Summary

These days, companies and customers face increasingly sustainability challenges. When they get aware of a problem they often have no idea what it entails and how to solve it. As there is no answer to the problem yet, a creative solution has to be found.

Creative problem solving exists for as long as humans have been thinking creatively and solving problems. The term problem solving describes the process of working through the details of a problem in order to reach a solution for each kind of problem, including sustainability issues. Besides logical or systematic thinking, problem solving may require creative skills. In that sense, creativity is the ability to find a solution or to develop a product, which is evaluated as functional, original, unique and adequate by a professional group and discerning persons.
When a person encounters a problem, the natural tendency is to propose possible solutions. Consequently, the thought and discussion focuses on the merits and problems of proposed solution(s), rather than an in-depth discussion of possible causes of the problem itself. However, creative problem-solving usually begins with defining the problem. Depending on the problem statement this may lead to a simple non-creative solution, or to finding a 'textbook solution'. The creative problem-solving process may also lead to the discovery of creative solutions by others.

### 9.1 Creative problem solving

As mentioned before, companies and customers face many sustainability challenges. When they get aware of a problem they often have no idea what it is about and how to solve it. As there is no answer to the problem yet the company has to find a creative solution.

Creative problem solving exists as long as humans have been thinking creatively and solving problems. Problem solving is the process of working through details of a problem to reach a solution. A problem may occur when there is a difference between what “should be” and what really “is”. Thus, a problem expresses the difference between the desired and the actual situation. It’s directly or indirectly related to a desired outcome or standard of behaviour. Identifying a very clearly defined and specific problem is the first critical step to successfully implementing the problem-solving process.

Besides logical or systematic thinking problem solving may require creative skills. The psychiatrist and creativity scientist Gottlieb Guntern became famous through his precise definition and clarification of the term creativity. Guntern’s understanding of creativity is the ability to find a solution or to develop a product, which is evaluated as functional, original, unique and adequate by a professional group and discerning persons (Guntern, 1991).
Most commonly, people like to use creative solutions to solve problems. As every problem constitutes the difference between the actual and desired status, creativity only functions if this difference can be recognised and formulated. Therefore, communication plays a huge role in the phenomenon of creativity.

The ideation processes are based on the phenomenon that new ideas can only form when we swap ideas. Similar to cross-breeding roses, crossing ideas allows new ideas to develop (Guntern, 1991). Thus, it is important to gather a large number of ideas. A study by the consultancy company Kienbaum (1991) showed that from around 1900 fixed initial ideas, 75% of all ideas were immediately discarded during the first evaluation stage. In either larger or smaller projects, the teams pursued a good 520 ideas. Of these, the companies created 180 products that they presented to the market. Approximately 50 products existed longer on the market; however, only 11 products were really successful. The rest was only partly successful or even generated a loss (Berth, 1990, p. 4).

If this study is taken as a rule of thumb, this means that a company has to generate around 170 initial ideas for every successful product or service.

9.2 The creative problem solving process
In the early 1950s, the American scientists Sidney Parnes and Alex Osborn, who invented traditional brainstorming were the first to develop and formalise creative problem solving as a process (Parnes/Harding 1962). Ever since, creative problem solving is a well-defined process that can help companies as well as individuals from problem definition to implementing solutions. As Jeffrey Baumgartner states in an article: “Creative Problem Solving (CPS) is a simple process that involves breaking down a problem to understand it, generating ideas to solve the problem and evaluating those ideas to find the
most effective solutions. Highly creative people tend to follow this process in their heads, without thinking about it.” (Baumgartner, 2013)

Creative problem-solving usually begins with defining the problem. Depending on the problem statement this may lead to a simple non-creative solution or finding a ‘textbook solution’. The creative problem-solving process may also lead to the discovery of creative solutions by others (Parnes/Harding 1962).

