During the process of product innovation, numerous problems that require creative solutions are encountered. These problems include recognizing of customer needs, generating ideas for new products or product applications, developing new product concepts, finding solutions for technical problems, adjusting the production process, and developing a marketing concept for the market launch.

A number of solutions may be developed for each of these problems. Through screening and evaluation, the best solutions serve as a point of departure for the next step in the product-innovation process (see Exhibit 1). Solutions can be found by means of technical know-how and experience. However, solutions can also be developed systematically by applying creativity techniques.

New product ideas often result from the efforts of a few highly creative individuals whose brilliant ideas are turned into new products. Although this method of developing new product ideas is often successful, an organization cannot merely depend on a few highly creative individuals. The reasons for this are:

Only a limited number of people within an organization can be labelled “highly creative.” Experience shows that within certain professions less than 10% of the people can be indicated as highly creative. This means that when these people are the only ones that an organization can depend on, the production of useful ideas is rather limited.

New products are now being developed systematically. Because the process of product development has a fixed sequence, creative input is required at certain fixed moments in the process. Therefore, a company must be able
to plan and foresee when this creative input will be required. When only a few ideas that come up spontaneously from creative individuals are relied on, a high risk and the danger of delay occur.

The nature of the product-innovation process has become increasingly complex in the past 20 years. It seems almost impossible for a single individual to have all the knowledge that is needed to find feasible solutions for problems that arise. Problems need an interdisciplinary approach and can be better dealt with by an interdisciplinary working group. Today’s innovation process requires that these working and project groups be formed. Group creativity techniques should be applied within these groups to generate creative inputs to the innovation process.

Fortunately, many sophisticated creativity techniques that have proven their value in the product-innovation process have been specially developed for use within groups.

This chapter focuses on applying creativity techniques in product innovation. First, a general classification of creativity techniques is presented. Common techniques are next described in detail and clarified by practical examples. Then, the concept of creativity workshops is introduced. These workshops are often organized in the light of innovation management. Finally, idea evaluation is discussed. A short screening and evaluation of ideas should always be the final step in a creativity session.

The first methods of idea generation were developed more than 40 years ago. These years of experience with these methods have led to a set of sophisticated creativity techniques that provide the following advantages:

- They permit systematic problem solving, especially for unstructured problems. In product development, some tasks are well structured and can be solved by applying an algorithm, but other tasks must be solved creatively. Many alternative solutions are generated, permitting a few good solutions to be selected rationally.
Most technical problems are now complex, requiring an interdisciplinary approach to solving the problem. Creativity techniques are suited for interdisciplinary groups. Ideas generated by groups comprising specialists from different departments with different professional backgrounds have a higher acceptance level than ideas generated by one expert. A well-prepared and skillfully moderated idea-generation session can always be expected to produce some good ideas. Therefore, the creative input to the conceptual phases of technical development processes can be planned with regard to quality and time.

In addition to these results, the following positive side effects result from the use of creativity techniques:

- The creativity of individuals increases, because the sessions have a training effect;
- Communication between people who had previously participated in a group improves;
- The number of conflicts within groups reduces;
- People stop being afraid of dealing with problems that involve risk and uncertainty;
- People increasingly consider their colleagues as useful sources of knowledge, rather than rivals; and
- The private lives of people are positively influenced.

**THE BASICS OF CREATIVITY TECHNIQUES**

**How Creativity Is Triggered**

The human brain is a place where knowledge and experience are laid out in fixed lines and paths. In a normal logical mode, humans think along these structured paths. This conventional mode of thinking often does not result in original ideas or novel solutions to a given problem. Only when people leave these structured paths and merge previously unconnected pieces of knowledge and experience that have no obvious relationship can creative thinking occur. Creative thinking can be stimulated by applying heuristic (i.e., learning or discovering) principles such as association, abstraction, combination, isolation, variation, and the transfer of structures between unconnected problems. Creativity techniques are based on these specific heuristic principles, which are integrated into the rules of the techniques and guarantee that the techniques are properly applied.

