

5 – Background Material

5 – Textbook: Innovation and creativity, option generation



In many fields, technical or economic as well as personal, problems may arise which require solutions that go beyond commonly acknowledged experience. Such problems need innovative solutions which can only be found by creative thinking. Many people believe that creativity is an innate personal trait but, in fact, it can be learned and trained. A number of training courses and exercises can help to discover and enhance the creative potential of employees or even a company as a whole! In Volume 5 “Innovation, creativity and option generation” of the Toolkit you will learn how to apply these techniques in order to find new and efficient CP options.

Creativity is not an isolated part of our thinking. It is not a luxury which only artists can afford. Creativity is such a central part of our thinking that it exists in all areas. All definitions of creativity stress the novelty of ideas – the qualitative aspect – and the abundance of ideas – the quantitative aspect. Creative thinking can thus also be defined as the ability to bring something new into being, something that did not exist before. In this sense creativity has to go beyond previous experience and to revolutionize in a certain way.

The aim of this volume is to foster the individual creativity and the creative potential in each of us by stimulating a creative, open-minded mentality. It introduces different creativity techniques as well as methods of idea and option generation and provides an overview of the most common thinking barriers together with possible ways of overcoming them. Furthermore the process of creative thinking in general and the generation of innovative solutions for companies in particular are described.

5.1 The precondition of creativity

In addition to day-to-day business, a company has to face the challenge of finding and introducing new products. During the last few years, this classical product innovation has been extended to service innovation. Product innovation and service innovation both arise from ideas developed in a systematically designed idea generation process.

Whereas years ago innovation was often a product of coincidental findings (a striking example are the “post-its” which were invented because the newly developed glue was not strong enough), nowadays especially big companies have set up innovation teams which are responsible for the targeted development of new ideas, products and services.

Ideas are born when people who are looking for a new way of solving a problem intellectually break new ground. This requires a high degree of creativity. In the following a summary of the most accepted definitions of creativity is provided.



Special innovation teams

Definitions of creativity

- **Creativity can be defined as the ability to generate new ideas in order to find the most practicable solution for problems.**
- **Creativity is not limited to a few. Each person has a more or less high creative potential. So far, the problem has been that this creativity was neither trained nor fostered.**
- **Every innovation requires a creative strategy which, in turn, uses creative thinking as an evolutionary variable and successfully introduces innovations as an impulse for social change.**
- **Creative solutions involve not necessarily entirely new inventions but often combine already known, but not yet linked elements. Creativity thus summarizes and restructures knowledge by establishing new relations and connections.**



5.2 Creativity and the thought processes

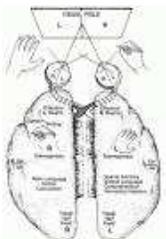
Usually we distinguish between convergent and divergent thinking. While convergent thinking is a fixed, narrow but also very structured and logical way of thinking, divergent thinking is a free, disordered and imaginative way of thinking which cannot be followed logically. Productive creativity could be called “**controlled divergence**”. Creative thinking is a type of divergent thinking which is adapted to reality. Creativity is a synthesis of divergent and convergent thinking.



The creative process starts with a logical sequence, in which the problem is analysed in a rational way (convergent). On the one hand the problem and the solution are considered from all possible points of view, on the other hand people go beyond their usual behavioural patterns. The second stage could be described as the creative process itself. This stage is characterized by the transfer from the rational to the intuitive-creative level (convergent).

Creativity and brain research

Hence it follows that convergent and divergent thinking do not stand in contrast to each other but that they complement each other. Creative problem solving involves summarizing and restructuring partial systems which *per se* do not fit together. Thus the idea that scientific progress can only be achieved by logical thinking is considered obsolete today. (Einstein could never have put forward his theory of relativity in this way!)



In this context, a short digression to brain research is appropriate. Researchers distinguish between the right and the left hemisphere of the brain which have different functions. While the left half is responsible for logical, target-oriented and sequential thinking as well as for language, in other words for the analytical part of our thinking, the right hemisphere is in charge of simultaneous, visual, rhythmic, holistic and networked thinking, in short for creativity.