However, there are numerous approaches to CPS. Based on Osborne’s CPS-process model in his book, a 6-step CPS approach is used to develop sustainable innovations including following steps:

- Identifying the problem
- Defining the problem
- Understanding the problem
- Generating ideas
- Evaluating ideas and decision-making
- Implementing the solution

**Identifying the Problem**

Before being able to deal with a problem, companies or individuals have to become aware of its existence. Relatively often, problems have had an impact for some time before they are recognised or brought to the attention of someone who can do something about them. When a person faces a problem, the natural tendency is to immediately propose possible solutions. Consequently, the thought and discussion focuses on merits and problems of proposed solution(s), rather than an in-depth discussion of possible causes of the problem itself. Thus, if a company or person wants to resolve the root problem, they have to treat the cause, not the symptom. Persistent and recurrent problems are often symptoms of deeper-lying is-
sues. A ‘quick fix’ may seem convenient, but it is really just a temporary solution and it may solve only part of the problem. Thus, the stakeholders may need to state the problem in broad terms since they may not recognize the exact problem:

- they may lack information to define it
- they can confuse symptoms with underlying causes

For example, if somebody takes an aspirin for a headache, he’s treating the symptom (the pain) and not treating the cause. He might experience temporary relief, but if the cause (e.g. a broken tooth) is left untreated, it’s likely that the headache will return. Sometimes numerous negative symptoms are all outcomes of a single root problem – so solving the root problem will resolve many related problems.

**Defining the problem**

Once a company has identified the problem, the management needs to determine its exact nature: what is the job-to-be-done and what are the barriers to do so? Thus, the management can outline some of the main elements of the problem, and make a first attempt at defining the problem. This definition should be clear enough to be able to easily explain the nature of the problem to others.

<table>
<thead>
<tr>
<th>Jobs-to-be-done</th>
<th>Barriers to do so</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get rid of a broken tooth.</td>
<td>I am afraid of the dentist.</td>
</tr>
<tr>
<td>Set up a new business.</td>
<td>The entrepreneurs do not know where to start.</td>
</tr>
<tr>
<td>Reduce the waste of food.</td>
<td>Customers buy attractive-looking food only.</td>
</tr>
</tbody>
</table>
Looking at the problem in terms of ‘jobs-to-be-done’ and ‘barriers to do so’ can offer an effective way of defining many problems and splitting bigger problems into more manageable sub-problems. By this means, sometimes it will become apparent that what seems to be a single problem, is more accurately a series of sub-problems.

In addition, the stakeholders can further clarify the problem by asking questions such as: “What do we really wish to accomplish?”, “What is preventing us from solving this problem?”, “How do we envision our company in one-year respectively five years as a result of solving this problem?” as well as “Are other companies dealing with similar problems? If so, how are they coping?” By the time a company has answered all these questions, they should have a clear idea of what their real problem is (Baumgartner, 2013).

During this stage of problem solving, it is important to get a first working definition of the problem. A well-stated problem is one that can be stated in a single sentence. Thus, the problem statement should be a concise description of issues that need to be addressed and should be agreed on by all stakeholders (or created by them) before they try to solve the problem.

Although it may need to be adapted at a later stage, a good working definition makes it possible to describe the problem to others who may become involved in the problem-solving process. One test for checking to see if somebody has identified the real problem, is to ask the question, “if the problem I’ve stated had been resolved from the beginning, would this current situation be happening?”

The final step of this stage is to decide what criteria a company wants to use to evaluate or judge the ideas. Are there any budget limitations, sustainability criteria or other restrictions given that will affect whether they go ahead with an idea? The management should set up a list of three to five evaluation criteria and then put the list aside until the ideation process is completed (Baumgartner, 2013).
Understanding the Problem

The third stage of the problem-solving process involves gaining a deeper understanding of the problem. After problem identification and identifying of the sub-problems, structuring the problem is all about gaining more information about the problem and increasing understanding. This phase focuses on finding and analysing facts, as well as building a more comprehensive picture of both job(s) and barrier(s). This stage may not be necessary for simple problems but it is essential for problems of a more complex nature. To structure the problem, first, facts need to be checked.

