First Line Management CMI Level 3

Session 4

Problem Solving

Contents

The Five Stages of Problem Solving

The problem solving process can be separated into five stages. By doing this, the problem solving process is divided into smaller, more manageable sections, making the problem solving process clearer and easier to follow. The five stages of problem solving are:

1. Problem Identification
2. Problem Analysis
3. Idea Production
4. Evaluation
5. Implementation

These stages can help you in solving a problem, as they allow you to work through the problem a stage at a time.

Stage 1: Problem Identification

In order to solve a problem it is first important to identify the problem. The first step to solving a problem is to read the description of the problem area. By examining the description of the problem area, you will be able to determine what the problem is to be solved. Understanding the problem and what needs to be done is of the up most importance if you wish to solve the problem. Not understanding the nature of the problem can lead to not being able to produce a solution, or producing an incorrect solution. From the description you need to identify questions. The questions are asked within the description of the problem need to be identified. As well as identifying these questions within the description of the problem, you need to ask questions of the description, for example;

What is the current situation?
What is the required situation, the desired end point?
What needs to be done, the action that needs to be undertaken?
What resources are available?
Are there any constraints affecting the solving of the problem?

Any questions, which are asked within the description, show a problem, which needs to be addressed. In identifying a problem you also need to know the type of problem you are faced with before you actually attempt to solve the problem. Problems may be simple or complex, but are one of two types. The two types of problem are;

- **Closed (Tame)**

- **Open (Wicked)**

Closed.
A closed problem has a definite answer; the solution is correct or incorrect.

Open.
Only suggestions can be offered as possible solutions to an open-ended problem. These possible solutions are then judged to see which best offers a possible answer to the problem.

Other important factors to look for when identifying a problem are;

- Givens
- Conditions
- Objects
- Information
- Goals
- Constraints
- Objectives
- Obstacles, which change the givens into goals (Mayer 1991).

Once the questions, type of problem and conditions, constraints etc. have been identified, you will be able to see what is required in order to solve the problem.

Keeping a record of the afore mentioned factors will help you clearly visualise the requirements and objectives of the problem, in order to assist you in producing a solution.

Once the problem has been identified, what is required, under what set of conditions, using given information and overcoming stated obstacles, the problem can then start to be solved. You can then move onto the next stage of the problem solving process, Problem Analysis.

Stage 2: Problem Analysis

The next stage of the problem solving process is problem analysis. This involves the further consideration of the identified problem. Problem solving is different to studying. It requires the thinking process more. You have to actively think about the problem in order to solve it.

It is important to analyse a problem once it has been identified. On analysis you may find constraints and conditions that you may have previously missed on first identification of the problem. Analysis of a problem is the way in which you look at the problem. Looking at the problem from a number of different perspectives is the key to correctly diagnosing a problem and also gaining a full picture of the problem. Robson (1993) states that one of the major reasons for failure to solve problems is a "wrong diagnosis" of the "real causes" of the problem, and therefore,

"This stage of the problem solving cycle is crucial to success."
(Robson 1993.)

It is important to look at all sides of the problem (Robson 1993), by doing this you will be able to produce a correct diagnosis for the problem. A correct diagnosis will lead to a correct solution to the problem. An incorrect diagnosis will lead to an incorrect solution. It is therefore important to correctly and thoroughly analyse the problem.

By examining a problem from all sides, from as many perspectives as possible, the analysis of the problem will be more complete. There are a number of ways in which you can analyse a problem. Asking questions of the problem is one way in which to analyse the problem. Another way in which to analyse the problem is to ask the opinions of others, to obtain different perspectives of the problem. Alternatively you could try placing yourself in the position of others and how they may view the problem. The opinion of others may be especially important in the solving of research problems. In research the production, or not, of a solution to a research problem may affect others. For example you may develop a new method of doing something:

Would people using the existing method welcome this change?
Would they benefit from this new method?
How would they be affected by your solving this problem?

You may need to consider their views before you attempt to produce a solution to your research problem, for example by carrying out a survey or a questionnaire.

