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Introduction to the tools for analysis

What are the Tools for Analysis?

- Ishikawa Diagrams to analyse cause-and-effect factors
- Deployment Flowcharts to analyse processes
- The Kano Model to analyse customer needs
- Measles Diagrams for analysis by location of occurrence
- Movement Maps to analyse the movement of work, people or customers

Involving the right people

- If the tool is being used in project work, the methodology will have ensured that the correct people are present as part of the set up stage
- In other situations, ensure that everyone in the area under study is involved
- Make sure people bring any relevant information with them, for example if flowcharting an administrative process it is always useful to bring examples of any forms used

Room set up

Make sure the room is set up appropriately. The Tools for Analysis require use of wall space - a flipchart stand is not big enough. Arrange the chairs in a u-shape without tables around the wall space to be used so that everyone can participate.

A word of warning

There is a possible pitfall that a group using these tools can strive to produce a technically perfect Ishikawa Diagram or Deployment Flowchart and forget that the purpose of what they are doing is to analyse something. The reason a tool is being used is to help and not to hinder. The guidelines in this section are intended to cover all possible scenarios and this means they are very comprehensive. Common sense needs to be applied alongside the manual.

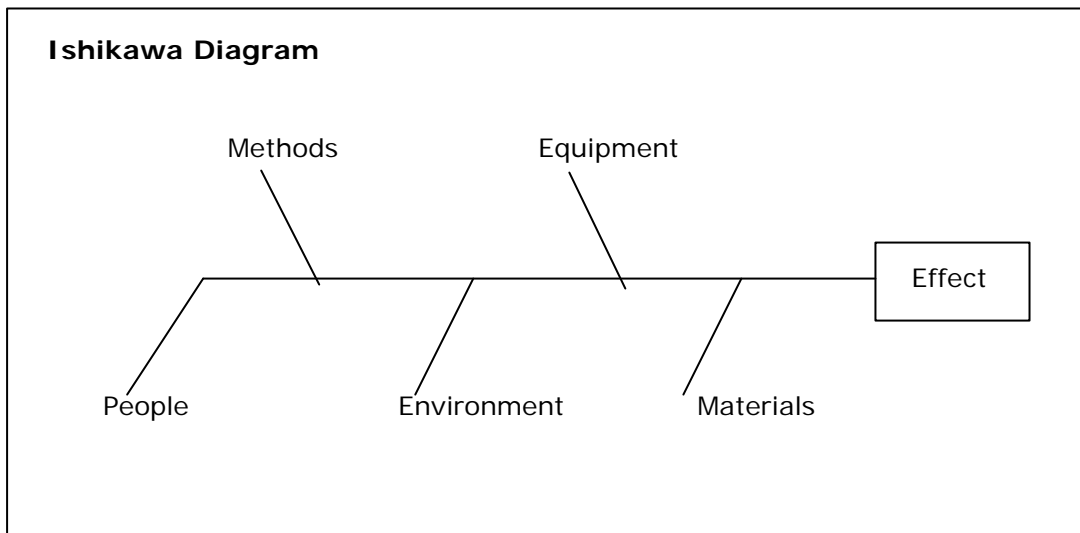
Using a Facilitator

Ishikawa Diagrams and Deployment Flowcharts in particular are much easier when a **UIMPROVE** Facilitator is used.

Ishikawa Diagrams - Introduction, principles and when to use them

Description

Ishikawa Diagrams, also referred to as Cause-and-Effect or Fishbone Diagrams, are a tool intended to show causal relationships by stating an 'effect' in the 'head' of the diagram and then listing possible causes along branch arrows.



When to use Ishikawa Diagrams

(1) *In Improvement Methodology*

Stage 1.7 of Improvement Methodology is 'produce an Ishikawa Diagram'. This is for project scoping - it will identify all areas the project needs to consider and ensure all angles are covered. It will also identify any processes that need to be flowcharted and analysed.

(2) *In Problem Solving Methodology*

Stage 1.3 of Problem Solving Methodology suggests using an Ishikawa Diagram. This is to identify possible causes of problems and how they relate to each other.