<table>
<thead>
<tr>
<th>Initial situation</th>
<th>Checking Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>“We have to increase our output but we don’t have the production capacity and we don’t have enough money to buy new manufacturing equipment.”</td>
<td>Do we really have to increase our output? Why?</td>
</tr>
<tr>
<td></td>
<td>Do we really have no access to additional production capacity? Why?</td>
</tr>
<tr>
<td></td>
<td>Can we really not afford to buy new manufacturing equipment? Why?</td>
</tr>
</tbody>
</table>

These questions could be asked to make sure whether the stated job-to-be-done is the real goal? Are the barriers actual barriers and what other barriers are there? In this example, at first the problem seems to be that the company doesn’t have the production capacity to increase its output. But, if the problem gets investigated it turns out that the lack of money is the main problem.

This is a good opportunity to look at the relationships between the key elements of the problem. For example, in the ‘output-production-money’ problem, there are strong connections between all the elements. By looking at all the relationships between the key ele-
ments, it appears that the problem is more about how to find investors, because solving this sub-problem will, in turn, solve the others.

Doing research is another way to get a better understanding of the problem. The best place to start these days is with one’s favourite search engine. But one should not neglect more traditional sources of information and opinions such as libraries or polls (Baumgartner, 2013).

**Generating ideas to solve the problem (ideation)**

Based on information gathered in the first three phases of the problem-solving framework it is now time to start thinking about possible solutions to the identified problem (e.g. by ideation). In a group situation, this stage is often carried out as a brain-storming session, letting each person in the group express their views on possible solutions (or part solutions). In organisations, different people will have different expertise in different areas and it is useful, therefore, to hear the views of each party concerned. This step will be deepened in the following chapter 12 “Ideation”.

**Evaluating the ideas and decision-making**

This step is perhaps the most complex part of the problem-solving process. Following the ideation process, it is now time to look at each potential solution and carefully analyse it. Using the criteria that the stakeholders have devised earlier, they can choose all the ideas that broadly meet these criteria. Baumgartner points out that this is not always sufficient: “With complex ideas, a simple evaluation may not be enough. You may need to do a SWOT-analysis (strengths, weaknesses, opportunities and threats) or discuss the idea with others who will be affected by it. If the idea is business related, you may need to do a business case, market research, build a prototype or a combination of all of these.” (Baumgartner, 2013)
On the other hand, some solutions may not be feasible, due to other problems, such as time- or budget constraints. Sometimes trying to solve a problem that leads to many more problems requires very creative thinking and innovative ideas.

**Implementing the solution**

Implementation means acting on the chosen solution. During the implementation process more problems may arise especially if identification or defining of the original problem was not carried out fully. Furthermore, the final stage of problem solving is also concerned with checking if the process was successful. This can be achieved by monitoring and getting feedback from people affected by any changes that occurred. It is good practice to keep a record of outcomes and any additional problems that occurred.

To solve problems properly, the stakeholders need to drill through the symptoms to the underlying cause. There are different techniques, which help them to find the underlying cause and to define the problem as exact as possible.

### 9.3 Questioning techniques to identify a problem

**Purposing**

Purposing is a simple technique to create an effective focus for creative problem solving. Companies can use it

- when they are starting out, to define the problem which they are seeking to solve.
- when they are stuck, to think again about what they are trying to achieve.
to discover the purpose of the person to whom they are selling the idea.

Procedure

- Ask ‘What is it for?’ The basic principle of purposing is to return to asking about the real purpose. Hence, ask ‘What is it for?’ Seek the reason behind what you are trying to do.
- Ask the person or people for whom you are creating why they want it. Ask what they are going to do with it. Observe them to learn more.
- Now do it again: And when you think you know, ask the question again. Take another viewpoint. Ask ‘Who else is interested in this? What do they want?’ Look deeper. Ask the same question again and again.
- Think about different technical or other aspects of the problem. Ask questions such as ‘Am I trying to achieve this, or trying to do that?’ Look at it in as many different ways as possible. (Straker, 2015)

5 Why’s technique

The 5 Why’s technique is a simple tool for quickly uncovering the root of a problem. Sakichi Toyoda, one of the fathers of the Japanese industrial revolution, developed the technique in the 1930s. He was an industrialist, inventor and founder of Toyota Industries. His technique became popular in the 1970s and Toyota still uses it to solve problems today.