Most creativity techniques should be applied in groups. In a group, the knowledge elements of the members can fuse to new ideas. The optimal group size has turned out to be between five to seven members. Participants should come from different departments and/or should have a different professional background. Although creativity techniques also exist for individual use, such techniques are often less effective because there is less discipline and stimulation in individual settings.
Classifications of Common Techniques

Creativity techniques can be classified on the basis of two sets of principles:

1. **Working principles contained in the techniques.** The generation of ideas can be improved either by 1) stimulating the problem solver’s intuition of the (methods fostering intuitive thinking), or 2) approaching the problem systematically (systematic idea generation methods). Systematic idea generation methods steer the problem solver toward analyzing the problem structure and elaborating solution components systematically. These methods differ from those that foster intuitive thinking, which stimulate the problem solver to come up spontaneously with ideas.

2. **Applied triggering principles.** Ideas can result from 1) variation of existing ideas (forming of idea chains through further development of ideas), or 2) from the confrontation with impressions not related to the problem, which leads to the coupling of stimulus elements resulting in new ideas.

The combination of the working and triggering principles results in the following four classes of idea-generation methods:

- Intuitive association;
- Intuitive confrontation;
- Systematic variation; and
- Systematic confrontation.

More than 100 creativity techniques are known. Most of these techniques are simply variants of a few fundamental methods. In Exhibit 2, the four classes of idea-generation methods are classified according to their working and triggering principles.

**DESCRIPTION OF CREATIVITY TECHNIQUES**

It is important to note that the creativity techniques discussed in this section can only be successfully applied after the problem in question has been thoroughly analyzed. This analysis should finally result in a precise problem definition, which is the starting point for all problem-solving sessions.

**Methods of Intuitive Association**

**Brainstorming.** Brainstorming, which is based on four fundamental rules, is the best-known and most commonly used of all creativity techniques. It offers people the opportunity to carry out problem-solving sessions efficiently.

Conventional meetings often contain long discussions on insignificant details, because it is difficult for many people to really concentrate on the problem itself. Instead, people tend to judge other people’s ideas first. Therefore, the first of the four fundamental rules of brainstorming is that judgment or negative criticism is not allowed. Negative remarks such as “that
### Exhibit 2
Classification of Creativity Techniques

<table>
<thead>
<tr>
<th>Working Principle</th>
<th>Triggering Principle</th>
<th>Association/Variation</th>
<th>Confrontation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulation of Intuition</td>
<td>Methods of intuitive association</td>
<td>Methods of intuitive confrontation</td>
<td>Methods of intuitive confrontation</td>
</tr>
<tr>
<td></td>
<td>—Brainstorming</td>
<td>—Stimulating word analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>—Traditional</td>
<td>—Excursion synectics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>—Variants</td>
<td>—Visual confrontation techniques</td>
<td></td>
</tr>
<tr>
<td></td>
<td>—Brainwriting</td>
<td>—Picture projecting group confrontation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>—Ring exchange technique</td>
<td>—Picture folder brainwriting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>—Brainwriting pool</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>—Circulating card technique</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systematic Structuring</td>
<td>Methods of systematic variation</td>
<td>Methods of systematic confrontation</td>
<td>Methods of systematic confrontation</td>
</tr>
<tr>
<td></td>
<td>—Morphological tableau</td>
<td>—Morphological matrix</td>
<td></td>
</tr>
<tr>
<td></td>
<td>—Progressive abstraction</td>
<td>—Effective stimuli development</td>
<td></td>
</tr>
</tbody>
</table>
has been tried before” or “that’s impossible” should not be made during brainstorming sessions.

Brainstorming’s second rule is that participants should mention all ideas that come into their minds. Even ideas that are at first sight utopian or fantastic should be mentioned, because they may initiate other realistic ideas.

Third, ideas from group members should be picked up by the other members and further developed into new ideas (i.e., variations). This means that group members must be able and willing to listen to one another.

Fourth, as many ideas as possible should be produced. The more ideas that are generated, the greater the probability that a really original and feasible idea will emerge.