(3) *In Data Collection, Display and Analysis Methodology*

Ishikawa Diagrams can be used to break down a 'quality characteristic' into its component parts (sorry about the jargon). A quality characteristic is something that is important to the customer, for example 'politeness' or 'cleanliness'. An Ishikawa Diagram ensures all possible contributory factors are identified. This section of the manual does not cover this application. See instead Data Collection, Display and Analysis Methodology.

Ishikawa Diagrams - Introduction, principles and when to use them

The underpinning principle - MEPEM

The key principle that underpins an Ishikawa Diagram simply relates to it being a tool for *analysis*. If we were to tackle the situations listed above using Brainstorming, we would not be analytical. The brain will take us down our usual pathways and we will not be systematic - experience shows that typically we will overemphasise people issues and underestimate other areas.

Professor Ishikawa studied all possible factors that might lead to a given situation and the ultimate result of this work is the five 'universal' categories of *methods, equipment, people, environment and materials* - MEPEM.

The Ishikawa Diagram makes the user think systematically about areas they wouldn't normally and that can make it strenuous work - because it requires use of pathways in the brain that are seldom used.

Some general advice about using Ishikawa Diagrams

Not for everyday use

Bear in mind that the Ishikawa Diagram is not a tool for everyday use. By comparison, the Tools for Planning and Organising such as Brainstorming and Chronological Clustering for example have many day-to-day uses. As a general rule, an Ishikawa Diagram should be used only when needed - i.e. when a methodology tells you to. It is not a stand-alone tool.

It's hard work

The Ishikawa Diagram is probably the hardest work of all the tools in this manual. This is not a bad thing, indeed it is good. The whole purpose of an Ishikawa Diagram is to make the user think about factors they would not normally. It is a tool for analysis and therefore requires more thought and effort. Compared to the easy flow of tools such as Brainstorming, the Ishikawa Diagram makes people sweat.

When is an Ishikawa not an Ishikawa?

When training people in how to use the Ishikawa Diagram, we often start with "hands up if you've ever seen one of these before". In a typical group of managers, a quarter will put their hands up. Next we say "keep your hands up if you have ever used one for real". Nearly all hands go down.

Exploration of this has shown us two things. The people who initially put their hands up have seen Ishikawa Diagrams on a training course at some stage in the past. However, only a tiny percentage have actually applied the tool mainly because there is no clear link between the tool and a real-life situation. Secondly there is little, if any, consistency between what different training providers and authors say about when and how to use the tool. This section is based on the original writing of Professor Ishikawa (more on him later), other authors who have built on his work and our own practical experience of using the tool for real.

Ishikawa Diagrams - Introduction, principles and when to use them

Can headings other than MEPEM be used?

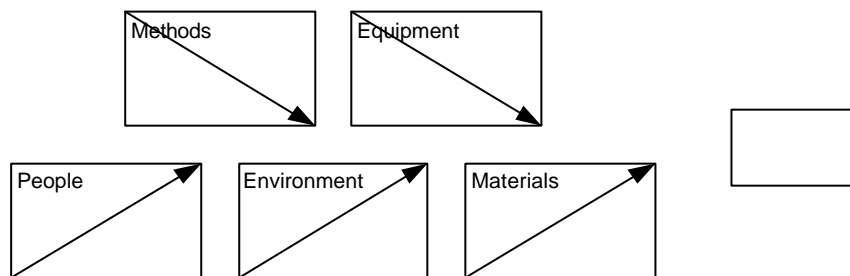
No.

Once upon a time in the dim and distant past when ditherers roamed the world, our advice used to be "if you can think of better headings, use them". No-one ever has and it dawned upon us that Professor Ishikawa had already done the hard work. If you use your own headings, you will think like you normally do and this will not help analytical working.

Ishikawa Diagrams - How to produce them

Preparation

You will need flipchart paper, pens, post-it notes, blu-tack and plenty of wall space. Blu-tack up 5½ sheets of flipchart paper as shown using one sheet for each of the MEPEM categories and half-a-sheet for the effect.



Write the five headings - methods, equipment, people, environment and materials on the sheets and draw in the arrows or 'bones'.

