Resource Kit for the YES Programme
Product Engineering Methods

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Introduction

This is a set of simple tools and techniques that have been compiled to assist you in your ‘YES’ (Young Enterprise Scheme) projects. Look through them and select appropriate methods to stimulate creativity, help with planning, solve problems or to simply structure your thoughts and ideas. These methods are not meant to be prescriptive nor exhaustive, but you will find value by using them, when creating new products or services. Many innovative companies use these and other methods frequently. Some examples have been drawn from the simpler product design engineering projects carried out at Massey University.

List of Techniques

1. Brainstorming
2. Collective Notebook
3. Analogy
4. Image Board
5. Challenge Listing – ‘Scamper’
6. Free & Forced Association
7. Word Storm
8. Mind-mapping
9. Six Thinking Hats
10. Attribute Analyses
11. Affinity Diagram
12. Who-When Map or Action Plan
13. Gantt Chart
14. Pareto Analysis
15. Flowchart
Brainstorming

**Definition:** A group decision-making technique designed to generate a large number of creative ideas through an interactive process.

**Purpose:** To generate alternative ideas to be considered in making decisions.

**Guidelines:**

- Make sure that all team members fully understand the objective of the brainstorming session.
- Encourage active participation of all members.
- Develop a high energy, enthusiastic climate.
- Avoid discussing ideas as they are presented, including criticizing and complimenting.
- Encourage creative thinking, including far-out ideas.
- Build and expand on the ideas of others.
- Record all ideas exactly as presented on a flipchart, possibly using two recorders.
- Avoid stopping when the ideas slow down. Rather, try to generate as long a list as possible.

**How to conduct a brainstorming session:**

1. Review the steps for brainstorming.
2. Clarify the objective of the brainstorming session.
3. Members take turns shouting out ideas.
4. Each idea is recorded exactly as presented on a flipchart.
5. Members pass when an idea does not come to mind quickly.
6. After all ideas have been presented, the team clarifies the list by discussing the ideas to assure that all members have the same understanding of each idea. Duplications are also eliminated in this step.

**Collective Notebook**

- Record a problem and request peers/end-users to write solutions or sketch ideas
- Circulate among peers
- Build on each other's ideas
- Requires 5-6 people, and about 2-3 weeks
- Select the best concepts to improve on, based on criteria such as uniqueness, achievability, ease of making, ease of selling, attractiveness to target market etc.
**Analogy**

- Observe nature for insight and as stimuli to prompt ideas for adaptation
- How to use it – look at existing solutions to similar problems – develop these for your specific problem

E.g. burrs (prickly furry seeds) lead to the creation of Velcro

**Examples**

Inspirations for Helmet designs

Like armadillo spikes or sardines
Image boards

A powerful way of understanding and specifying the usage elements of a product. Good for team building and stimulating creativity. A powerful way of communicating who the product is targeted at.

**Description**

Collections of images can be used in a number of different ways, to represent types of user, visual values, technologies, product usage and usage scenarios. A typical board should contain between 10 and 15 carefully chosen images.

**Two types of image boards**

1. **Lifestyle board**
   Images representing the target customers or the lifestyles of the target customers. The images should indicate the target customer's personal and social values and cultural trends. The lifestyle board will be 'idealistic' in its portrayal of customers and helps to explore the range of target customers.

2. **Mood Board**
   Often derived from the lifestyle board, the mood board aims to capture the 'values' of the product which will appeal to the previously identified customer types and helps to build a common view of the styling objectives. The mood of a product is the sentiment, feeling or emotion which the product engenders when first seen - for example, soft and comforting, hard and rugged, business like or frivolous. Images of products which are similar in either form or function to the proposed new product should be avoided.

**Notes**

- Collect magazines and images which could be used in the boards
- Select carefully to prevent irrelevant, inappropriate and unnecessary images from being used
- The aim is not to fill the page, but to find appropriate and useful images
- A good team building exercise at the start of a project - to discuss and decide which ones should be selected and why
**Challenge Listing**

- Prepare a list of challenges (e.g. expand, minimize, divide, lighten…)
- Analyse a current product against this list

The **SCAMPER** technique will assist you in thinking of changes you can make to an existing product to create a new one via a checklist, these can either be used directly or as starting points for lateral thinking.