5.2.1 Stages of creative problem solving

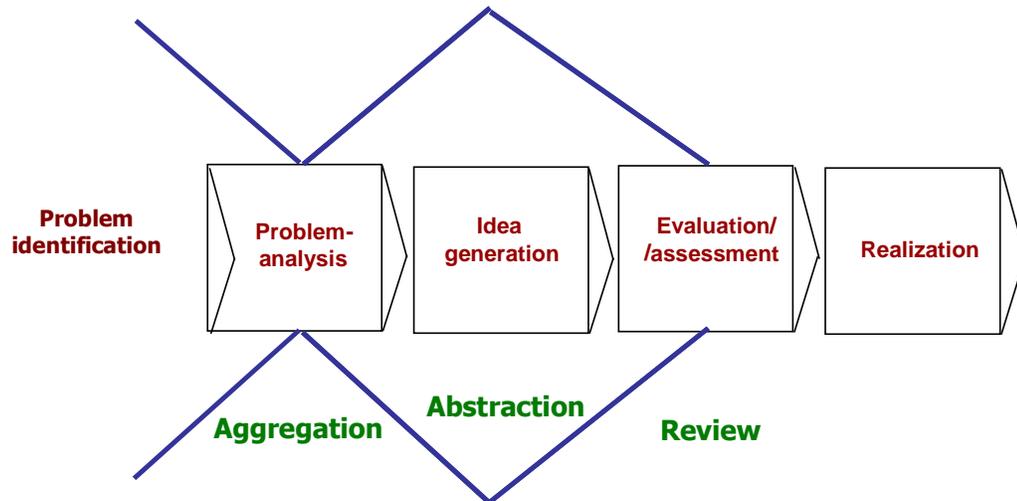


Figure 1: Creative thought process

Figure 1 shows the schematic sequence of a creative thought process. First the problem is identified and then analysed. For the problem analysis the thoughts are concentrated on the actual problem. At this stage we generally use logical and systematic (convergent) thinking. After having recognized and analysed the problem, we enter the stage of the actual creative idea generation process. We leave the concrete level and abstract the problem (divergent thinking) opening our mind in order to find solutions. Next a stage of strict convergent thinking follows: all ideas are evaluated and assessed undergoing a strict critical review (strict convergent thinking).

This whole thought process can also be defined as divergence with controlled convergence and is characterized by the connection between open imagination and strictness of logical conclusions. If the last step is omitted, the process is not properly finished and the necessary conclusion cannot be drawn. It is important to distinguish between the different stages and to know at which stage you are at the moment, as a person cannot think in a divergent and convergent way at the same time.

The pattern described above applies to nearly every process of creative thinking, regardless whether it is performed by an individual person or a group. For more complex problems or for bigger companies it can make sense to set up separate groups for each stage with carefully chosen members, for example, there could be an analysis group, an idea-generation group, an assessment group and a realization group.



5.2.2. Where are creative ideas generated?

Surveys have established that about 75% of all new ideas are generated externally and not in the company. The following table provides more detailed information:

About 75% of all new ideas are not generated in the company

Workplace	4%
Break	3%
Exhausting meetings	6%
Boring meetings	10%
Using creativity techniques	1%
Business trips	11%
Holidays	13%
Hobbies and games	4%
Meals	4%
Watching TV	5%
Bath	1%
Sports	5%
Club	4%
Nature	28%
Other places	1%



Inside the company



Outside the company

Source: Manager Magazin 4/1993

5.2.3 Factors influencing creativity

In this context the basic question is whether creativity is an innate or an acquired human characteristic. It goes without saying that learning capacities have individual limits which apply also to creativity: not everyone can be an exceptionally gifted inventor.

What influences our creativity?

Nevertheless certain creativity techniques can develop and train the existing creative potential. In addition, a number of factors have a positive or negative effect on creative thinking: on the one hand organizational settings such as working conditions or corporate culture and on the other hand individual factors like motivation, qualification and willingness to accept risks.

The following table provides a list of factors which influence creativity.