Ishikawa Diagrams - How to produce them

Producing the Ishikawa Diagram

(1) Define the 'effect' and write it in the head

In Improvement Methodology, the effect is going to be the desired improvement that is being aimed for.

Examples: 'The ideal reception area', 'reduction in anti-social behaviour', 'reduction in rent arrears'.

In Problem Solving Methodology, the effect is the problem itself.

Examples: 'Breakdowns of forklift trucks', 'faults on train doors', 'needle stick injuries'.

Clues about what the effect should be will be found in the project remit.

(2) Pick one of the MEPEM bones to work on first

Try to choose one that will get you off to a good start. Generally it is a good idea to ask the group where they would like to start but do not start with 'people'.

(3) Analyse each bone in turn

Go around the group in rotation Round Robin style, list possible causes or factors on post-it notes and place them against the appropriate branch arrow. Related post-it notes should be grouped together to form sub-bones.

Note especially that this is not Brainstorming. As this is a tool for analysis, it is important to pause for debate and clarification when needed. A Facilitator will help get the balance of discussion versus moving forward with the next idea right.

Short, snappy post-its are usually not appropriate. Good explanatory phrases are required. Think 'cause-and-effect' - the words written on the post-it should cause the effect as written in the head of the Ishikawa. Whatever is written on the post it *leads to* whatever is written in the effect box.

Ensure you exhaust all ideas under each bone before moving on to the next.

Fully explore sub-bones as they arise.

You may well find that ideas are duplicated under more than one bone. Don't worry about this.

Do not jump around from bone to bone but if an idea comes up that obviously belongs under a different bone, place it under that bone straight away.

Ishikawa Diagrams - How to produce them



Ishikawa Diagram in progress

(4) *Tidy up the diagram*

Ensure the sub-bones are tidy and look for any gaps. Add in extra post-its as they are thought of. Finally, draw in the actual shape of the sub-bones using a flipchart pen.

What to do next

Next steps will depend on the nature of the work you are doing. A good starting place is to ask the group what they think. Some options are:

- Continue to follow the methodology
- Allocate specific actions to individuals
- Flowchart processes identified under the methods bone
- Must-Should-Could or short-term, medium-term, long-term
- Vital few/useful many
- Quick hits
- TPN Analysis
- Identify specific areas for investigation
- Collect data about individual factors

Ishikawa Diagrams - How to produce them

Ishikawa or Cocktail Party?

Another common question is whether Cocktail Party can be better than Ishikawa as it would be possible to stick up blank sheets with the MEPEM headings. Cocktail Party is more suited to Major Project scoping. Ishikawa is used when a specific area has been identified for improvement. Using an Ishikawa has the following advantages:

- More systematic (and therefore analytical)
- Emphasises cause-and-effect
- Opportunity for interaction and dialogue between people

However, it is not appropriate to produce an Ishikawa Diagram at a Project Kick-Start. In this case, Cocktail Party prompts based on MEPEM are a good idea. The outputs from this can then be reviewed later when an Ishikawa Diagram is produced.

Extra tips

- ✓ A **UIMPROVE** Facilitator is essential for this
- ✓ Bring along any pre-work or other relevant information
- ✓ A common cause of confusion in service industry settings is the distinction between 'equipment' and 'materials'. It helps to clarify this at the start. Equipment can be described as fixed or mobile plant - vehicles, machinery or photocopiers. Materials are consumables, fuel, component parts in production or stationery.
- ✓ Double check that factors under the people bone are definitely people issues. Groups have a habit of attributing process (i.e. methods bone) issues to people.
- ✓ Have an Issue Park to capture any ideas that come up as the Ishikawa Diagram is being constructed
- ✓ Don't worry if there is an imbalance between bones.
Sometimes there will be an equal spread of factors between all bones. Sometimes one or two bones will have very few factors. On other occasions all factors are mainly concentrated on one bone with few on the others. It's hard to predict where a concentration might be but there is often a pattern dependent upon the nature of the topic under study. Service industries for example will often have few factors on 'equipment' and 'materials'.
- ✓ Use the Ishikawa Diagram as a starting point for data collection.
This applies particularly in problem solving but in all situations, once an Ishikawa Diagram has been constructed, it is important to evaluate the relative importance of each factor identified. Collect data about how important each factor is and display this as a Pareto Chart.
- ✓ Do not attempt to type up an Ishikawa Diagram. Take a digital photo instead.