Brainstorming is often considered a simple method, but it requires an experienced moderator and discipline from the participants. This method is especially useful for tackling problems of a simple nature where the number of possible solutions is large. Brainstorming sessions should last no more than 30 minutes. After the ideas are generated, they should be briefly evaluated. This first evaluation can be subjected to a more thorough screening and selection process, which is discussed later in the section on structuring and screening ideas.

It is important to prepare a brainstorming session in advance. Participants should be informed about the problem to be dealt with and the date and duration of the session at least two days in advance.

In a classic brainstorming session, the following steps are followed:

The moderator should explain the problem, give background information and requirements, and stress the four fundamental rules of brainstorming mentioned earlier.

Next, all ideas coming to mind should be expressed. Even the most ridiculous ideas can be useful, because they can stimulate other group members to come up with something new. A golden rule of brainstorming is that “quantity breeds quality.”

Obvious ideas should be mentioned at the beginning of the session so that there will be room for really original ideas.

It is crucial for everyone to get a chance to speak up without being interrupted. An idea may be presented in a general way; there is no need for detail.

The moderator should write down all ideas on a flipchart. Recording all ideas on tape is an additional mode that can be used.

The moderator should ensure that the rules are obeyed.

If participants run out of ideas, the moderator can add some of his or her own. The moderator can also mention some new principles that may lead the thinking into new directions or read the ideas that have been stated already again. When repeating the ideas, the moderator should stress general statements, very original ideas, and unclear suggestions.

Brainstorming is widely known and frequently applied in companies, although the rules are often not very well observed and the kind of problems
that companies tackle are not suitable for brainstorming. Brainstorming is especially suited for working on problems that emphasize original ideas. Therefore, it may be applied particularly when the basic product idea is established and developed. It may also be used when a wide range of new product applications is sought (e.g., in searching for new indicators that show whether the freezing chain of foods is interrupted or for new applications for specialty glues).

Brainstorming may always be applied when a group is not familiar with other methods or when it spontaneously decides to generate ideas for a question that has come up in a meeting. However, other techniques are more effective for complex and very difficult problems that usually come up in the conceptual phase of the product-innovation process. These techniques are described in the following sections.

**Brainwriting.** Brainwriting is a collective name for a number of creativity techniques developed for groups. Although brainwriting is based on the same principles as brainstorming, brainwriting participants form their ideas in writing instead of by speaking. Problems of group dynamics as well as the skills of the moderator are less important with brainwriting. Ideas are written on cards or other sheets of paper and circulated in the group. Participants are stimulated by reading the ideas that the others write down.

Brainwriting has the following advantages over brainstorming:

- All ideas are automatically recorded. The pile of cards or sheets serves as a complete record of the idea-generation session.
- There is no room for judgment or criticism; participants work individually and have time to really consider and develop their own ideas.
- Brainwriting can be applied even without an experienced moderator.

One of the disadvantages of brainwriting methods is that, in contrast to brainstorming, spontaneity might get a bit lost. However, problems that need solutions that take some individual time to develop are especially suitable for brainwriting techniques. People can take their time and even use graphics or figures to express their ideas. Brainwriting techniques, therefore, are especially suited for design tasks.

One valuable brainwriting method is the circulating card technique. In using this technique, all participants sit in a circle and write down their ideas on cards with a thick marker so that they can be seen from a distance. Participants lay their completed cards down to their right, within easy reach of their neighbors. As participants need new ideas, they look through the pile of cards that their neighbor has placed on their left and try to develop new ideas through variation on the basis of these ideas. The idea-generation phase should be completed after 20 to 25 minutes.

The major advantage of the circulating-card technique method is that the resulting ideas are easy to structure and evaluate later. This is best done by
clustering the idea cards on a long table and giving these card clusters specific headings (thematic groupings). Only then should these cards be put on a bulletin board for further processing. The ideas are evaluated by distributing adhesive colored dots that represent a participant’s approval of an idea. As the ideas all lie on the flipcharts on the wall, the participants place their dots on their favorite ideas. With a group of over 50 people, the total number of dots that each person receives equals about 10% of the ideas. On the other hand, when there are less than 50 group members, the budgeted dots for each person equal approximately 20% of the ideas. In addition, color coding is sometimes used in this method to represent different subgroups (i.e., marketing staff as opposed to research and development staff) or the rank of the participants, and therefore the value of their judgment.