Individual factors	Organizational factors
Personality	Hierarchy
Age	Autonomy
Qualification	Management style
Motivation	Information, communication
Stress	Working environment
Willingness to take risks	Uniformity of procedures

5.3 Innovation



Whereas in the past innovations were often made by coincidence, nowadays more and more companies systematically foster their innovative potential by using creativity techniques. Therefore we will examine in more detail the creative stages of the innovation process.

Definition of innovation

- Only the **economic implementation** of an idea can be called innovation. The innovation process therefore comprises three stages: the generation of an idea, its acceptance (decision) and realization (implementation). Creative thinking is required particularly during the first stage of this process.
- Innovation includes any type of change performed on a process. At the beginning it is irrelevant, whether this change is new *per se* or if it is introduced in a particular company for the first time. Consequently the successful transfer of previously known solutions to new applications has to be considered an innovation.
- A new idea is not inevitably the result of creative thinking but can be based on modification or imitation. What is more, not every creative process is followed by the implementation of an idea.

5.4 Creativity methods and techniques

Human creativity can be developed and fostered by special methods and techniques. More than a hundred different techniques using a systematic-analytical approach are designed to improve intuition or to increase creativity. They all have in common that they are based on the following typical procedure patterns for the development of creativity:



- Variation of existing elements;
- Transfer of the problem from one area to another or to many others (the creation of so-called analogies);
- Splitting up the whole structure of the problem;
- Alienation of the problem by combining it with unrelated elements;
- Considering the problem from an entirely different perspective.

5.4.1 Methods of splitting up a problem

These methods are used for very complex problems and combine convergent thinking with the systematic specification of the problem.

5.4.1.1. Morphological analysis

With this method the problem is split up into sub-problems (parts). By solving all the sub-problems first, a solution for the whole problem can be found.

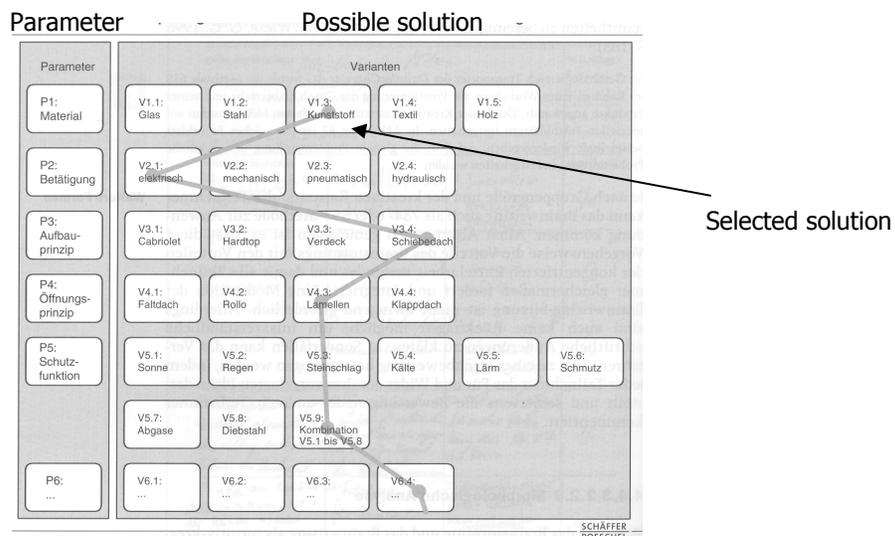


Figure 2: Morphological analysis

Figure 2 shows an example of a morphological analysis: every parameter provides a range of different alternatives. By determining the best option for each alternative the solution as a whole is identified.

5.4.1.2 Progressive abstraction

This method is used for determining the underlying problem. The crucial question and thus the core of a problem are identified by a systematic and hierarchically structured procedure.

5.4.2. Linking methods

These methods are used if a problem is clearly defined, easy to describe and not too complex. Linking methods are characterized by divergent thinking with free and spontaneous associations.

5.4.2.1 Brainstorming

Brainstorming, certainly the best known creativity technique, belongs to the linking methods. Classical brainstorming is a free discussion obeying the following four principles:

The four principles of brainstorming:

- **Any kind of criticism is strictly forbidden.**
- **There are no limits to imagination.**
- **Quantity comes before quality.**
- **Take up the ideas of others and develop them.**

Based on classical brainstorming many other forms were developed.