Two other ways in which you can analyse a problem are by;

1. Cause and effect diagrams
2. The six word method (Robson 1993).

Cause and Effect Diagrams
These diagrams help to separate the 'causes' and 'effects' of the problem, in order to help view the problem as a whole. This helps the problem to be seen from a different

perspective; it helps the importance of causes to be seen and highlights key issues. The cause and effect diagram can be described within five stages.

Stage 1
Identification of the effect. This needs to be as accurate as possible, as stating too general an effect of a problem will result in the identification of too general causes. This will lead to difficulty in solving the problem. Causes identified must also be as precise as possible.

Stage 2
The next stage is to draw the cause and effect diagram. There are 6 main problem areas to a cause and effect diagram, these and the structure of a cause and effect diagram are shown in figure 6 below.

Not all headings may be of relevance to your problem or in addition you may need to add other headings relevant to the problem you are trying to solve.

Stage 3
Stage 3 involves the process of brainstorming in order to expand on each of the main headings of the cause and effect diagram. This expands on the cause and effect diagram as shown below in figure 6.

Stage 4
The next stage of the process is the incubation of the ideas developed in stage 3.

Stage 5
Analysis of the whole cause and effect diagram to identify the most important causes, those that stand out most from the diagram.

Cause and effect diagrams are a useful way in which to utilise both analytical and creative thought in the problem solving process. An example of the structure of a cause and effect diagram is shown in figure 6 below.

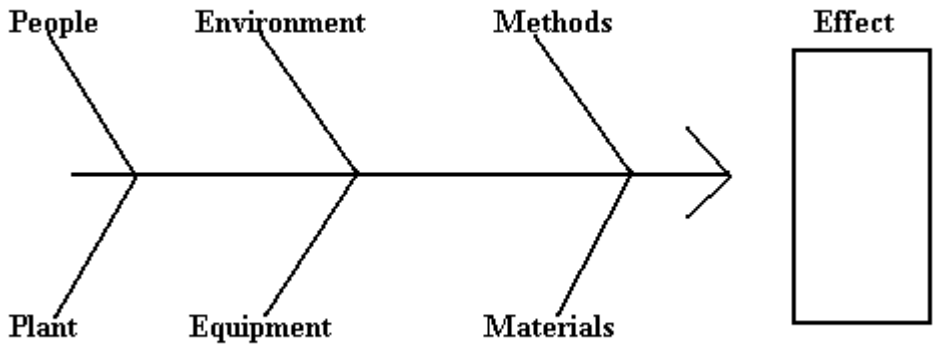


Figure 6. A Cause and Effect Diagram.

The Six Word Method
This method of analysis involves looking at the problem in terms of the six words;

What
Why
When
How
Where
Who

As before, for the cause and effect diagram, the problem must be clearly defined. The problem is questioned twice in terms of the six words, for example;

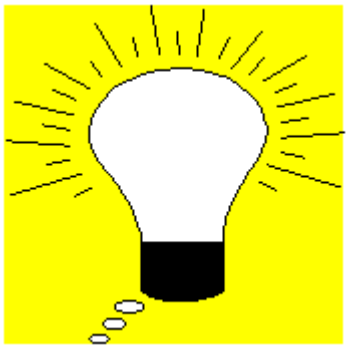
What is causing the problem?
What is not causing the problem?

By questioning the problem twice you will be able to separate what is related to the problem and what is not related to the problem. As with the cause and effect diagram, the next stage of the six word method is brainstorming in relation to what has been identified as being related and not related to the problem. Next the ideas related to the problem are incubated, before the final analysis of the results of the six word method as a whole, to isolate key issues and collect information on these key issues.

Once you have fully analysed the problem it is time to move onto the next stage of the problem solving process.

Stage 3: Idea Production

The next stage of the problem solving process is to produce ideas to the identified and analysed problem. These ideas will provide possible solutions to the problem. To identify possible solutions the technique of brainstorming is often a good way in which to produce ideas.



There are five rules to the process of brainstorming (Robson 1993). These five rules are;

1. No criticism of any ideas.
2. To encourage the process of ‘freewheeling’, the process of random and creative idea production.
3. Generate as many ideas as possible.
4. Record all ideas, even repetition.
5. Incubation of ideas before evaluation of the ideas as possible solutions.