The changes **SCAMPER** stands for are:

- **S** - **Substitute** - components, materials, people
- **C** - **Combine** - mix, combine with other assemblies or services, integrate
- **A** - **Adapt** - alter, change function, use part of another element
- **M** - **Modify** - increase or reduce in scale, change shape, modify attributes (e.g. colour)
- **P** - **Put to another use**
- **E** - **Eliminate** - remove elements, simplify, reduce to core functionality
- **R** - **Reverse** - turn inside out or upside down.

**Example**

For instance, imagine that you are a producer of computers and printers, and you are looking for new products. **SCAMPER** would give you:

Substitute – use of high tech materials for specific markets – use high-speed components?
Combine – integrate computer and printer, printer and scanner
Adapt – put high quality ink in printer, use high quality paper
Modify – produce different shape, size and design of printer and computer
Put to another use – printers as photocopies or fax machines
Eliminate – eliminate speakers, colour screens, colour ink etc…
Reverse – make computer desks as well as computers and printers, or computer chairs etc…

By using **SCAMPER** in this instance we have been able to identify possible new products. Many of the ideas may be unfeasible or may not suit the equipment used by the manufacturer, but some ideas could be good starting points for discussion of new products.
Free Association

Free association: start with a trigger, you record the flow of ideas that come to mind, each idea triggering the next, ultimately reaching a potentially useful one.

It prompts you to generate multiple associations to the original trigger so that you ‘delve’ into a particular area of associations.

Three hints:

Suspend judgement. Follow the intriguing and look for ideas that attract your attention as particularly strong, intriguing, surprising, etc. even if they don’t seem instantly appropriate to your problem. This attraction frequently signals links to a useful set of associations, and so could possibly justify a further phase of centred free association around the ‘attractive’ idea.

Use solution-oriented phrasing. The idea ‘lighter’ is not much use as it stands. However, when transformed into a phrase such as:

- ‘Could we make it lighter?’
- ‘In what ways might I make it lighter?’
- ‘How might it be made lighter?’

Makes the idea ‘lighter’ potentially a more useful one.

Word Storm

Use trigger questions to stimulate ideas such as, Where, What, Why, When etc.

Example: Snack food

- Where? – school lunches, journeys, after sport/swimming
- What? – easily eaten, not messy, variety of flavors, shapes
- Why? – easy to carry, fun, meal for one, saves time, convenient
Attribute Listing

Attribute Listing, Morphological Analysis and Matrix Analysis are good techniques for finding new combinations of products or services.

How to use tools:

To use the techniques, firstly list the attributes of the product, service or strategy you are examining. Attributes are parts, properties, qualities or design elements of the thing being looked at. For example, attributes of a pencil would be shaft material, lead material, hardness of lead, width of lead, quality, colour, weight, price, etc. A television plot would have attributes of characters, actions, locations, weather, etc. For a marketing strategy you might use attributes of markets open to you, uses of the product, skills you have available, etc.

Draw up a table using these attributes as column headings. Write down as many variations of the attribute as possible within these columns. This might be an exercise that benefits from Brainstorming. The table should now show all possible variations of each attribute.

Now select one entry from each column. Either do this randomly or select interesting combinations. By mixing one item from each column, you will create a new mixture of components. This is a new product, service or strategy.

Finally, evaluate and improve that mixture to see if you can imagine a profitable market for it.

Example:

Imagine that you want to create a new lamp. The starting point for this might be to carry out a morphological analysis. Properties of a lamp might be power supply, bulb type, light intensity, size, style, finish, material, shade, etc.