The circulating card technique is especially useful where a large number of ideas of quite different natures are expected. In the process of product planning, this technique has particularly proven its value for searching for attractive market segments, identifying user problems, and finding product or product application ideas.

**Methods of Intuitive Confrontation**

Empirical research shows that original ideas are often born when the problem solver is confronted with a situation or an object that has no direct relation to the problem. This phenomenon is part of the natural individual creative process.

The anecdote of Archimedes, the famous Greek geometrician, is a classic example of a brilliant idea found during a moment of estrangement. Archimedes was assigned the task of verifying that a crown that his master had received was made of gold. Normally, he would have simply compared the weight of the object to be verified with the weight of a piece of gold having the same volume as that object. However, he found that the crown had a very complicated form, and after days of trying he concluded that calculating the crown’s volume was impossible using classical geometry. When he later relaxed by taking a hot bath, he saw that the water flowed over the edge of the bathtub under the influence of his body’s volume. He realized that by measuring the volume of the amount of water that flowed over the bathtub’s edge after putting the crown in a tub full of water, he could measure the crown’s volume simply. Archimedes had transferred the principles of a situation that had nothing to do with the problem (i.e., overflowing water) to the problem itself.

This principle of estrangement and confrontation has been used to develop methods of intuitive confrontation. People are confronted with unconnected situations or objects from which inherent principles, structures, or functions are used to generate ideas. The application of this principle differs from principles of classical brainstorming and brainwriting methods. In this case:
There is a difficult problem for which solutions are not at all obvious. Other efforts (individual work or other simpler creativity techniques like brainstorming or brainwriting) have achieved no satisfactory results. The emphasis is on finding exceptionally original ideas.

Intuitive confrontation can be used both by individuals working on a problem or by a group. The methodological approach of intuitive confrontation can best be illustrated by the method of stimulating word analysis.

**Stimulating Word Analysis.** After a thorough problem analysis, a group (five to seven persons) is confronted with a series of words that can simply be chosen at random from, for example, a dictionary. Nouns are most suitable. For these words, which are unconnected with the problem, the group determines the inherent principles, structures, functions, and the like, and it spontaneously derives solutions from this confrontation.

The following is an example of idea generation by means of being confronted with words.

---

**Problem:** A company manufactures tools for skilled and unskilled craftsmen (e.g., levels, cramps, and bench vices). The company is searching for new products that will simplify the work of their customers. A tool for simplifying the time-consuming task of perpendicularly attaching heavy shelves could be a successful new-product idea.

**Stimulating word:** bird (randomly chosen).

**Principles attached to the word “bird”:**
- It flies and glides.
- It has wings that can spread out widely.
- It has talons.
- It has a pointed beak.
- It has very good eyes.

**Idea generation from these principles:**
- An air cushion could be placed underneath the shelf. By adding or letting out air, the shelf could be brought into the desired position where it can be screwed on without difficulty. This idea was suggested by “flying and gliding.”
- A special level can simply be attached to the wall. This level can be used to mark the right drilling holes on the wall. This idea was suggested by “wings that can spread out widely.”
- Two or more rails with hooks could be attached to the wall in an upright position. The hooks could be adjustable to any position. In this way, a shelf could be fastened to the hooks in any desired position. This idea was suggested by “talons.”
- A shelf could be hung on the wall on one single point with a strong wire and fixed. This idea was suggested by “a pointed beak.”
- A system consisting of rectangular elements with integrated levels could be constructed. These elements could be connected with each other by laser beams. By special sounds, the elements indicate whether they are perpendicular to each other. By attaching these elements to the shelf, deviations from the exact position could be heard. This idea was suggested by “very good eyes.”