The 5 Whys technique is easy to use: when a problem occurs, you uncover its nature and source by asking “why” at least five times. You can use the 5 Whys in troubleshooting, quality improvement and problem solving. It is best for simple or moderately difficult problems. For more complex or critical problems, it can lead you to pursue a single track of enquiry when there could be multiple causes.
This simple technique, however, can quickly direct you to the root of the problem (Ohno, 2006).

Procedure

The 5 Why’s is a simple tool that is easy to use. When a problem arises, simply keep asking the question “why” until you reach the underlying source of the problem, and until a robust counter-measure becomes apparent. Keep asking “why” until you feel confident that you have identified the root cause and can go no further. At this point, an appropriate counter-measure should become clear (Ohno, 2006).

9.4 Analytical techniques to identify a problem

Positives, Negatives

Sometimes individuals or companies have to look at the other side of the coin to find the cause of a problem.

Procedure

- Explore negatives
  Seek to understand the negative things that are happening. Think of what you are doing as ‘problem-solving’. Ask questions such as: What kind of problems are we trying to solve? What is going wrong that we want to fix? Who is affected? What other problems do they have? What would we like to leave behind? What do we want to go away from?
  Write the answers down as coherent problem statements, where the problem to be resolved is clearly identified.

- Explore positives
  Take a break to clear your mind of negative things, then start
looking at the other side of the coin. Look for the positive things to be gained. Think of what you are doing as ‘adding value’. Ask questions such as: What new benefits can we introduce? What is going well that we want to improve? Who is involved? What are they trying to achieve? What does ‘value’ mean to them? What would we like to gain? What do we want to move towards?

- Write the answers down again as clear benefits statements, where the value to create is clear. Review the statements you have created and decide whether you want to work solving a negative problem or creating positive value. Both are equally valid.

**CATWOE-Technique**

CATWOE stands for Customers, actors, transformation process, world view, owner and environmental constraints. Peter Checkland and other academics at the University of Lancaster Systems Department developed the CATWOE technique through a ten-year action research program. It is a simple checklist for thinking (Checkland, 2001).

**Procedure**

Use the areas below to stimulate thinking about the problem and/or implementing the solution.

- **C = Customers**
  Who is on the receiving end? What problem do they have now? How will they react to what you are proposing? Who are the winners and losers?

- **A = Actors**
  Who are the actors who will ‘do the doing’, carrying out your solution? What is the impact on them? How might they react?
• **T = Transformation process**
  What is the process for transforming inputs into outputs? What are the inputs? Where do they come from? What are the outputs? Where do they go to? What are all the steps in between?

• **W = World View**
  What is the bigger picture into which the situation fits? What is the real problem you are working on? What is the wider impact of any solution?

• **O = Owner**
  Who is the real owner or owners of the process or situation you are changing? Can they help you or stop you? What would cause them to get in your way? What would lead them to help you?

• **E = Environmental constraints**
  What are the broader constraints that act on the situation and your ideas? What are the ethical limits, the laws, financial constraints, limited resources, regulations, and so on? How might these constrain your solution? How can you get around them?
  (Checkland, 2001)

**The Nine Windows Creativity Technique (TRIZ)**

The nine-windows creativity technique, or the system operator, can help cut through the complexity so that the problem that needs to be solved becomes clear. One of the challenges individuals or companies face in creative problem solving is to mentally change their thinking pattern. They tend to be so trapped in their own perspective that it limits their ability to see other possibilities. What they need is a structured way to look at a problem through different “lenses”. The nine-windows creativity technique enables them to look at innovation opportunities across the dimensions of time (past, present, future) and level (super system, system, subsystem). In other words, it gives them a set of tools that they can use to consider a problem by
breaking it into smaller pieces as well as considering the larger context into which it fits (Silverstein et al., 2012, p. 57-58).

