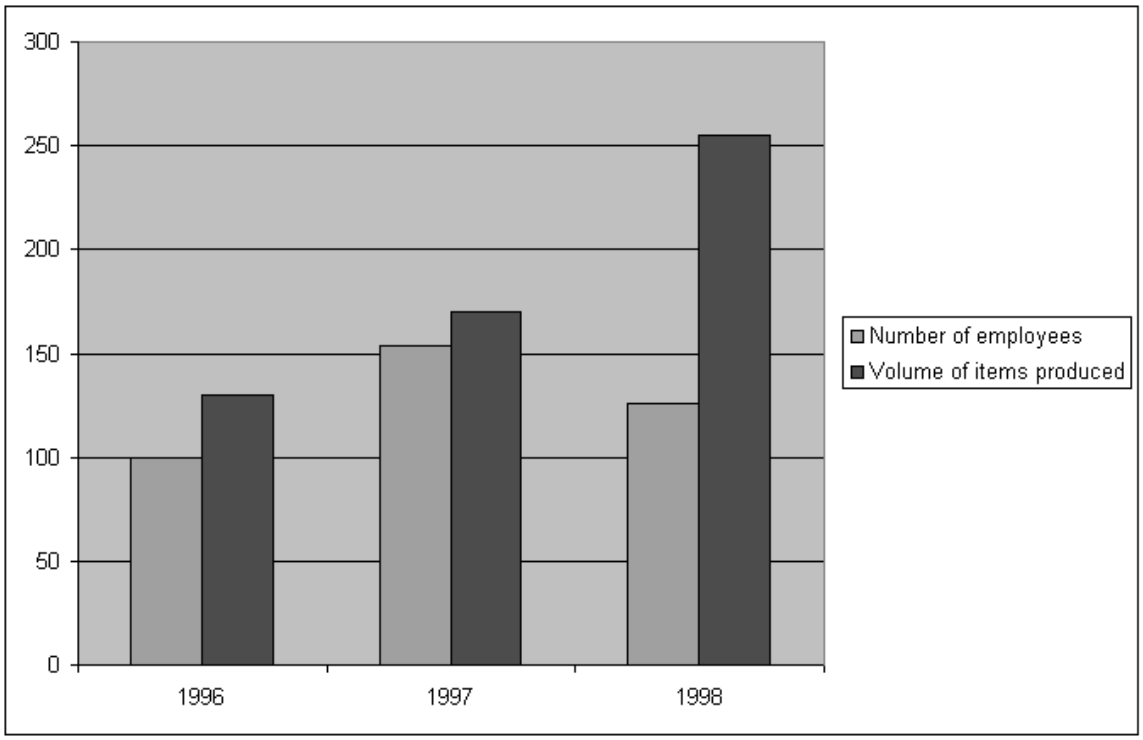
They can be enhanced by using colour to differentiate between the bars or to indicate relationships.

We used a simple bar chart, but they can be used in other ways. You can show relationships and variations by using more than one item of data for each time period.

For example, if we look at data on Employees and production levels over three periods of time, our table could be

	1996	1997	1998
Number of employees	100	154	126
Volume of items produced	130	170	255

This could be shown on a bar chart as:



Activity 17

We used both tables and graphs. What are the advantages of a graph over a table?

Tables are often used in addition to any form of chart to give the precise information on figures.