- Anonymous brainstorming: ideas are written down anonymously.
- Destructive-constructive brainstorming: first all possible weaknesses of a solution are worked out and then continually and systematically corrected.
- Stop-and-go brainstorming: creative stages (go) alternate with stages of critical evaluation (stop).
- Discussion 66: a big group is divided into groups of 6 persons who have 6 minutes to find a solution independently. Then the big group is brought together again and discusses the solutions.



5.4.2.2 Brainwriting



This method is similar to brainstorming and follows the same approach. Ideas are spontaneously written down on sheets or forms which are then passed on to the next person of the group. The advantage is that the persons do not have to be afraid of being criticized or of exposing themselves.

5.4.2.3 Method 635

6 persons have 5 minutes time to write down 3 ideas in a table. This table is then passed on to the next member of the group who completes the table by considering the ideas of his/her predecessor. The table below provides the example of a removal firm who wants to improve its customer service.

Problem:		
Which additional services can we (a removal firm) offer to our customers?		
Participants:		
Smith, Lewis, Hetfield, Armstrong, Bailes		
Suggestions		
Cleaning of furniture (Smith)	Transport service for pets (Smith)	Security service for valuable objects (Smith)
Offer new furniture, if needed (Lewis)	Open overnight hotel for pets (Lewis)	Offer 24 h-service (Lewis)
Furniture rental agency (Hetfield)	Offer specific relocations, e.g. for managers, families, etc. (Hetfield)	Offer direct service (Hetfield)
... (Armstrong)	... (Armstrong)	... (Armstrong)
...

5.4.3 Analogical methods

5.4.3.1 Synectics

This is a very sophisticated creativity technique which can only be carried out by an experienced moderator. The method is based on the systematic creation of analogies and has as central principle:

Trust things that are alien.

Alienate things that are trusted.

The process of generating a solution is stimulated by forming analogies which seem to be unrelated to the problem – they are alienated from the problem.

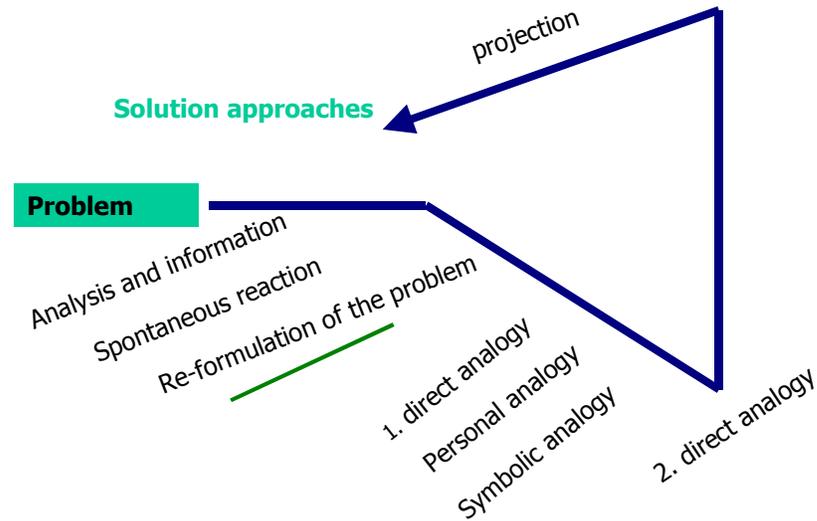


Figure 3: Synectic funnel

5.4.3.2 Bionics

This word is a combination of biology and electronics. Methods and systems found in nature are copied and applied in order to find entirely new solutions (e.g. the lotus surface for the development of new lacquers used in the car industry, the skin of a shark for the structure of a wetsuit, etc.).

Summary

The selection of a creativity method you chose depends on the problem you want to solve. For simple and clearly defined problems use linking methods, such as brainstorming, brainwriting, method 635, etc. For more complex problems which are not clearly defined, choose a splitting-up method, such as morphological analysis or progressive abstraction. For the last two methods you need a good moderator. This also applies to the analogical methods, where the moderator has to be very experienced.