Ishikawa Diagrams - Additional information

A little philosophy

Dr Juran coined the 85-15 rule. This suggests that whenever there is a problem, 85% of the time it will be something to do with the system and not the fault of the person doing the job. Dr Deming believed the figures were more like 98-2.

An Ishikawa Diagram provides a whole system view, broader than just understanding the process because it includes equipment, environment and materials.

If we take a step back to the overarching purpose of the **UIMPROVE** approach, i.e. to improve an organisation, the use of Ishikawa Diagrams can contribute to a change in organisational culture. It is a practical way of moving from a blame culture of 'who's to blame?' to 'what's to blame?'.

What to put on the people bone?

The 85-15 rule suggests that there should be relatively little on the people bone. Think about these:

Negligence	=	Method (why hasn't the opportunity to be negligent been error-proofed out?)
Inconsistency	=	Method (why hasn't the process been standardised?)

Our advice is to see what comes up from the group. A good Facilitator will let the ideas run and then look for those that should probably be under one of the other four bones.

Sub-bones around training, recruitment and the like are a good idea. Whilst one argument might be that these are methods, our view is that the methods bone is about 'production methods' as opposed to 'people methods'.

Who was Ishikawa?

Ishikawa Diagrams are named after their inventor, Professor Kaoru Ishikawa. Professor Ishikawa graduated from the Department of Applied Chemistry at the University of Tokyo in 1939. He had a varied industrial and academic career including acting as an instructor for the Quality Control Research Group of the Japanese Union of Scientists and Engineers. He first used his diagram in the summer of 1943 while he was working with a group of engineers at the Kawasaki Steel Works. The root of the Ishikawa Diagram in heavy industry and manufacturing is apparent but experience has shown it is equally valuable in service industries. This is because Ishikawa recognised the importance of both people and their interaction with other factors and this relationship is vital in every situation.

Deployment Flowcharts - Introduction, principles and when to use them

Description

All routine operation happens through processes. Therefore if we don't understand our processes, we don't understand how work gets done. Flowcharting of processes is the answer to this. Flowcharting is a tool for working on processes with the help of the people who work in them.

A Deployment Flowchart is a diagram of the people, tasks and decisions that make up a particular process. The unique feature of a Deployment Flowchart is that it shows the people or departments involved across the top or down the side of the chart and therefore their relationship with the process and each other.

One of the biggest benefits of flowcharting is that it helps us to see the bigger picture. People doing their bit of a process simply don't understand how the whole process fits together, who does what and what problems other people have. Flowcharting a process is better than simply saying "everyone should work together as a team".

Flowcharting, Process Charts, Process Mapping, Deployment Flowcharts - Confused?