You can set these out as column headings on a table, and then brainstorm variations:

<table>
<thead>
<tr>
<th>Power Supply</th>
<th>Bulb Type</th>
<th>Light Intensity</th>
<th>Size</th>
<th>Style</th>
<th>Finish</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery</td>
<td>Halogen</td>
<td>Low</td>
<td>Very Large</td>
<td>Modern</td>
<td>Black</td>
<td>Metal</td>
</tr>
<tr>
<td>Mains</td>
<td>Bulb</td>
<td>Medium</td>
<td>Large</td>
<td>Antique</td>
<td>White</td>
<td>Ceramic</td>
</tr>
<tr>
<td>Solar</td>
<td>Daylight</td>
<td>High</td>
<td>Medium</td>
<td>Roman</td>
<td>Metallic</td>
<td>Concrete</td>
</tr>
<tr>
<td>Generator</td>
<td>Colored</td>
<td>Variable</td>
<td>Small</td>
<td>Art Nouveau</td>
<td>Terracotta</td>
<td>Bone</td>
</tr>
<tr>
<td>Crank</td>
<td></td>
<td></td>
<td>Hand held</td>
<td>Industrial</td>
<td>Enamel</td>
<td>Glass</td>
</tr>
<tr>
<td>Gas</td>
<td></td>
<td></td>
<td></td>
<td>Ethnic</td>
<td>Natural</td>
<td>Wood</td>
</tr>
<tr>
<td>Oil/Petrol</td>
<td></td>
<td></td>
<td></td>
<td>Fabric</td>
<td>Stone</td>
<td></td>
</tr>
<tr>
<td>Flame</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Plastic</td>
<td></td>
</tr>
</tbody>
</table>
Interesting combinations might be:

- Solar powered/battery, medium intensity, daylight bulb - possibly used in clothes shops to allow customers to see the true colour of clothes.
- Large hand cranked arc lights - used in developing countries, or far from a mains power supply
- A ceramic oil lamp in Roman style - used in themed restaurants, resurrecting the olive oil lamps of 2000 years ago
- A normal table lamp designed to be painted, wallpapered or covered in fabric so that it matches the style of a room perfectly

Some of these might be practical, novel ideas for the lighting manufacturer. Some might not. This is where the manufacturer's experience and market knowledge are important.

**Key points:**

Morphological Analysis, Matrix Analysis and Attribute Listing are useful techniques for making new combinations of products, services and strategies.

You use the tools by identifying the attributes of the product, service or strategy you are examining. Attributes might be components, assemblies, dimensions, color, weight, style, speed of service, skills available, etc.

Use these attributes as column headings. Underneath the column headings list as many variations of that attribute as you can.

You can now use the table by randomly selecting one item from each column, or by selecting interesting combinations of items. This will give you ideas that you can examine for practicality.

**Notes:**

- Attribute Listing focuses on the attributes of a product/service, seeing how each attribute could be improved.
- Morphological Analysis uses the same basic technique, but is used to create a new product by mixing components in a new way.
- Matrix Analysis focuses on businesses. It is used to generate new approaches, using attributes such as market sectors, customer needs, products, promotional methods, etc.
Affinity Diagrams

**Definition:** A group decision-making technique designed to sort a large number of ideas, process variables, concepts, and opinions into naturally related groups. These groups are connected by a simple concept.

**Purpose:** To sort a list of ideas into groups.

**Guidelines:**

- Insure ideas are described with phrases or sentences.
- Minimize the discussion while sorting -- discuss while developing the header cards.
- Aim for 5-10 groups.
- If one group is much larger than others, consider splitting it.

**How to Conduct an Affinity Sort:**

1. Conduct a brainstorming session on the topic under investigation.
2. Clarify the list of ideas. Record them on small cards or Post-It notes.
3. Randomly lay out cards on a table, flipchart, wall, etc.
4. Without speaking, sort the cards into "similar" groups based on your gut reaction. If you don't like the placement of a particular card, move it. Continue until consensus is reached.
5. Create header cards consisting of a concise 3-5 word description; the unifying concept for the group. Place header card at top of each group.
6. Discuss the groupings and try to understand how the groups relate to each other.

**Tips:**

- Inquire whether ideas are adequately clarified.
- Use only 3-5 words in the phrase on the header card to describe the group.
- If possible, have groupings reviewed by non-team personnel.
- While sorting, physically get up and gather around the area where the cards are placed.
- Team members will ultimately reach agreement on placement, if for no other reason than exhaustion.
- Sorting should not start until all team members are ready.
- If an idea fits in more than one category or group, and consensus about placement cannot be reached, make a second card and place it in both groups.
Example of Affinity Diagram
Mind-Mapping

An easy method to structure your thoughts and plans.