---
**Excursion Synectics.** Excursion synectics is a pioneer method of creative problem solving aimed at stimulating all phases of the natural creative process by intensive consideration of the problem, incubation (estrangement), illumination, and verification. The sessions on this method promote unconventional thinking and therefore often result in truly novel ideas. The 10 stages of this method are:

1. Explain, define, and analyze the problem.
2. Elicit spontaneous ideas (purge the mind).
3. Check the generated ideas and redefine the problem as understood by the group.
4. Create direct analogies.
5. Create personal analogies (personal identifications).
6. Create symbolic analogies (contradictions).
7. Create direct analogies to a selected symbolic analogy.
8. Transfer structures of the direct analogy to the problem (force fit).
9. Develop approaches to solutions.
10. Select and develop promising ideas.

**Visual Group Confrontation.** Visual group confrontation, a methodology that is similar to stimulating word analysis, is derived from the stages of the natural creative process. This method particularly emphasizes relaxation and estrangement.

Following a thorough analysis of the problem, group participants are shown a series of approximately five pictures for their relaxation and dissociation. These pictures should not contain too many clearly recognizable details. Quiet background music can help to show these pictures. The process of relaxation and dissociation should take about five minutes, after which participants are ready to develop ideas by means of a new set of pictures.

This group is presented with six to eight pictures. These pictures should be clear and not too abstract or emotional. They must evoke positive feelings. To make the picture concrete to the group, one group member describes what he or she sees in detail. Individual participants then pick out elements of the picture, identify principles related to these elements, and try to draw solutions to the problem under investigation. The ideas are simultaneously written down on a flipchart.

The other group members should consider and elaborate on the ideas that are generated. Communication within the group is, therefore, very important. Both visual confrontation and verbal variation within the group will lead to new ideas.

Confrontation techniques should be applied when one is looking for new solutions under rather stringent conditions (when the problem is a tough nut to crack because there are no obvious answers, and one is happy to find just a few feasible solutions). In the product-innovation process, these methods should be applied during the development process when technical problems
come up or conventional solutions are not satisfactory. The following are examples of these situations:

- Developing a new method to facilitate the process of separation of waste.
- Developing a method of attaching a plug for thin or hollow walls.
- Developing help for truck drivers where the driver has no one to help navigate and must drive backwards to the loading bridge.
- Developing a new kind of snow chain that is simple to install.

Confrontation techniques require a distinct way of thinking aimed at developing new aspects by relating the problem with nonrelated objects. Therefore, some advance training is absolutely necessary. Confrontation techniques are very strong, because when they are applied, the natural creative process is copied and enforced. For example, in a training session, two objects (e.g., a book and a toaster) are chosen. The participants then try to give out ideas about relating these two objects to the problem in any possible way. The moderator at the same time helps the participants by stimulating them to come up with thoughts. In the next step, the individuals attempt to do the same without any help from the moderator. Finally, the group as a whole comes up with even more creative ideas to connect these objects and the problem together.

**Methods of Systematic Variation**

Morphological Tableau. The best-known method of systematic variation is the development of a morphological tableau (see Exhibit 3). There are two major steps in this tableau. First, all different elements, subproblems, or sub-functions of the problem under investigation are identified (i.e., parameters are set). Second, solutions (options) for each parameter are found. These solutions are then tied together to generate an array of overall solutions. Problems are solved by this method in the following way:

1. *Describing, discussing, and formulating the problem.* The problem definition should be formulated in a more broad setting than the actual problem being worked on. An example: The problem should be “city car,” not “concept of a new car of carmakers X and Y suitable for use in the city.”
2. *Collecting and selecting parameters.* Make sure that all the problem’s main parameters are covered. These parameters must be independent from each other. It might be practical to write down each parameter on a card. Pin all cards to a pinboard. These cards form the first column of the morphological tableau.
3. *Searching for alternative options for each parameter.* This can be done by means of brainstorming or brainwriting. Be sure that all options are written on cards.
4. *Forming the morphological tableau.* Pin all options down the line behind the parameters that already form the first column of the tableau on the pinboard.
5. Choosing an optimal combination of options as the best solutions. Each arbitrary combination of alternative options can be an overall solution to the problem being investigated. However, considering all possible solutions is not feasible. For example, a simple morphological tableau with seven parameters and five options for each of the seven parameters contains 78.125 possible solutions. Therefore, it is recommended to concentrate on the (at first sight) most interesting and feasible options. Finally, the best solution can be selected from this chosen set. Special computer programs (e.g., MOSEL) are available to support the overall solution selection.