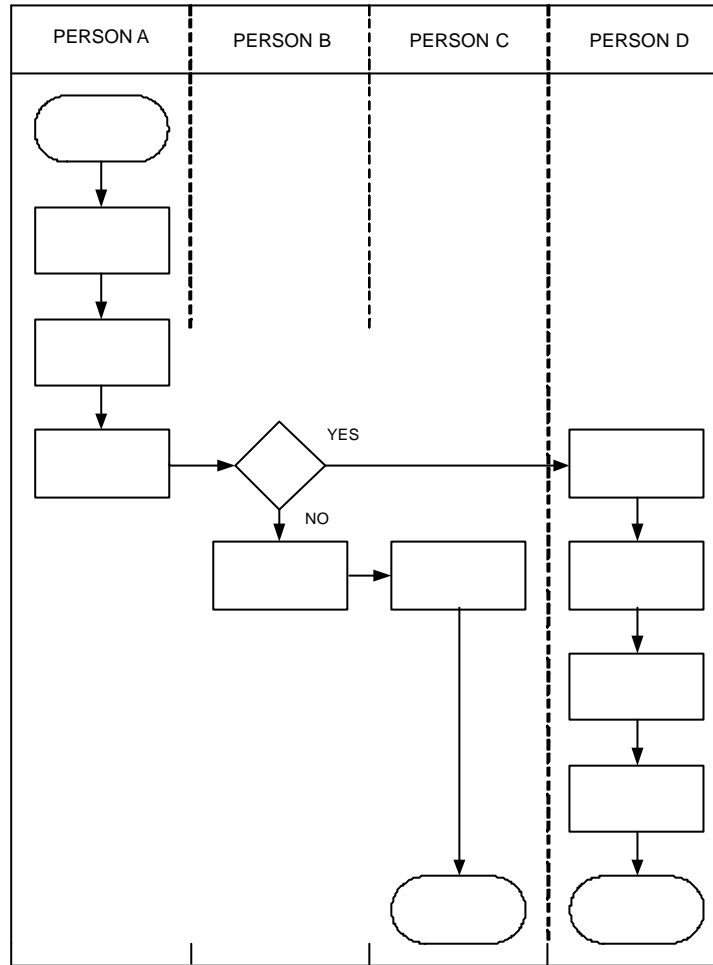
Flowcharting is the generic term for a diagram showing the different stages of a process. Flowcharts were originally called Process Charts by their inventors, Frank and Lillian Gilbreth.

Process Mapping is a more recent term popularised in the late 1980s. Process Mapping encouraged organisations to carry out wholesale mapping of processes, sometimes onto rolls of brown paper. What this lacked was the focus of organisational improvement and has now gone out of fashion.

We recommend Deployment Flowcharting. This is a particular type of flowchart, the unique feature being that it shows the people or departments involved across the top (or alternatively along the side) so that it is clear both who does what and how different individuals or departments interact with each other. An 'ordinary' flowchart does not have the 'who does what' element.

Deployment Flowcharts - Introduction, principles and when to use them

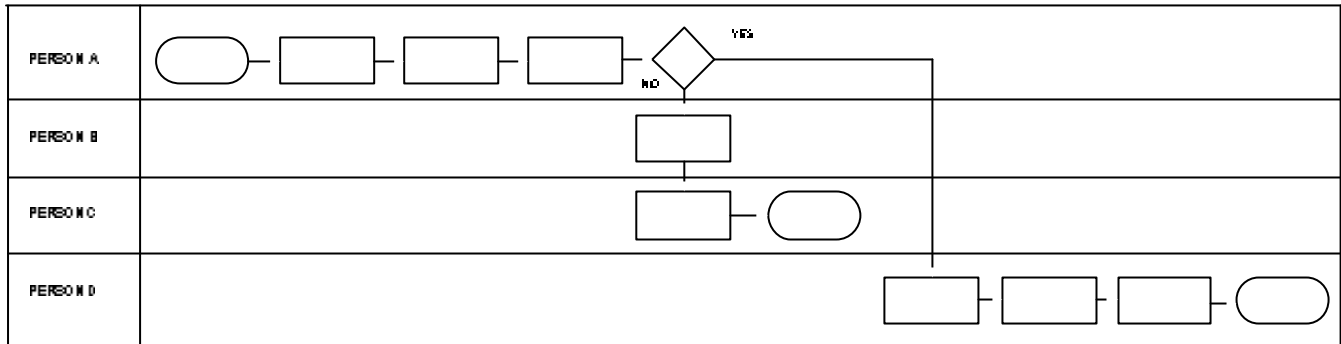
Deployment Flowchart - 'portrait' layout



In a 'portrait' layout Deployment Flowchart, the individuals or departments are shown across the top.