1. Gather information or brainstorm ideas – put down on paper
2. Link using lines and colour

- Useful tool for generating ideas, visualising a topic and how these relate to each other.
- Images and colour can be helpful in stimulating your mind to generate ideas and in recalling information.
- Don't worry if your mind-map becomes cluttered, it is just a tool for getting your thoughts on paper and to assist in visualising all parts of the topic.

Example

Mindmap using the draw tool in word
Six Thinking Hats

'Six Thinking Hats' is an important and powerful technique. It is used to look at decisions from a number of important perspectives. This tool was created by Edward de Bono in his book *6 Thinking Hats*.

If you look at a problem with the 'Six Thinking Hats' technique, then you will solve it using all approaches. Your decisions and plans will mix ambition, skill in execution, public sensitivity, creativity and good contingency planning.

How to Use the Tool:
You can use Six Thinking Hats in meetings or on your own. In meetings it has the benefit of blocking the confrontations that happen when people with different thinking styles discuss the same problem.

Each 'Thinking Hat' is a different style of thinking. These are explained below:

- **White Hat:**
  With this thinking hat you focus on the data available. Look at the information you have, and see what you can learn from it. Look for gaps in your knowledge, and either try to fill them or take account of them.

- **Red Hat:**
  'Wearing' the red hat, you look at problems using intuition, gut reaction, and emotion. Also try to think how other people will react emotionally. Try to understand the responses of people who do not fully know your reasoning.

- **Black Hat:**
  Using black hat thinking, look at all the bad points of the decision. Look at it cautiously and defensively. Try to see why it might not work. This is important because it highlights the weak points in a plan. It allows you to eliminate them, alter them, or prepare contingency plans to counter them.

  Black Hat thinking helps to make your plans 'tougher' and more resilient. It can also help you to spot fatal flaws and risks before you embark on a course of action. Black Hat thinking is one of the real benefits of this technique, as many successful people get so used to thinking positively that often they cannot see problems in advance. This leaves them under-prepared for difficulties.

- **Yellow Hat:**
  The yellow hat helps you to think positively. It is the optimistic viewpoint that helps you to see all the benefits of the decision and the value in it. Yellow Hat thinking helps you to keep going when everything looks gloomy and difficult.

- **Green Hat:**
  The Green Hat stands for creativity. This is where you can develop creative solutions to a problem. It is a freewheeling way of thinking, in which there is little criticism of ideas.

- **Blue Hat:**
  The Blue Hat stands for process control. This is the hat worn by people chairing
meetings. When running into difficulties because ideas are running dry, they may direct activity into Green Hat thinking. When contingency plans are needed, they will ask for Black Hat thinking, etc.

A variant of this technique is to look at problems from the point of view of different professionals (e.g. product engineers, architects, sales directors, etc.) or different customers.

**Example agenda** for a Project, using the 6 Hats Technique:

Step 1: List the facts of the project (information you know) (**White Hat**)
Step 2: Generate ideas on how the problem could be handled (**Green Hat**)
Step 3: Evaluate the merits of the ideas - list the benefits (**Yellow Hat**), list the drawbacks (**Black Hat**)
Step 4: Get everybody’s gut feelings about the alternatives (**Red Hat**)
Step 5: Summarize the meeting (**Blue Hat**)

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**Summary of 6 Thinking Hats**

![Diagram of Six Hats](image)

AGENDA, DECISION, GLOBAL, OVERVIEW, CRITIC, ANALYST, BLACK

WHITE, FACTS, DATA, FIGURES, GREEN, CREATIVE, GROWTH, IDEAS, YELLOW, LOGICAL, POSITIVE, RED, EMOTIONS, HUNCHES, FEELINGS, INSTINCTS
**Who-When Map or Action Plan**

*Who is involved and when and to what level.*

The overall map should include:
1. The different 'functions' or people who can be involved
2. The major stages of the project, due dates
3. Level of involvement of each stakeholder, from low to high
4. Indicate who takes the lead role at each phase
5. Can map usage of tools etc.
Gantt Charts

How to use tool:

Gantt Charts are useful tools for analyzing and planning projects. They:

- Help you to plan out the tasks that need to be completed
- Give you a basis for scheduling when these tasks will be carried out
- Allow you to plan the allocation of resources needed to complete the project, and

When a project is under way, Gantt charts help you to monitor whether the project is on schedule. If it is not, it allows you to pinpoint the remedial action necessary to put it back on schedule.