6. Interpreting and working out the details for the chosen solutions. Creative efforts are especially required in the final step to further develop the best solutions.

An approach to developing good overall solutions out of a morphological tableau systematically is presented in the next section.

In Exhibit 3, options for the first two parameters are first looked at. Then, a meaningful combination between two options, one from each parameter, is sought and the two options are then connected with a line. Afterwards, the next row of options is considered and the best fitting option is added to the line. This connecting line continues until an overall solution (i.e., combination) is reached at the bottom. In Exhibit 3, three of these combinations are shown.
**Sequential Morphological Analysis.** A morphological tableau can become cluttered because the morphological analysis produces an enormous amount of possible solutions. To avoid this, an alternative method, sequential morphological analysis, has been developed by Horst Geschka and Helmut Schlicksupp. This analysis uses the following steps:

1. The morphological tableau is built up as described in the previous section.
2. The parameters are then ranked on the basis of their impact on the final result.
3. The two parameters that have the biggest impact are put in a matrix, in which two to three attractive, new, and strong combinations (core solutions) are to be found. These solutions serve as a basis for the further morphological solution development.
4. The remaining parameters are considered one after the other, in order of ranking. That is, from the options of the third parameter, one option is chosen that fits the core combination best. To this three-element combination, the best-suited option of the fourth parameter is added, and so on. At the end of this procedure, two to three overall solutions to the problem under investigation are available.

The morphological tableau is well-suited for the conceptual phase of new-product development, when the type of new product is already determined but the product concept is still open. The morphological tableau is also helpful for finding new combinations within a given product structure when an innovative change of an existing product is needed or for looking for variants of special application fields.

For a morphological tableau to be successfully applied, the concept under investigation absolutely must be divisible in separate components or functions. As a result, products or systems like machines, appliances, and service packages are especially suitable for using a morphological tableau. Examples of these products or systems are:

- Separated waste treatment;
- Movable hedge clippers;
- Demolition processes;
- Wall-cleaning equipment; and
- Alarm systems for cars.

**Progressive Abstraction.** In progressive abstraction, a given problem is discussed and analyzed, and suggestions for its solutions are put forward. The concept here is to look at a complex problem from different levels of abstraction (broadness). “What really matters?” is the key question asked in every stage, whereupon the problem in reconsidered at a higher level of abstraction and possibly reformulated every time. As the problem is viewed from different angles, different approaches to its solutions are produced. Finally, the most effective level at which the problem could be attacked and solved is identified.
This method is well suited for analysis problems, where a fundamental insight into the problem structure is needed.

**Methods of Systematic Confrontation**

In the discussion of methods of intuitive confrontation, methods that were useful for idea generation were presented. These methods were based on the stimulation of creative thinking by means of unrelated objects or situations presented by words or pictures randomly given to the problem solver. Like methods of intuitive confrontation, methods of systematic confrontation are also based on the stimulation of the idea-generation process by confrontation with different elements. The main difference is that the elements presented are not randomly chosen, but are systematically developed as part of the method.

**Morphological Matrix.** The morphological matrix is a variant of the morphological tableau. The difference between the two is that a morphological matrix has only two parameters, one put on the X axis, and the other on the Y axis. The options that go with each parameter are also put on the corresponding axis. In this way, all single options can be confronted with each other in the fields of the matrix. All important aspects of the problem are systematically brought together and analyzed, and they may stimulate solution ideas, ideally one idea per field of the matrix.