Deployment Flowcharts - Introduction, principles and when to use them

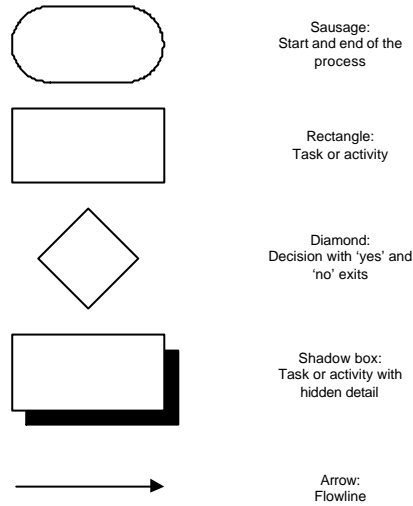
Deployment Flowchart - 'landscape' layout



Deployment Flowcharts - Introduction, principles and when to use them

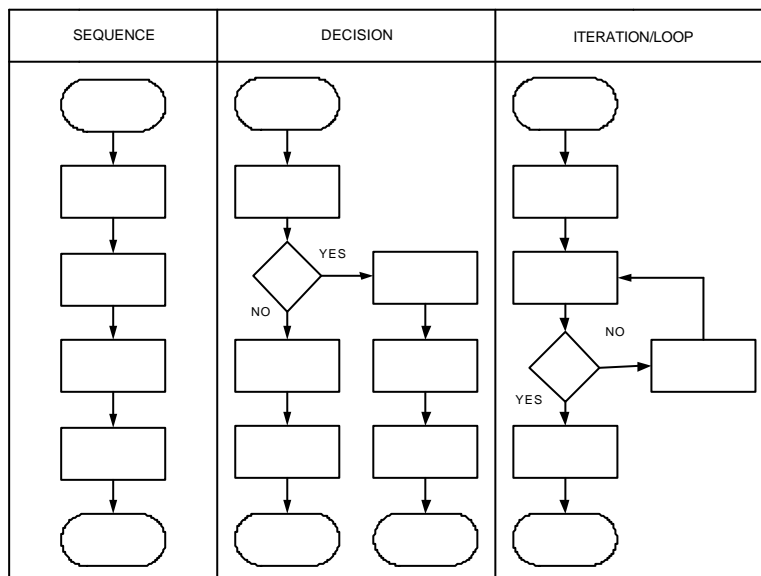
Standard symbols

There are many symbols in flowcharting, some of which have specialist applications. We advocate keeping it simple and the following symbols are all that are needed.



Typical Flowchart structures

There are three common structures in flowcharting - a sequence (i.e. one task follows another), a decision (i.e. a junction in the process with different outcomes) and an iteration (i.e. the process doubles back on itself).



Deployment Flowcharts - How to produce and analyse them

Advance preparation

(1) ***Ensure the people involved in the process can attend***

(2) ***Book a Facilitator***

Flowcharting is a tricky and tiring activity and it is important that those involved in the process are able to give 100% of their attention. Therefore having a Facilitator to shoulder the burden of constructing the flowchart is vital. **UIMPROVE** Facilitators are fully trained in Deployment Flowcharting.

(3) ***Book an appropriate room***

Plenty of wall space is required. A typical Deployment Flowchart can easily require six to twelve sheets of flipchart paper.

The participants need to be arranged in a u-shape so they can see the wall where the flowchart will be constructed.

Natural light is always a must for this type of work.

The room should be interruption and distraction-free. It is preferable if refreshments can be served outside the room.

(4) ***Book equipment***

A flipchart stand will be required.

On the day - before the participants arrive

(1) ***Set up the room***

Arrange the chairs in a u-shape around the wall where the flowchart will be constructed. Remove any spare chairs and other unnecessary furniture.

(2) ***Blu-tack up eight sheets of flipchart paper***

These need to be arranged portrait style, stacked two high and four across with no gaps between the sheets.

Note: obviously, the more complex the process, the more flipcharts will be needed. Ideally it should be possible to display all the sheets simultaneously - add extra sheets to the initial eight as required.

Deployment Flowcharts - How to produce and analyse them

Producing the Flowchart

(1) ***Set the scene***

Run through:

- (a) The aims of the session
- (b) How the flowcharting will be carried out including the meaning of the symbols

Don't go into too much detail.

Explain any intricacies of the tool as they come up.

(2) ***Identify the start and end of the process***

There may be more than one start and end.

Use the project remit if there is one for guidance.

Write the first and last things to happen on rectangular post-its. Stick these up on the flipchart.

(3) ***List the 'players'***

The players are the people, job titles or departments involved.