To draw up a Gantt Chart, follow these steps:

1. List all activities in the plan
   For each task, show the earliest start date, estimated length of time it will take.

You will end up with a task list like the one below. This example shows the task list for a computer project.

*Task list Example: Planning a computer project*

<table>
<thead>
<tr>
<th>Task</th>
<th>Start</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High level analysis</td>
<td>week 1</td>
<td>5 days</td>
</tr>
<tr>
<td>2. Selection of hardware platform</td>
<td>week 1</td>
<td>1 day</td>
</tr>
<tr>
<td>3. Installation and commissioning of hardware</td>
<td>week 3</td>
<td>2 weeks</td>
</tr>
<tr>
<td>4. Detailed analysis of core modules</td>
<td>week 1</td>
<td>2 weeks</td>
</tr>
<tr>
<td>5. Detailed analysis of supporting utilities</td>
<td>week 1</td>
<td>2 weeks</td>
</tr>
<tr>
<td>6. Programming of core modules</td>
<td>week 4</td>
<td>3 weeks</td>
</tr>
<tr>
<td>7. Programming of supporting modules</td>
<td>week 4</td>
<td>3 weeks</td>
</tr>
<tr>
<td>8. Quality assurance of core modules</td>
<td>week 5</td>
<td>1 week</td>
</tr>
<tr>
<td>9. Quality assurance of supporting modules</td>
<td>week 5</td>
<td>1 week</td>
</tr>
<tr>
<td>10. Core module training</td>
<td>week 7</td>
<td>1 day</td>
</tr>
<tr>
<td>11. Development of accounting reporting</td>
<td>week 6</td>
<td>1 week</td>
</tr>
<tr>
<td>12. Development of management reporting</td>
<td>week 6</td>
<td>1 week</td>
</tr>
<tr>
<td>13. Development of management analysis</td>
<td>week 6</td>
<td>2 weeks</td>
</tr>
<tr>
<td>14. Detailed training</td>
<td>week 7</td>
<td>1 week</td>
</tr>
<tr>
<td>15. Documentation</td>
<td>week 4</td>
<td>2 weeks</td>
</tr>
</tbody>
</table>
2. Head up graph paper with the days or weeks (or months for longer projects) through to task completion

3. Plot the tasks onto the graph paper or Excel spreadsheet.
Next draw up a rough draft of the Gantt Chart. Plot each task on the graph paper, showing it starting on the earliest possible date. Draw it as a bar, with the length of the bar being the length of the task. Above the task bars, mark the time taken to complete them. This will produce an untidy diagram like the one below:

An example project is shown below:

Key points:

Gantt charts are useful tools for planning projects. They allow you to assess how long a project should take and lay out the order in which tasks need to be carried out. Gantt charts are useful for monitoring its progress. You can immediately see what should have been achieved at a point in time, and can therefore take remedial action to bring the project back on course. This can be essential for the successful implementation of the project.
Pareto analysis

Pareto charts are arranged in decreasing order from left to right. The fundamental idea is that the first few (as presented on the diagram) contributing causes to a problem usually account for the majority of the result. Thus, targeting these "major causes" for elimination results in the most cost-effective improvement decision.

How to Construct:

1. Determine the categories and the units for comparison of the data, such as frequency, cost, or time.
2. Total the raw data in each category, then determine the grand total by adding the totals of each category.
3. Re-order the categories from largest to smallest.
4. Determine the cumulative percent of each category (i.e., the sum of each category plus all categories that precede it in the rank order, divided by the grand total and multiplied by 100).
5. Draw and label the left-hand vertical axis with the unit of comparison, such as frequency, cost or time.
6. Draw and label the horizontal axis with the categories. List from left to right in rank order.
7. Draw and label the right-hand vertical axis from 0 to 100 percent. The 100 percent should line up with the grand total on the left-hand vertical axis.
8. Beginning with the largest category, draw in bars for each category representing the total for that category.
9. Draw a line graph beginning at the right-hand corner of the first bar to represent the cumulative percent for each category as measured on the right-hand axis.
10. Analyze the chart. Usually the top 20% of the categories will comprise roughly 80% of the cumulative total.