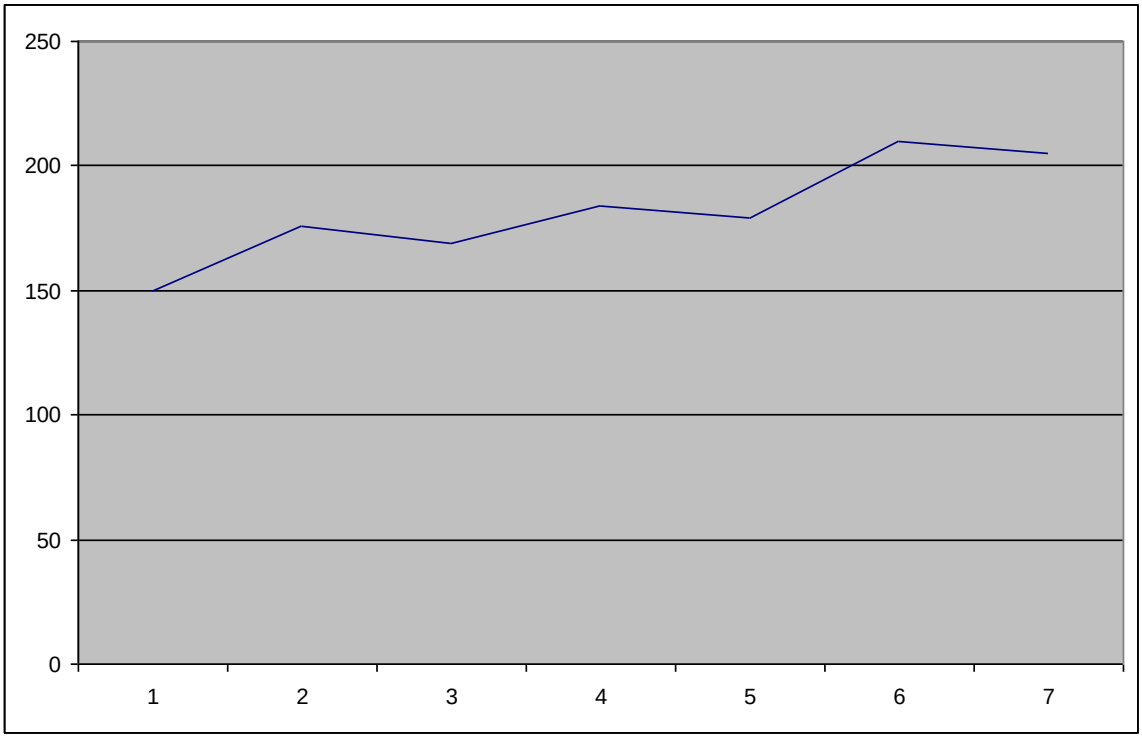
Graphs are excellent for displaying data where you want to be able to show trends or predict future values.

Your graph can show a trend from the actual figures.

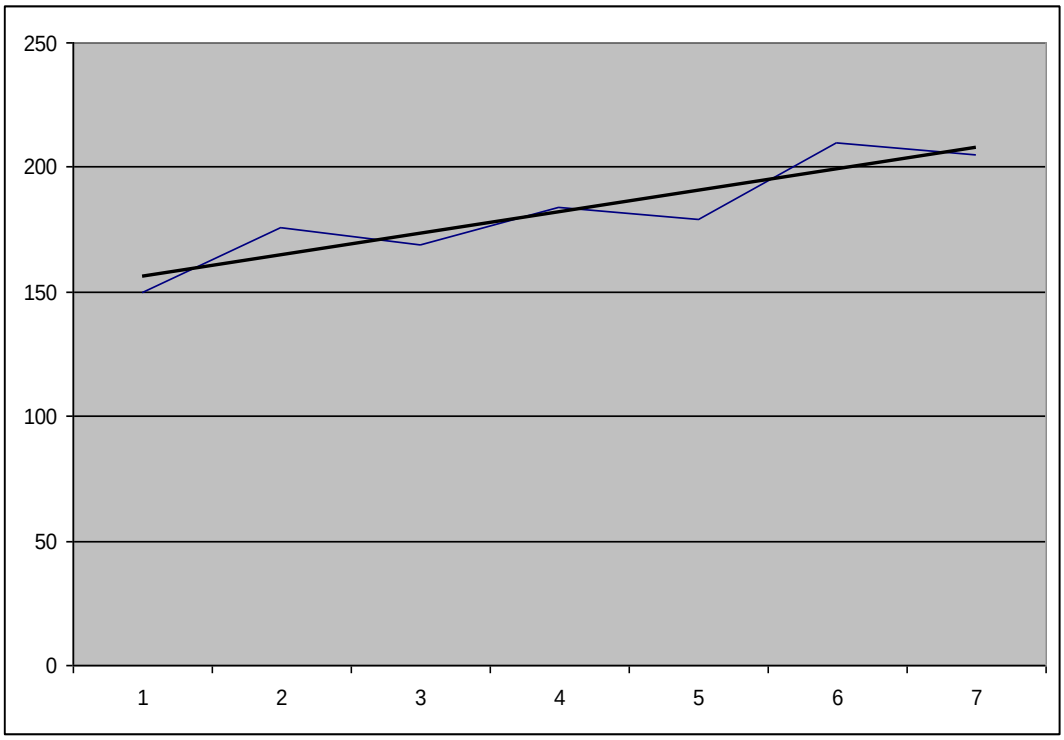
If we were to use the following data which gives profit over 7 years

Year	Profit (£m)
1990	150
1991	176
1992	169
1993	184
1994	179
1995	210
1996	205

It would end up looking like this:



But we could add a ‘trend line’ to show the way things are progressing. It would then look like:



Conclusion

Solving problems and making decisions are two key skills for any manager.

Frequently, in dealing with possible solutions it will be necessary to provide information to others so they can see the justification for the decisions that you are making. Presenting the data in an easy to understand way can make all the difference between a decision being accepted or rejected.

You should now be in a better position to achieve your goals.