Write the names of these onto the non-yellow rectangular post-its.

These need to be placed either across the top (for portrait-style flowcharts) or down the left-hand side (for landscape-style flowcharts). Although there is no hard-and-fast rule for which style to adopt, landscape-style flowcharts generally work best when carrying out live flowcharting as it is possible to keep going right for whatever distance is required whereas flowcharting top-to-bottom reaches its limit when the post-its get to the floor.

Arrange the 'player' post-its in a rough order to reflect the sequence in which people are involved in the process.

Note: If one of the players is missing, stop now and start again when you have them in the room.

Once the order has been decided, rearrange the seating of the participants to reflect this. It makes the flowcharting easier if people sit in roughly the order they interact.

Deployment Flowcharts - How to produce and analyse them

(4) **Ask 'what happens first?'**

Refer back to the start and end of the process on the flipchart stand.

Take the first post-it and place it under or next to the appropriate person or department. Draw on the sausage shape. It is not unusual to have to rephrase what was originally written.

(5) **Ask (and keep asking) 'what happens next?'**

Place the post-its in order against the person or department.

Change row or column where the work transfers to the next person or department.

Leave a small gap between post-its so you can draw in the arrows later. Don't draw arrows at this stage.

Don't go into too much detail too soon. Use shadow boxes to hide detail and, if necessary, construct separate flowcharts for these later.

Where there are decisions, these should be phrased so that the answer is 'yes' or 'no'. As an example do not have a decision box with 'what colour is it?' but several with 'is it red?' - yes, no, 'is it green?', yes, no and so on. Follow the most common answer and then return later to complete the other exit.

(6) **Continue until the end of the process is reached, talk through and tidy up**

Check that the final stages correspond with the start and end of the process defined earlier.

Check that both exits have been completed for all decision boxes.

Talk through the flowchart from beginning to end to ensure it makes sense.

Tidy it up as required.

Draw in the flowlines using a pencil first.

Double check the flowlines are correct and then draw them properly using black flipchart pen.

If it will help with clarity, there is an option to draw dotted lines in red flipchart pen to separate the players.

Deployment Flowcharts - How to produce and analyse them



A completed Deployment Flowchart

How much detail?

It is hard to determine the level of detail required for a Deployment Flowchart in advance - this will emerge once the group begins. Three levels of detail are often described:

- | | | | | |
|-----|----------|---------------------------------|----|-------------------------|
| (1) | System: | High level overview - no detail | or | Atlas of the world |
| (2) | Process: | Medium level | or | Road map of the country |
| (3) | Task: | Low level - lots of detail | or | Street map of the town |

In the majority of projects, it is the middle (i.e. process) level of detail that is needed although it sometimes helps to start off by constructing a system level chart to get an idea of how the process works.

If in doubt about how much detail to go into:

- (1) Consider the context. If it is part of a project, consider the remit. What level of detail is needed to accomplish the remit?
- (2) If the necessary level of detail is still not clear, use lots of shadow boxes. Once the flowchart is complete, review it. You can always go back and expand shadow boxes whereas any time wasted on unnecessary detail can never be recouped.

Deployment Flowcharts - How to produce and analyse them

Analysing the Flowchart

Once the Deployment Flowchart has been completed, it needs to be analysed, drawing conclusions and identifying ideas for improvement. It is suggested that the group looks at each of the following headings in turn and lists any ideas onto flipchart as they come up.

Ensure the group is sat in front of the flowchart, write up each of the headings from the checklist below on a sheet of flipchart paper, ask the group to look through the flowchart and then list their thoughts and ideas for each. Do this on post-its to allow for later rearrangement.

- Things going wrong
- Duplication
- Unnecessary work
- Many people involved in simple activities
- Unnecessary waiting
- Differences between procedures and actual practice
- Differences between the way individuals work
- Differences between the way different departments or locations work
- Any other inconsistencies
- Inefficient work layout
- Alternative methods
- Any dead ends
- Suggestions for improvement

What to do next

The next steps generally are to act upon the issues and ideas generated during the analysis stage. A revised Deployment Flowchart can be produced showing the improved process in a 'to be' state.