The type of the problem determines the creativity method

5.5. General rules for creativity techniques

Independently from the creativity methods you apply, observe the following general rules:

- **Always search for new information.**
- **Consider alternatives.**
- **Change your view.**
- **Try to get away from the problem.**
- **Be willing to take risks.**
- **Work in an interdisciplinary way.**
- **Create a favourable environment for creativity.**
- **Set deadlines and keep to them.**
- **Strictly separate the stage of idea generation from the evaluation phase.**

5.5.1 Preparation of a creativity meeting



Before the meeting consider the following items:

- Select the persons you want to invite.
- Prepare a favourable atmosphere for stimulating ideas.
- Define the roles: moderator, person who take notes, etc.
- Set a time frame for the meeting.

Include the following points in the meeting:

- Introduce and define the problem.
- Define the objectives.
- Determine which creativity method is to be used.
- Do not forget to thank the participants for their efforts at the end.

It is extremely important to record the meeting fully:

- Take the complete minutes.
- Sum up all possible solutions.
- Take note of everything.
- Point out the most interesting possible solutions.

5.6 Thinking barriers



Of course you will meet a lot of different barriers which may hinder the development of new ideas. In the following the most frequent thinking barriers are listed:

- **Routines and habits**

If we are used to a certain way of doing things, we tend to switch off our minds and mechanically repeat the same action over and over again.

- **Wrong categories**

Generalizations, wrong presumptions or earlier experiences make it difficult to look at the problem from a different perspective.

- **Premature evaluation**

It should be strictly avoided to evaluate ideas at a preliminary stage. If criticism is voiced too early, it can eliminate stimulus and ideas instead of fostering them.

- **Emotional insecurity**

People who are afraid of exposing themselves are unwilling to accept risks. Creative thinking is thus suppressed.

- **Pressure of conformity**

Each group develops its own rules and norms which influence the thinking categories of the members. An individual usually supports the opinion of the group when it comes to taking decisions in an ambiguous situation.

- **Cultural barriers**

Creative thinking is blocked by the high importance our culture attributes to logical and conclusive conceptual models.

- **Working environment**

Our working environment can easily block creativity due to external or internal factors, such as layout of the rooms or personal problems with colleagues.

- **Intellectual barriers**

Sometimes too much experience or too “high intelligence” can represent a barrier, because the concerned persons are used to deductive reasoning and hesitate to break new ground.

5.7 CP option generation

All that has been said above on creativity, innovation and creativity techniques applies also to CP option generation. In addition a number of “golden rules” should be observed during the implementation of an environmental project. We distinguish between the so-called standard options and creative options.

5.7.1 Information sources for standard options

The good news is that to date cleaner production projects have already been carried out in many parts of the world. The bad news, however, is that so far no central database has been established where all the generated and implemented options are collected. But of course useful tips and accounts of experiences are documented in different media. Various sources of information are specified below.

➤ **General checklists from manuals**

The following checklists are included in the Resource Kit for Training Trainers available from UNEP (<http://www.financingcp.org/training/Menu/Checklists.htm>).

CP checklists:

- A – Barriers to CP
- B – CP implementation
 - B1 – Scope of CP
 - B2 – Strategic CP options for enterprises
 - B3 – Government intervention to promote CP investment
- C – CP investment proposal
 - C1 – CP investment data sources
 - C2 – CP investment decisions: Detailed cost checklist
- D – CP funding
 - D1 – Funding options
 - D2 – Funding application format
 - D3 – Checklist for bankers on CP issues
 - D4 – Information required by banks and credit institutions for the evaluation of applications for finance
 - D5 – Checklist for credit officers on CP issues
 - D6 – Risks in lending to smaller businesses
- E – Complementary tools for further improvement of environmental performance



Textbook 5 – Innovation, creativity and option generation

➤ **Sector-specific manuals and studies**

Sector-specific manuals are generally elaborated by the National Cleaner Production Centres. Manuals and studies for specific industrial sectors are also issued by UNIDO and UNEP.