Table 9.1: Nine Windows Creativity Technique (TRIZ)

<table>
<thead>
<tr>
<th></th>
<th>Past</th>
<th>Present</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Super system</strong></td>
<td>(Step 4)</td>
<td>System environment-present (Step 3)</td>
<td>(Step 5)</td>
</tr>
<tr>
<td>(Environment)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>System</strong></td>
<td>(Step 4)</td>
<td>Product/Problem (Step 1)</td>
<td>(Step 5)</td>
</tr>
<tr>
<td><strong>Subsystem</strong></td>
<td>(Step 4)</td>
<td>Subsystem-present (Step 2)</td>
<td>(Step 5)</td>
</tr>
<tr>
<td>(Subarea)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Silverstein et al., 2012, p. 58.

The super system relates to how the product or problem interacts with the surrounding environment: “What larger system encompasses the product or problem?” Conversely, the subsystem breaks the present product or problem down into the components and characteristics that constitute it: “What makes up the object in its present form?”
Chapter 9: Identification of sustainability issues

Procedure

- Draw nine boxes arranged in a 3 x 3 matrix on a blank sheet of paper. Label the bottom row of boxes (from left to right) past, present and future. Label the far-left boxes (from top to bottom) super system, system, subsystem.
- Put your problem in the middle square: Use whatever makes sense to describe your problem.
- Identify the system environment (super system) and subsystem: Fill in the boxes above and below the centre box in the present dimension (the middle column).
- Determine the past: Fill in the past boxes to the left. What did the product or solution look like in the past? What happened to the product from its creation to its present form or function? Before the present product or solution existed, what was the previous solution for the job-to-be-done?
- Complete the grid: Fill in the future boxes to the right. Don't limit yourself to just the immediate future. Instead, experiment with defining this temporal dimension in more than one way by asking questions such as these: What will the product or solution look like in the future? What will happen to the product or solution after it ceases to work in the present? What future solution could be developed to address the same job-to-be-done? How can the system inputs be modified to eliminate, reduce or prevent a harmful? (Silverstein et al., 2012, p. 58-61).

The nine windows technique is taken from the problem-solving approach of TRIZ.\(^2\) The Soviet inventors and scientists Genrich Altshuller and Rafael Shapiro developed it between 1954-1956. An important part of the theory has been devoted to revealing patterns

\(^{2}\) TRIZ is the Russian acronym for “the theory of inventive problem solving.”
of evolution. Overall, there are three primary findings of this research:

- Problems and solutions are repeated across industries and sciences;
- Patterns of technical evolution are also repeated across industries and sciences;
- Innovations used scientific effects outside the field in which they were developed.

TRIZ applies all these findings to create and to improve products, services, and systems. Based on extensive research covering hundreds of thousands of inventions across many different fields, the theory defines generalizable patterns in the nature of inventive solutions and the distinguishing characteristics of the problems that these inventions have overcome.

Jobs to done

A completely different approach was developed by the American scientists Clayton Christensen and Tony Ulwick. They describe the Job-to-be-done concept as follows: ‘[…] the consumer has a different view of the marketplace. He simply has a job-to-be-done and is seeking to ‘hire’ the best product or service to do it.” (Christensen et al., 2007, p. 2) If a company is able to understand the jobs their customers want done, they gain new market insights and create viable growth strategies. Sometimes a good solution for a job-to-be-done does not exist yet at all. When this is the case, they have a great opportunity to innovate. In general, there are two different types of jobs-to-be-done:

- Main jobs-to-be-done, which describe the task that customers want to achieve.
- Related jobs-to-be-done, which customers want to accomplish in conjunction with the main jobs-to-be-done.
Jobs-to-be-done are completely neutral of the solutions a company creates (their products and services). While the jobs, a customer wants to be done remain fairly stable over time, their products and services should change at strategic intervals as they strive to provide ever increasing value (Silverstein et al., 2012, p. 3-4).