In projects continue to follow the methodology.

Using a Deployment Flowchart to establish measurement points

A Deployment Flowchart is an excellent tool for establishing where to measure how a process or a particular part of it is performing. Typical measurements are 'how quickly', 'how many', 'how often' and so on. Some places to try are:

- At the start and end of a process to establish time from start to finish
- At decision points to count how many go each way
- At customer - supplier interactions, between people, departments or organisations
- Wherever obvious

Deployment Flowcharts - How to produce and analyse them

Recording and storing the Flowchart

(1) *Number the sheets*

Before taking the finished flowchart off the wall, number each sheet numerically from left to right and alphabetically from top to bottom. Each sheet will therefore be numbered for example 1A, 2B and so on. This will make it easy to put the flowchart together again.

(2) *Photograph the flowchart*

Photograph the whole flowchart and each sheet individually. When storing the documents, name them to match the numbering system (e.g. 1A, 2B).

(3) *Document the flowchart*

There is a variety of flowcharting software on the market. The flowcharts in this manual were created using Microsoft Visio.

(4) *Store the originals carefully*

Do not roll-up the sheets as the post-its will curl permanently and then it will not be possible to read them when the flowchart is subsequently displayed. Also avoid folding for similar reasons. Instead store the sheets in a flipchart case to keep them flat.

Deployment Flowcharts - How to produce and analyse them

Extra tips

- ✓ Important issues and ideas will emerge while the flowchart is being constructed - have an Issue Park for these
- ✓ When flowcharting an existing process, it is important to flowchart the process as it actually works and not how it would work if all the existing procedures were followed
- ✓ There isn't a 'right way' to draw a Deployment Flowchart - they are all different. Use these guidelines as far as possible but remember that success is determined by how well those who create it understand and use it.
- ✓ It can be useful to write an aim for the process. Consider whether to do this before or after construction of the flowchart.
- ✓ It can sometimes be useful to physically walk round the process from desk-to-desk or location-to-location to get a clear picture of what happens. Construct a Movement Map as well as a flowchart to assist with this.
- ✓ It can be useful to have a look at 'bits of paper' used at each stage, particularly in administrative processes. It is helpful if these are brought along on the day.
- ✓ A flowchart can be used to cost each stage of a process

Some common mistakes

- ✗ Some teachers of flowcharting say 'brainstorm all the things that need to be done and then put them in order'. This is wrong. Flowcharting is a tool for analysis and requires a step-by-step analytical approach. A brainstorm of all the things that need to be done put in order, may miss key stages.

Following the 'what happens next?' approach means nothing can be missed. When working on a Deployment Flowchart, each person says, in order, what they do from their first task to handover to the next person in the process. Brainstorming means this logical sequence and the opportunity to see the sequence of the process build up is lost.
- ✗ Do not write 'start' and 'end' in the sausage shapes at the beginning and end of the process. Instead write the very first and very last task or activity.

Deployment Flowcharts - Additional information

Who invented flowcharting?

The earliest diagrams showing the flow of work can be credited to husband and wife team Frank and Lillian Gilbreth around 1919. Frank Gilbreth was an engineer and 'efficiency expert'. A film was made about him and his family in 1950 called 'Cheaper by the Dozen'. Don't confuse this with the awful 2003 remake. Their paper 'Process Charts - first steps in finding the one best way to do work', presented to the American Society of Mechanical Engineers in December 1921 is a must-read classic for Improvement Professionals.

We first came across Deployment Flowcharting in 1989 at a seminar by Myron Tribus in London. He first saw this tool in use at the Komatsu tractor factory in Japan. It was Myron who invented the shadow box.

Quotes from 'Process Charts' by Frank and Lillian Gilbreth

The process chart is a device for visualising a process as a means of improving it. Every detail of a process is more or less affected by every other detail; therefore the entire process must be presented in such a form that it can be visualised all at once before any changes are made to any of its subdivisions.

The mere act of investigating results in many ideas and suggestions for improvement.

To overcome the obstacles due to habit, worship of tradition and prejudice, the more intelligence shown by the process chart recorder, the sooner hearty cooperation of all concerned will be secured.