To build up a morphological matrix, these steps should be followed:

1. Determine several independent parameters.
2. Search for options for each parameter and place them in the matrix along the X axis for one parameter and the Y axis for the other. Construct several matrixes with the parameters and try first-idea finding. This test idea generation allows one to judge which matrix (i.e., parameter combination) stimulates the finding of the most original ideas.
3. Work out the most suitable matrix in more detail and check it for completeness.
4. Work through the matrix field by field.
5. Think of solutions for the problem under investigation that result from combining these two options. The combinations of two options have to be interpreted very creatively. Even if a combination does not seem feasible at first sight, the confrontation of both options might lead to new innovative ideas after further effort.

The morphological matrix is a very effective structuring method that can be used to approach any new field to be considered for the first time. It has a fixed place in the innovation-planning process and is being used for structuring search fields for new products. It may also be applied in technical areas, again as a first method of structuring before focusing on specific fields. This matrix has been used in the following areas:
New body care product identification;
Gardening tools;
Applications for a color-recognition device; and
Refrigeration at home.

**COMPUTER SUPPORT FOR CREATIVITY TECHNIQUES**

Although the application of computer software in creative thinking processes might seem inadequate at first sight, the right software can support the working process of generating ideas by helping to store data, providing information and guidance, and allowing for quick modifications of data and calculations. It can also ensure that rules and the sequence of methodical steps are correctly applied. Software as a supportive tool in the idea-generation process can speed up the creative-thinking process by 50 percent.

One of the most comprehensible software presently available that supports creative problem solving is FLUVIUS, which supports the whole problem-solving process and is now on its third generation. FLUVIUS helps the user find a precise problem formulation, generate ideas as possible solutions for the problem under investigation, structure the generated ideas, and screen and evaluate the ideas. The user is completely guided through all steps of the

### Exhibit 4
**The Morphological Matrix: An Example**

<table>
<thead>
<tr>
<th>P₂</th>
<th>food</th>
<th>electrical devices</th>
<th>person</th>
<th>pets</th>
<th>plants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>solid</td>
<td>liquid</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>living room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bedroom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bathroom</td>
<td>X</td>
<td>X</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>kitchen</td>
<td>C</td>
<td>C</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>children's room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>store rooms</td>
<td>I</td>
<td>I</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>car</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>garden</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>balcony</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>picnic</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

P₁ = What could be cooled? (objects)
P₂ = Where could be cooled? (locations)
C = covered
I = interest
X = not possible, not to be considered
problem-solving process. Problem clarification takes place through a series of questions that make the user consider all factors that influence the problem.

With FLUVIUS, idea generation is based on applying several creativity techniques like brainstorming, stimulating word analysis, visual confrontation, and the morphological tableau (module MOSEL). The user is directed through these techniques in order to be stimulated to generate and store ideas.

After this process, the program helps to structure the unsorted list of ideas so that they can have further practical use.

Once the unsorted list of ideas is structured, the ideas can be screened. The user first has to formulate a list of criteria for evaluating the ideas. These criteria are classified with respect to the steps of the selection process: culling, rating, and scoring. With the help of these criteria and various methodological procedures, the ideas can be ranked and the most promising ideas for further development can be selected. Finally, FLUVIUS helps to create a plan of action for the realization of the solutions.

As supportive software in the idea-generation process, FLUVIUS has the following specific benefits:

- The systematic application of the various creativity techniques increases the number of ideas for various kinds of problems.
- By integrating different steps of the idea-generation process in the comprehensive idea-management system, FLUVIUS ensures a fast and complete problem-solving process.
- Each step of the problem-solving process can be saved and printed.
- The problem solver is guided through all steps of the problem-solving process.
- The problem-solving techniques are easy and quick to apply.
- Alternative techniques are offered to the problem solver for the choice of the most suitable techniques for the actual problem.
- The results can be automatically documented for deeper analysis and evaluation of the ideas.