Tips:

✧ Create before and after comparisons of Pareto charts to show impact of improvement efforts.
✧ Construct Pareto charts using different measurement scales, frequency, cost or time.
✧ Pareto charts are useful displays of data for presentations.
✧ Use objective data to perform Pareto analysis rather than team members opinions.
✧ If there is no clear distinction between the categories -- if all bars are roughly the same height or half of the categories are required to account for 60 percent of the effect -- consider organizing the data in a different manner and repeating Pareto analysis
Exercise:

Construct a Pareto diagram from the data given in the table below. You can check your answer once you have finished.

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>Percent of total</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong dose</td>
<td>100</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Wrong time</td>
<td>70</td>
<td>35</td>
<td>85</td>
</tr>
<tr>
<td>Wrong medicine</td>
<td>15</td>
<td>7.5</td>
<td>92.5</td>
</tr>
<tr>
<td>Wrong patient</td>
<td>8</td>
<td>4</td>
<td>96.5</td>
</tr>
<tr>
<td>Medicine old</td>
<td>4</td>
<td>2</td>
<td>98.5</td>
</tr>
<tr>
<td>Missed dose</td>
<td>3</td>
<td>1.5</td>
<td>100</td>
</tr>
<tr>
<td>Grand Total</td>
<td>200</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Answer

Does your Pareto Chart look like this one?

The Pareto analysis is a very simple technique that helps you to choose the most effective changes to make.

Using the Pareto analysis tool:

Step 1: Create a list of the changes you could make. If the list is long, break it up into related changes.

Step 2: Score the changes. The scoring method you use depends on the sort of problem you are facing. If, for example, you were trying to improve profitability, you would score options on the basis of how much profit each option would generate. If you were trying to improve customer satisfaction, you might score on the number of complaints eliminated by each change.

The first change to tackle is the one that has the highest score, as it will give you the biggest benefit if you implement it.
The options with the lowest scores may not even be worth spending time on as solving these problems may cost you more than the solutions are worth.

Example:

A manager has taken over a failing service centre. He commissions research to find out why customers think that service is poor.

He gets the following comments back from the customers:
1. Phones are only answered after many rings.
2. Staff seem distracted and under pressure.
3. Engineers do not appear to be well organized. They need second visits to bring extra parts. This means that customers have to take more holiday to be there a second time.
4. They do not know what time they will arrive. This means that customers may have to be in all day for an engineer to visit.
5. Staff do not always seem to know what they are doing.
6. Sometimes when staff members arrive, the customer finds that the problem could have been solved over the phone.

The manager groups these problems together. He then scores each group by the number of complaints, and orders the list:

<table>
<thead>
<tr>
<th>Problem category</th>
<th>Items in this group</th>
<th>Number of complaints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of staff training</td>
<td>5 and 6</td>
<td>51</td>
</tr>
<tr>
<td>Too few staff</td>
<td>1, 2 and 4</td>
<td>21</td>
</tr>
<tr>
<td>Poor organization and preparation</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

By doing the Pareto analysis of the above numbers, the manager can see that 69% of problems can be solved by improving staff skills. Once this has been done, it may be worth looking at increasing the number of staff.

Alternatively, as staff become better trained and start to solve problems over the phone, the need for new staff may decline.

From the numbers, it looks as though comments on poor organization and preparation may be quite rare, and could be caused by problems that may be beyond the manager's control. By carrying out a Pareto Analysis, the manager is able to focus on training as the main issue that needs to be resolved, rather than spreading effort over training, taking on new staff, and possibly installing a new computer system, for example.

Key points:

Pareto Analysis is a simple technique that helps you to identify the most important problem to solve.