It is important at this stage of the problem solving process to take into account all ideas and to document these ideas, so that you have a record of all possible ideas and can move onto the next stage of the problem solving process.

Stage 4: Evaluation

Stage 4 of problem solving is the evaluation of all ideas, possible solutions to the problem, produced in stage 3. It is at this stage, that ideas are evaluated and kept or discarded.

Evaluation of ideas to produce a solution to the problem you wish to solve is not an easy process. You may have to make some mistakes, wrong turns or choices within the problem solving process, before the correct or most probable solution is discovered or selected. Problem solving can often be a trial and error process (Oliver 1997), and this can be especially evident at the evaluation stage of the problem solving process. You may need to test a number of possible solutions before you find the correct or most suitable one.

In order to identify and evaluate possible solutions you may have to;

- re-examine the problem
- question the information you have, for example is it accurate?
- interpret the facts/ data
- analyse the solutions in terms of cost - benefit analysis (Robson 1993).

Cost - benefit analysis is a useful way for you to evaluate a possible solution. You need to consider the advantages, the benefits of your solution along with the disadvantages, the costs. For example:

- Who will be affected by the solution, and in what way?
- What are the advantages?
- What are the disadvantages?
- Do the advantages outweigh the disadvantages? Or vice versa?

You will need to assess the advantages and disadvantages associated with the possible solution to your problem.

Another factor you need to consider when evaluating solutions for a problem is viability. Robson (1993) states that;

Solution + Viability = Acceptance

For a problem to be solved, a possible solution is required to be viable. If, for example, you have a problem to be solved to which a possible solution is to spend a thousand pounds, but you have only a hundred pounds available to you to implement a solution, then the solution is not viable. Undoubtedly the solution can be solved with the larger amount of money, but if you do not have access to this sum then it is not a viable solution to your problem. As the above equation shows for a solution to be accepted it needs to be viable. Your solution will not be accepted by others unless it is viable, and the same can be said of your research. If your

research is not considered viable, for example if it is not well supported by your testing of the research, then it will not be well accepted by others.

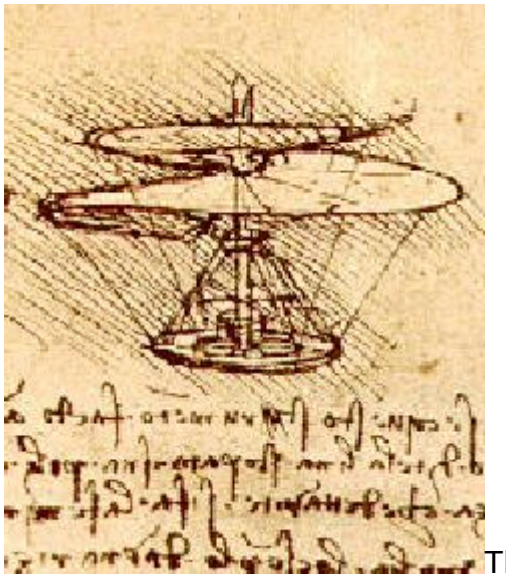
A final aspect of evaluation of possible solutions is risk assessment. Are there any risks involved in the implementation of the solution? You will need to consider if there are any risks associated with applying your chosen solution to the problem. This is closely related to cost-benefit analysis of solutions in that it is examining the possible negative aspects of a solution. This is especially true for your research where you will need to assess your research in terms of any risks it may possess. For example you may be carrying out research, which will affect others, the development of a new medical treatment, or yourself, the completion of your research degree.

Evaluation of ideas may require you to make some mistakes and wrong choices before you find a suitable solution, however this should be expected as mistakes play an important role in the problem solving process. Once you have found what you consider a suitable or correct solution to the problem you can move onto the next stage of the problem solving process, implementation.

Stage 5: Implementation

The final stage of the problem solving process is the implementation of a solution to a problem.

It is just before this stage that you may be required to present your possible solution to others. The presentation of ideas to others can often be the most difficult aspect of the problem solving process, as there is often the fear that your ideas will be unacceptable and you will be made to appear or feel foolish on the non-favourable or non-acceptance of your work. A famous example of this is the work of Leonardo Da Vinci, his helicopter design was ridiculed, but today the helicopter is widely in use. So although your ideas may not be accepted at first, they may be accepted eventually.