**STRUCTURING AND SCREENING IDEAS**

The application of creativity techniques in solving a problem can result in as many as 30 to 50 ideas. Not every idea is feasible and promising, because no idea is initially rejected during the idea-generation phase. This might cause dissatisfaction among the participants, because they may want to leave the session with a certain result. It is therefore necessary to conduct a rough initial evaluation and screening right after the idea generation. Unrealistic ideas should be rejected in this phase so that only feasible ideas are left.

The initial screening of a list of ideas might be done simply by preference voting for a few ideas, distributing adhesive dots, marking good ideas, or ranking them. For this spontaneous evaluation, it is very helpful to present the ideas in a structured list. For this purpose, the ideas should be grouped into classes under different headings.
The initial screening produces a short list of evaluated ideas that will be assessed and further developed.

After the first screening and structuring of the ideas, a detailed evaluation takes place. This should not be done too mechanically. Some ideas may be merged and reconsidered, others that head in a specific direction may lead to a new idea-generation session, and still others may need more information on markets, laws, or technical feasibility.

The evaluation process has these five characteristics:

1. The number of ideas to be further processed is progressively reduced.
2. The quantity of background information for ideas carried forward must increase steadily.
3. Increasingly stringent and more sophisticated evaluation methods are used, from rough intuitive judgment to the calculation of return on investment (ROI).
4. An increasing number of experts is involved.
5. The ideas are increasingly elaborated (developed from ideas to concepts).

Although several more sophisticated methods of idea evaluation and selection exist, the complexity of these methods might make it difficult for them to be fully taken advantage of in a group setting. Sophisticated software is now available to simplify and speed up the screening process. With these tools, more complicated screening methods can also be applied in group sessions.

CREATIVITY WORKSHOPS
Experience shows that a good preparation and a good selection of participants are major conditions for a successful workshop. The optimal duration for a workshop is one to two days. By working this relatively long time together, the group can unify and really come to grips with the problem under investigation.

Typical characteristics of a creativity workshop are:

- A complex problem;
- A group of eight to fourteen people;
- One moderator;
- One to two problem owners;
- A structured and fixed agenda;
- The use of group techniques;
- The major role of creativity techniques; and
- The visualizing of all information and results.

In the product-development process, 10 to 20 problem-solving cycles are worked through (see Exhibit 5). Each cycle consists of the following steps:

- Definition and specification of the problem;
- A wide and creative search for solutions (i.e., idea generation);
Selection and concentration on one or a few directions for solutions;  
A deepening of the information base; and  
Definition and specification of the task of the following problem-solving cycle.

A creativity workshop typically consists of more than one problem-solving cycle. The result of each problem-solving cycle serves as the basis for the next cycle.

The workshop is scheduled in detail and the techniques that are going to be applied are determined. More than one creativity technique is normally used. The selection of these techniques depends on the problem under investigation, the group, the phase of the product-development process, and the preference of the moderator. The group is a social entity; the moderator needs to lay down rules and an agenda.

A case example of a creativity workshop aimed at finding new product ideas and further developing them into product concepts is given in Exhibit 6.

All results generated in the workshop are recorded by means of a flipchart or simply by sticking the sheets on the wall. This way, all results are constantly available to all group members during the workshop, creating clarity and stimulating motivation and team spirit of the group members. During a workshop, 30 to 40 sheets with results are often produced.
An important side effect of a creativity workshop is a gain in time in the product-development process. For example, work done in a workshop of two days with a group of 12 people may take four to six weeks of effort in total, including preparation and finishing off, when done by an individual. Because the effort needed from all group members is relatively small, easy to foresee, and concentrated in a short period of time, this way of working is more
effective than the conventional way of working together. The product-
innovation process is speeded up, and products can be introduced to the
market quicker. This lead can be the difference in the product launch’s
success.

There are several reasons why creativity workshops cannot be used for all
problems in the product-innovation process. First, only complex problems are
suited for creativity workshops. Next, a lack of information might make it
necessary to continue the conceptual phase of the product-innovation process
outside the workshop with help of additional experts. Third, after a number
of problem cycles have been run through, management may have to be
informed and support the final decision-making around the product-
innovation process.

Recommended Reading
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