Examples:

- Cleaner Production in Breweries, A Workbook for Trainers, issued by UNEP;
- Cleaner Production Assessment in Fish Processing, issued by UNEP in first edition in 2000.

➤ **Information from suppliers**

Suppliers usually have up-to-date information on new technologies, products and process materials. However, they have to be explicitly asked to supply new, more ecological alternatives or to review their maintenance plan in order to contribute to saving energy, water, chemicals, etc. Involve the suppliers in the option generation process.

➤ **UNIDO/UNEP/other NCPs**

Use the UNEP/UNIDO network actively and share your experience and expertise with the other NCPs established all over the world.

➤ **Universities, research centres**

For special questions or problems cooperate with universities and research centres. A diploma thesis on a special technological or organizational issue can be highly valuable for option generation and implementation.

➤ **Databases**

A number of databases include CP options.

- Cleaner production
 - www.unep.org
 - www.unido.org/cp
 - www.epa.gov/p2
 - www.es.epa.gov
- Technical information
 - www.es.epa.gov/techinfo
 - www.ecodesign.at
 - www.acfcp.org.au/case-studies
- Companies
 - www3.volvo.com/environment
 - www.sulzer.com/environment
 - www.nokia.com/environment

These databases often contain very specialized know-how which has to be adapted to your needs.

➤ **Seminars, roundtables, congresses**



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Seminars and congresses are valuable opportunities for the acquisition and exchange of up-to-date know-how in the field of cleaner production. Use the personal contacts you can establish at these events. CP roundtables, such as the European Roundtable on Cleaner Production or the Asia Pacific Roundtable for Cleaner Production, are held regularly. In addition, UNIDO periodically organizes meetings and seminars.

➤ **Own experience**

Maybe the most important source for CP options is your own experience. These options have to be carefully recorded to ensure the appropriate transfer and management of information.

➤ **International reference centres**

The international reference centres have usually gathered a lot of experience in CP work in various branches and industries. They are integrated into a CP network and will help you to join in. Profit from their contacts, knowledge and experience.

➤ **Chamber of Industry and Commerce**

The role of the Chamber of Industry and Commerce depends on the country. Ascertain at the beginning of your project whether they are willing to support your CP work. They usually can establish valuable contacts with industries and service companies. Furthermore they can provide the NCPC with modern infrastructure including seminar rooms, state-of-the-art communication channels, updated databases containing information on their members and financial support for CP projects.

➤ **Government, ministries**

The role of the government and ministries varies from country to country. In principle the following ministries could be involved in a CP project: Ministry of the Environment, Ministry of Housing and Planning, Ministry of Education or Ministry of Trade and Industry. You should contact these ministries to obtain political and/or financial support to CP projects (please see also Volume 10 of the UNIDO Toolkit).

➤ **Other companies**

Other companies are an important source of information. Firstly, companies usually trust each other (more than they trust consultants!). Secondly, companies learn from each other through a direct and rapid process. CP options and information you find in other companies are usually very convincing.

➤ **Company staff**

The most valuable capital of a company is its staff! They have a profound and detailed knowledge of the company, its processes and organizational and technological weak points. Therefore it is essential to obtain all the information they can provide in order to determine the potential for optimization.



Textbook 5 – Innovation, creativity and option generation

➤ Internet/homepages

Information on CP can be found on the Internet but you should be critical in the choice of the web pages. First consult the UNIDO and UNEP pages, which provide valuable information. In addition, the national environmental agencies, such as the US EPA, are useful contacts. The Link section of the Toolkit provides an overview of information sources on the Internet.

5.7.2 Creative CP option generation

So far, we have presented many tools which enable you to find creative options for a CP project. It is, however, impossible to completely transfer a method or solution that worked in one project or company to another project or company. In each case you have to find an individual, specific adaptation which suits the culture of the company and the overall situation of the country. Nevertheless, the following general rules will help you to determine the CP potential of a company or institution you work with.