The helicopter design of Leonardo Da Vinci.

The Helicopter in use today. 

But how do you get your ideas accepted? Solving problems and implementing solutions within your research may or may not require the acceptance of others, though at some time in your future career or research you may require your ideas to be accepted by others. The way in which you present your ideas to others can affect

the acceptance of your ideas or solution. You need to focus on the advantages of your solution and present the benefits of your ideas clearly. As the way in which you present your solution to a group, may affect its acceptance, you may wish to refer to the Research Student Training Programme unit on Presentation Skills.

Once your solution has been accepted, if acceptance is required, you are then free to implement the solution to your problem. On implementing your solution you should be able to solve the problem, as well as may be possible, depending upon the nature of the problem. If you are unable to solve the problem you may have selected an incorrect, or impossible solution to that problem. If this is so you may have to restart the problem solving process or go back to previous stages of the problem solving process. As stated previously making mistakes is a part of the problem solving process, and so having to find a different solution is all part of the process.

The problem solving process is shown in full below in figure 7.

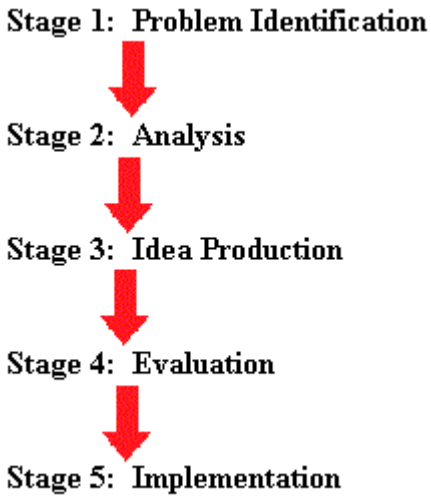


Figure 7. The problem solving process.

Vertical and Lateral Thinking

Vertical and lateral thinking are two different ways of thinking, both of which play a role in the problem solving process. Both types of thinking will be discussed within this section of the problem-solving unit, along with the differences between the two and their place within the problem solving process and research.

Vertical Thinking

Vertical thinking is considered to be the traditional form of thinking, which takes place in sequential steps. It is an ordered and selective way of thinking. The process of vertical thinking can be expressed as shown below (figure 8).

Figure 8. The process of vertical thinking.

Vertical thinking moves from one step to another in a logical ordered manner. De Bono (1988) states that in the process of vertical thinking, due to its ordered nature, you can only move through the process if there is a direction in which to move in. Vertical thinking moves in a clearly defined direction, which is towards the solution of the problem, using a definite technique.

A further quality of vertical thinking is that it is an analytical way of thinking. When utilising vertical thinking, you know what you are 'looking' for (De Bono 1988), you know what has to be analysed in order to produce a solution to a problem.

Due to the ordered nature of vertical thinking, one has to be correct at every stage of the problem solving process. **''Rightness''** is fundamental to the nature of vertical thinking. In order to maintain the 'rightness' of the vertical thinking process, vertical thinking involves the discarding of irrelevant information and concentrating on what is relevant to the problem and therefore the solution. Vertical thinking is selective by the exclusion of information. Vertical thinking selects the most appropriate paths or ideas and pursues them in order to find a solution.

Vertical thinking as already stated is an ordered process, and it is due to this ordered nature that vertical thinking is rigorous. Within vertical thinking the rigidity of definitions is observed. For example using categories, classifications and labels which are fixed, as in mathematics, where once a symbol is allocated it may not be changed (De Bono 1988).

Vertical thinking is a finite process, in that with vertical thinking one expects to produce a solution to a problem, for example the use of a mathematical method is guaranteed to produce an answer (De Bono 1988), and so the same is expected of vertical thinking, to produce a solution. In summary, the process of vertical thinking is;

- sequential
- precise
- selective
- analytical
- finite

Lateral Thinking

Lateral thinking is concerned with creativity. Lateral thinking is closely related to insight, creativity and humour, however it is a deliberate process. De Bono (1988) states that insight; creativity and humour can only be prayed for, whereas lateral thinking can be learned. It is as definite a way of using the mind as vertical thinking, but uses the mind in a different way. It also differs, however, from creativity, in that creativity is often a result while lateral thinking is a process, which can be learned.