To use it:
- List the problems you face, or the options that you have available
- Where possible, group options together if they are facets of the same larger problem
- Apply an appropriate scoring system to each group
- Work on the groups with the highest score
- A Pareto analysis not only shows you the most important problem that needs to be resolved, it also gives you a score showing how severe the problem is.
Flow Charts

Purpose: A flowchart is a pictorial representation of the steps in a given process. The steps are presented graphically in sequence so that team members can examine the order presented and come to a common understanding of how the process operates.

Flowcharts can be used to describe an existing process or to present a proposed change in the flow of a process. Flowcharts are the easiest way to "picture" a process, especially if it is very complex. Flowcharts should include every activity in the process. A flowchart should be the first step in identifying problems and targeting areas for improvement.

Steps in Flowcharting a Process:

1. Decide on the process to flowchart.
2. Define the boundaries of the process: the beginning and the end.
3. Describe the beginning step of the process in an oval.
4. Ask yourself "what happens next?" and add the step to the flowchart as a rectangle. Continue mapping out the steps as rectangles connected by one-way arrows.
5. When a decision point is reached, write the decision in the form of a question in a diamond and develop the "yes" and "no" paths. Each yes/no path must re-enter the process or exit somewhere.
6. Repeat steps 4 and 5 until the last step in the process is reached.
7. Describe the ending boundary/step in an oval.

When drawing a flowchart, constantly ask "what happens next?", "is there a decision made at this point?", "does this reflect reality?", "who else knows this process?", etc. When possible, do a walk-through of the process to see if any steps have been left out or extras added that shouldn't be there. The key is not to draw a flowchart representing how the process is supposed to operate, but to determine how it actually does operate. A good flowchart of a bad process will show how illogical or wasteful some of the steps or branches are.

Symbols in a Flowchart:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oval</td>
<td>Defines the boundaries of a process; shows the start or stop of a process.</td>
</tr>
<tr>
<td>Rectangle</td>
<td>Designates a single step in a process. Briefly describe the step inside the box.</td>
</tr>
</tbody>
</table>
Flowcharting a Clinic Visit

It cannot be emphasized enough how important it is for people to understand how work gets done. Managers do not understand the details (and the devil is in the details!) but are often held accountable for the outcomes of their area without a clear understanding of what contributes to the outcomes. Workers get very frustrated when things go wrong and often assume that others are deliberately trying to make their lives difficult. Conflict management is much easier to deal with when everyone can see problematic system!

Getting a picture of how a clinic functions begins with a high level flowchart, usually depicted horizontally and called the core process. It is the "backbone" of the clinic operations to which other sub-processes can be attached. Once the core process flowchart is done (this should take about an hour), it should be given to staff and physicians for their input. It is common for the flowcharting process to have many iterations, as revisions and changes almost always need to be made before the flowchart accurately reflects the actual process. The trick is to keep the initial charting "high level" and not get stuck in details just yet. I personally like to segment the core process into components, such as: access, intake, assessment/evaluation, treatment, discharge/follow-up, for manageability and to help identify indicators.

Once the core process is agreed upon by those who work in the clinic, the next step is to decide which processes need attention (the bottlenecks for patient flow).

The hardest part of flowcharting is keeping it simple enough to be workable, but with enough detail to show the trouble spots. I recommend that the flowchart for sub-processes be vertical (as opposed to the core process that goes horizontally), keeping the smoothest flow to the left of the page, and the complexity to the right. This does not always work out perfectly, but when it does, it allows us to see the non-value added steps very quickly. I also like to leave lots of room for comments, since revisions are the rule. The more buy-in, the more revisions you have. Another trick I have learned is to capture the "issues" that surface when you're trying to create a flowchart. These issues may not be boxes in the process, but they will eventually be clues as to what needs to be addressed. For example, patients forget to bring their x-rays. I write these issues on the bottom of the flowchart so that they do not slow us from moving ahead with the processes steps.

If you are creating a new process, then the ideal flowchart can be created first. Having the processes clearly outlined will allow everyone to see what is suppose to happen.
References:

1. Tony Buzan, Mindmapping
2. Edward De Bono, Six Thinking Hats

Exercises you may like to try…

1. Construct an Affinity Diagram (after brainstorming) on: The factors you would consider when buying a backpack (or your new product).

1. Draw a Mindmap of tasks for your project that you plan to work on. Then create a Gantt Chart and Action Plan.