Procedure

• Identify a focus market.
• Next, identify jobs customers are trying to get done: Study your customers and find out what they are trying to accomplish. What jobs have ad hoc solutions or no good solutions? When you see customers piecing together solutions themselves, these are great clues for innovation.
• Categorize the jobs-to-be-done: Jobs can be main jobs or related jobs.
• Create job statements: The job statement describes exactly the job-to-be-done. Key components of a job statement are an action verb, the object of the action, and clarification of the context in which the job is performed.
• Prioritize the opportunities: There are hundreds of jobs that customers are trying to get done in every market. Which one of these offers the best opportunities for you? Which ones offer opportunities to create uncontested market space? In most situations, the jobs that customers want to get done for which no good solutions exist are the ones that provide the greatest opportunity for innovation.
• Look for the “struggling moment”. By means of an interview ask your customer why he switched solutions from the previous product to yours. Alternatively, ask customers that no longer “hire” your products and who switched to a new solution, what they struggled with and how that made them look for a new and better solution.
(Silverstein et al., 2012, p. 7-11)
9.5 Techniques to visualize a problem

A visual representation and a working definition together make it far easier to describe a problem to others. Thus, we are introducing several techniques how to visualize a problem.

Listing

Listing the elements of a problem can also help to represent priorities, order and sequences in the problem. Goals can be listed in order of importance and barriers in order of difficulty. Separate lists could be made of related goals or barriers. The barriers could be listed in the order in which they need to be solved, or elements of the problem classified in a number of different ways. There are many possibilities, but the aim is to provide a clearer picture of the problem.

Chain Diagrams

Chain diagrams are simple ways of representing problems combining diagrams and words. The elements of the problem are set out in writing, usually placed in boxes, and positioned in different places on a sheet of paper, using lines to represent the relationship between them.

Chain Diagrams are the simplest type, where all the elements are presented in an ordered list, each element being connected only with the elements immediately before and after it. Chain diagrams usually represent a sequence of events needed for a solution. A simple example of a chain diagram illustrates the output-production-money problem as follows:
Flow Charts

Flow charts allow for inclusion of branches, folds, loops, decision points and many other relationships between the elements. In practice, flow charts can be quite complicated. There are many conventions as to how the flow charts have to be drawn, but generally, simple diagrams are easier to understand and aid in ‘seeing’ the problem more readily.

Tree Diagrams

Tree diagrams and their close relative, the Decision Tree, are ways of representing situations where a number of choices have to be considered. These types of diagram are particularly useful for considering all the possible consequences of solutions.

Remember that the aim of a visualisation is to make the problem clearer. Over-complicated diagrams will just confuse and make the problem harder to understand.
Mind mapping

A picture is worth a thousand words. It opens up associations, focuses the thoughts, is fun and results in better recall:

- Colours stimulate the right cortical activity of imagination as well as capturing and holding attention.
- The unique shape makes it more memorable and enjoyable. A frame makes the centre a monotony of shape and disconnects the branches.

Figure 9.1: Mind map for Behaviour Change for combating climate change

Source: Rea 2013.
Procedure

0. Take a blank piece of paper, A4 size or larger. Use the paper in landscape orientation and start in the centre. Make a central image that represents the topic about which you are writing/thinking.

1. The main themes around the central image are like the chapter headings of a book:
   - Print this word or phrase in CAPITALS or draw an image.
   - Connect directly to the central image.

2. Start to add a second level of thought. These words or images are linked to the main branch that triggered them. Your initial words and images stimulate associations. Attach whatever word or image is triggered. Allow the random movement of your thought; you do not have to ‘finish’ one branch before moving on.

3. Add a third or fourth level of data as thoughts come to you:
   - Use images as much as you can, instead of, or in addition to the words.
   - Allow your thoughts to come freely, meaning you ‘jump about’ the Mind Map as the links and associations occur to you.

4. Sometimes enclose branches of a Mind Map with outlines in colour. Enclose the shape of the branch, hug the shape tightly and use different colours and styles.

5. Add a little humour, exaggeration or absurdity wherever you can. Your brain will delight in getting enjoyment from this process and you will therefore learn faster, recall more effectively and think more clearly.
Training questions:

1. Explain Guntern’s understanding of the term creativity.
2. How does the “job-to-be-done” framework facilitate the innovation process?

Recommended literature


Internet resources


Rea, Juanita (2013): Mind maps from learning fundamentals, online: http://icanregrow.edusoil.com/uploads/1/2/7/0/12708433/behaviour-change.jpg