- **Apply the CP methodology consistently.**
- **Set up a committed team.**
- **Ask as many questions as possible (why, when, what exactly, who, where, why again).**
- **Collect input/output data as completely as possible.**
- **Carry out a material flow analysis for interesting material streams.**
- **Carry out a brainstorming session with the team (classical option generation for simple problems).**
- **Search for information from other sectors which use comparable procedures and methods (e.g. cooling, compressed air, employee motivation, etc.) and adapt it to your company.**
- **Implement options: distinguish between solution-oriented options with a quick implementation and problem-oriented options which solve the problem at its root.**
- **Carry out the technical, environmental and economic evaluation and elaborate an environmental programme.**



5.7.3 Tricks for CP option generation

Apart from the above mentioned general approaches, a number of unconventional methods – let us call them tricks – might help you to identify CP options in various fields.

1. The waste box

Collect the production waste from a single product in a box and analyse it.

2. Close the shop

Close the workshop.

3. "Why, why, why?"

Don't stop asking questions: What are the reasons for waste generation? What are really the reasons? What can we do to minimize it?

4. Learn from contradiction

Input = output? What do different data acquisition methods tell you? What do different people tell you about the same process or consumption? What happens, if you run the same process several times?

5. Indicators and benchmarking

Compete with the best, use indicators from the same sector.

6. Super-super-ideal

How much input do you ideally need to manufacture a product? How much do you need on average? What is the difference?

7. Method -10%

Reduce input materials, for instance chemicals, by 10%.

8. Leave it out

What happens if you do not use a particular material at all?

9. Keep it separate

Separate waste collection is a prerequisite for recycling.

10. Reuse it elsewhere

Reuse waste internally, e.g. cooling water can be used for cleaning (for more detailed information please refer to Volume 8 Recycling technologies).



5.7.4 Record and sort options

Once a number of CP options have been identified and recorded, they should be sorted into those that can be implemented directly and those that require further investigation.

It is helpful to observe the following guidelines:

- Organize the options according to unit operations or process areas, or according to input/output categories (e.g. problems that cause high water consumption).
- Identify any mutually interfering options, since the implementation of one option may affect the other.
- Cost-free or low-cost options do not require an extensive feasibility study and should be implemented immediately.

(Source: CP Assessment in Fish Processing, Chapter 5, issued by UNEP in 2000)

5.7.5 Evaluation and feasibility study

At this stage suitable options for implementation are selected. The options selected during assessment should all be evaluated in view of their technical, economic and environmental benefits. The depth of the study depends on the type of project. Complex problems naturally require more attention than simple projects. For some options it may be necessary to collect considerably more information. An important source of information are employees who are directly affected by the implementation.

Evaluation and feasibility study

Problem	Solution	Evaluation		
		Economic	Environmental	Technical
XXX	XXX			



Textbook 5 – Innovation, creativity and option generation

Evaluation criteria (this list is taken from CP in Breweries, A Workbook for Trainers, first edition published by UNEP 1996)

Availability	Is the cleaner production option available?
	Can you find someone to supply you with the necessary equipment or input material?
	Do you know an advisor who can help you to develop an alternative?
	Has the cleaner production option already been applied elsewhere?
	If so, what are the results and experiences?
Suitability	Is the option suitable for the way the company is run?
	Is the option in line with the company's product?
	What are the consequences of the options for the company's logistics, throughput time and production planning?
	Does the option require adjustments in other parts of the company?
	If so, what adjustments?
Environmental effects	Does the change require additional training of staff and employees?
	What is the anticipated environmental effect of the option?
	How big is the estimated reduction in waste streams or emissions?
	Will the option affect the health of workers or the public?
	If so, what is the magnitude of these effects in terms of toxicity and quantity (positive/negative)?
Economic feasibility	What are the anticipated costs and benefits from implementing the option?
	Can you estimate the required investment?
	Can you make an estimate of the benefits, such as reduction of environmental costs, waste reduction and/or improvement of the quality of the product?

Some environmental performance indicators for breweries:

Solid waste	Environment
Hazardous waste	Occupational health and safety
Wastewater	Payback period
Air emissions	Cost
Noise	Production quality
Odour	Production quantity
Water consumption	Legal regulations
Energy consumption	
Raw material consumption	Stakeholders' demand



Textbook 5 – Innovation, creativity and option generation

5.7.6 Technical, environmental and economic evaluation

During the technical, environmental and economic evaluation the following aspects have to be considered.