Lateral thinking is a way of handling information in order to generate new ideas and changes. Old ideas are disregarded being replaced by these new ideas. Lateral thinking generates new directions of thought and restructures old patterns of thought. It is in effect to do with change. Change in attitudes and approach, a different way of looking at things.

As mentioned when discussing vertical thinking, which moves only if there is a direction in which to move, the generative nature of lateral thinking means that lateral thinking acts to produce new directions in which to move. Unlike vertical thinking, which only moves towards the solution, lateral thinking may move both towards and away from something in order to find a new direction. The way in which the lateral thinking process moves is non-sequentially; this is shown in figure 9.

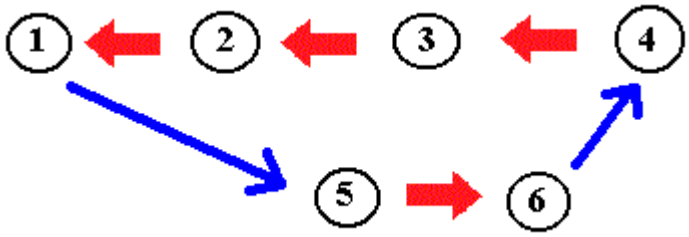


Figure 9: Lateral thinking is a non-sequential process.

Lateral thinking may involve you taking an illogical path before you reach the solution. It is this non-sequential and illogical nature that means that the lateral thinking process is not required to be correct at every stage, unlike the vertical thinking process.

Lateral thinking also differs from vertical thinking, in that rather than discarding irrelevant information; lateral thinking deliberately seeks out any irrelevant information discarding no possibilities. By doing this the process of lateral thinking investigates the least likely paths or ideas, which would usually be ignored. In doing this lateral thinking may assist in discovering some useful information from an unlikely source, a source that may not be investigated by vertical thinking. Lateral thinking is not a precise process.

Another quality of lateral thinking is that it is a probabilistic process. There may be no answer when using the lateral thinking process; however there is the probability that a solution will be produced.

De Bono (1988) describes lateral thinking as an **"insight tool"**, it is a way of using creativity but regarding it as a way of utilising the mind a way of handling information, De Bono (1988) states that this is what lateral thinking is all about.

To summarise lateral thinking is;

- non sequential
- not a precise process
- generative
- creative
- probabilistic
- explores the least likely paths
- does not exclude information

The Difference between Vertical and Lateral Thinking

The following table presents a summary of the difference between lateral thinking and vertical thinking.

The difference between vertical and lateral thinking: a summary.	
Vertical Thinking	**Lateral Thinking**
Sequential	Non Sequential
Analytical	Provocative
Selective	Generative
Finite	Probalistic
Only moves in a direction if there is a direction to move in	Generates new directions in which to move
Excludes irrelevant information	Uses irrelevant information
Logical	Illogical
Investigates the most likely paths	Investigates the likely paths
Exact	Not precise

Both lateral thinking and vertical thinking are required in the problem solving process. They are complementary to each other in that lateral thinking acts to generate ideas and vertical thinking selects from these ideas.

As previously discussed problem solving plays a role in the research process, the purpose of research is to solve research problems and questions. Therefore both vertical and lateral thinking are required in the research process. Lateral thinking involves creativity, the generation of new ideas, of new patterns of thought and change. Research is involved in change and progression, and therefore some form of thinking is required which will produce change, new ideas and new developments. Lateral thinking is this type of thinking, and it's place within the research process is to

assist in the production of changes, the development of new perspectives, new ideas and new advances, that research is all about.

The place of vertical thinking in the research process is to be applied to the ideas that are produced by the lateral thinking process. Vertical thinking acts to select the best or most appropriate ideas, by the disregarding of irrelevant information. Vertical thinking acts sequentially working in an ordered manner on ideas in order to produce a solution.

Overall in the process of research,

Lateral thinking = generation vertical thinking = selection

to assist in the production of a solution to a research problem.