Technical evaluation:

- Influence on product quality;
- Influence on productivity;
- Material consumption;
- Energy consumption;
- Influence on maintenance;
- Safety;
- Flexibility;
- ...

Checklist for the technical evaluation

Cleaner production option: ...			
	Yes	No	Not sure
Have you determined whether other companies have already gained experience with this option?			
Will this option maintain product quality?			
Will this option adversely affect production?			
Will this option require additional staff?			
Will workers be able to run the process with the implemented option?			
Is extra training of workers required?			
Are you certain that this option will generate less waste?			
Are you certain that this option will not simply move waste or emission problems from one medium into another (e.g. from solid waste to air emissions)?			
Is the plant layout and design suitable for the incorporation of this option?			
Will the provider guarantee this option?			
Have you determined whether this option will improve or maintain the workers' safety and health?			
Does this option reduce waste at the source?			
Are materials and parts readily available?			
Can this option be easily serviced?			
Does this option promote recycling?			



Textbook 5 – Innovation, creativity and option generation

Source: UNEP Workbook for Trainers "Cleaner Production in Breweries"

Environmental evaluation:

- Material consumption;
- Energy consumption;
- Emissions to air, water, soil;
- Shift of environmental problems to other media;
- Replacement of substances;
- Health and safety;
- ...

Checklist for the environmental evaluation

Cleaner production option: ...			
	Yes	No	Not sure
Does this option reduce the toxicity and volume of solid waste and sludge?			
Does this option reduce the toxicity and volume of wastewater?			
Does this option reduce the toxicity and volume of gaseous emissions?			
Does this option improve the health and safety conditions on the workforce?			
Does this option reduce the use of raw materials (per unit of product)?			
Does this option reduce the use of process materials (per unit of product)?			
Does this option reduce the energy consumption (per unit of product)?			
Does this option generate new environmental impacts?			
Does this option increase the possibility of recycling waste streams?			
Does this option increase the possibility of product recycling?			

Source: UNEP Workbook for Trainers "Cleaner Production in Breweries"



Economic evaluation

- Payback period;
- Other financial profitability calculations;
- Affected cost factors;
- Obvious environmental costs;
- Costs for lost raw material;
- Investment and depreciation costs of equipment;
- Personnel expenses;
- Outsourced services;
- “Hidden” costs.

Checklist for the economic evaluation

Cleaner production option: ...			
	Yes	No	Not sure
Does this option reduce the cost of raw materials?			
Does this option reduce the cost of utilities?			
Does this option reduce material and waste storage costs?			
Does this option reduce compliance costs?			
Will this option reduce the costs associated with workers' injury or illness?			
Will this option reduce insurance premiums?			
Will this option reduce waste disposal costs?			
Does this option have an acceptable payback period?			
Is this option economically acceptable for the company (consider both capital and ongoing operations)?			

Source: UNEP Workbook for Trainers “Cleaner Production in Breweries”



Textbook 5 – Innovation, creativity and option generation

Feasibility study

Checklist for the feasibility study

	Yes	No	Not relevant
Did you carry out a technical evaluation of the prioritized options?			
Did you carry out an economic evaluation of the prioritized options?			
Did you carry out an environmental evaluation of the prioritized options?			
Did you determine the training method of the employees for the successful implementation of the selected options?			
Can you identify the barriers which can be encountered on the workflow and which hamper the implementation of cleaner production options?			
Did you take measures to facilitate the implementation of these options, such as workshops, meetings, briefings, etc.?			
Did you record the feasible options selected for implementation?			
Did you record the non-feasible options?			
Did you coordinate the planning and time schedule of the cleaner production assessment or audit?			
Did you inform the management and employees about the progress of the cleaner production assessment?			
Did you prepare before-and-after sheets for the implementation phase?			
Based on the expected "before-and-after" situation, did you calculate the expected payback period?			

Source: UNEP Workbook for Trainers "Cleaner Production in Breweries"