Creative Problem Solving for New Product Development

Raymond M. Burynski, Jr., P.E.
Tripod Innovation, LLC

Product Development teams have a unique set of demands placed on their creative efforts. Their directive is to both envision the future and *turn that vision into a practical and functioning reality. Their results are judged not only by a shifting and flexible market place, but also by the timeless and unforgiving laws of nature. These diverse objectives challenge innovators as they strive to generate design concepts that are both imaginative and functional. Brainstorming and related ideation methods are not always the ideal choice in these situations. Creativity methods designed specifically for technical problems can improve performance by generating ideas that are more relevant. While they take time to master, a high level of expertise is not always necessary. Organizations can quickly begin to realize benefits by simply changing their approach to concept generation.*

Introduction:

When searching for new product designs or solutions to difficult problems, many organizations begin by brainstorming. Most readers are familiar with the process. The facilitator encourages the participants to suspend their beliefs and get as many ideas on the table as possible. Various random ideas or arbitrary objects are used to stimulate thought. The underlying assumption is within a large quantity of ideas are a few quality concepts.

There are (at least) three drawbacks to this scenario. Open brainstorms search for ideas without regard to context. But new products are developed to solve existing problems. Organizations do not need just any idea. They need to address the topic at hand. Second, manufactured products follow the predictable laws of nature. Since their behavior is not random or arbitrary, why search for solutions in such a manner? Lastly, such sessions hope to avoid psychological inertia by asking participants to suspend all judgment. In reality, most people find it difficult to set their knowledge aside.

Systematic ideation methods use the designer's skills and knowledge to extract creative solutions. These techniques are quite productive, as they generate relevant concepts, attract ideas from a wider array of solvers, and mesh cleanly with corporate workflow.

Generating creative ideas with analytical and knowledge driven processes is not a new concept. However, the techniques are underutilized. Steep learning curves, impatience, and a simple lack of awareness are among the culprits. This article explains how organizations can quickly begin using structured ideation methods and outlines the benefits to New Product Development teams.

Methodology:

For an accelerated process, structured ideation can be conducted in three phases. Feel free to customize and scale each phase appropriately. However, it is important that phases are not skipped.

Before proceeding to actual project work, reserve a place to record ideas as they arrive. Structured ideation is very thought provoking, and takes discipline to complete thoroughly. Too often teams pursue good ideas in haste, while better ones remain uncovered. Avoid the temptation to short circuit this process by following the first promising concept. Find a place to capture these ideas for eventual consideration.

Phase 1: Research

The research phase provides clarity in the form of a concise problem statement. Sessions go off track when targets are poorly defined or obstacles remain hidden. Rather than random wandering, organizations can utilize their knowledge to develop a roadmap. In fact, a great way to find solutions is to locate the obstacles and deal with them directly.

Begin with the major stakeholders. Understand their expectations and constraints. Find out how they define success. Next, seek out diverse and opposing viewpoints, asking similar questions. Sales, engineering, manufacturing and customers are excellent sources. Spend as much time listening and observing as possible. Identify all physical mechanisms, down to a reasonable level of

understanding. The familiar method of asking 'why?' several times is quite useful.

Recognizing constraints (or obstacles) is an important part of the research phase. Determine what stated and implied limitations are in place, and why they exist. Recurring themes among constraints will surface. Recognize what types of constraints exist, as this will suggest methods for addressing them. Constraint types include:

- *Institutional:* The hubs must be made from cast steel since the organization owns a steel foundry.
- *Perception:* Customers consider instant coffee inferior to freshly brewed.
- *Cost*: No one will pay over $75 for an electric can opener.
- *Physical*: The play set must safely support 100 lbs.
- *Legal*: A competitor's patent prevents using any type of ultrasonic sensor for vehicle parking assist.

Scope defines the boundaries of acceptable (or expected) solutions in the most general terms possible. Informally, the scope answers, "How far do you want to go with this?" For example, if asked to design a multi-stage filtration coffee brewer for improved taste, probe deeper. Is improved taste the real goal? Has testing already proven multi-stage filtration, and the goal is to design a system for consumer use? Brainstorm sessions go bad when there are inappropriate boundaries (too broad OR too narrow). There will always be concepts beyond the current scope (pre-brewed liquid coffee, caffeinated gum, etc.) It is important to explore those areas as well, *at the appropriate time*. Continually revisiting these questions is counterproductive. Decide that some things are fixed and move on.

Reflect on the research and formulate a decent problem statement. The bullet points should include a statement of the goals, brief history of the situation, the scope of desired concepts, a list of constraints and why they exist, and a description of known physical mechanisms. When writing, consider removing language that implies a solution. Do not "develop a tool to torque a bolt". Instead, find a way to "sufficiently tighten a fastener", or even "reliably join two components". The final solution might not require torque or even a bolt to achieve its goals.

Lastly, conclude the research where it began. Review this problem statement with the stakeholders, and try to resolve any disagreements before moving forward.

Phase 2: Analysis

The purpose of the Analysis stage is to create a comprehensive list of approaches, or solution categories. The category list should cover every conceivable type of solution. The categories themselves should be broad enough to accept multiple concepts, yet narrow enough to keep the group focused. If all of that sounds difficult, that's only because it is! Developing good category lists takes practice and experience. Below are some tips and tools to facilitate the process.

Start Simple: List all elements in the system. Examine how they are related. Then see what could be changed, adapted, or avoided. For example, some people have difficulty with paperbacks due to the small print. Paths for a solution could include:

- Modify the book to suit the eyes (ex. large print editions)
- Modify the eyes to suit the book (ex. laser surgery)
- Introduce an adaptor between the book and eyes (ex. eyeglasses, magnifying glass)
- Sidestep the issue (ex. books on tape, watch the movie instead)

Review Constraints: List all known barriers and their justifications. A way around or through these obstacles is called a solution. As an example, wet floor scrubbing machines must be large enough to accommodate two reservoirs, one for clean and one for dirty solution. The design of an autonomous robotic unit needed to be much smaller for space and power considerations. When attacking the reservoir size constraint, designers recognized the machine does not need to hold both clean and dirty water simultaneously. They replaced the hard plastic reservoirs with expandable bladders that shrink and grow as needed

Find Analogies: Just as mathematicians transform equations into known, solvable forms, designers can draw parallels from their current problem to one previously solved. In a classic example, water flowing through a pipe explains electricity flowing through wires. The analogy can be extended to

heat, light, automobiles, and information, which exhibit similar behavior. There are driving pressures, restrictions, preferred routes, etc. Even if imperfect, look to map the current problem onto one with known solutions.

Research Alternate Industries: Designers in another industry may have already solved a problem similar to yours. For example, a revolutionary room fan does not have large rotating blades. Without this feature, other means are needed to generate flow. The solution was an air amplifier. As the name implies, air amplifiers generate a large airflow from a small one. Other industries have been using air amplifiers long before the bladeless fan entered the consumer market. Consider adding categories to explore how the current issue relates to technology in other industries.

Employ TRIZ: The Russian Theory of Inventive Problem Solving is an extensive suite of problem solving techniques. It is impossible to realize the full power of TRIZ without experience and training. For a short but woefully incomplete introduction, investigate the Separation Principles and the Contradiction Matrix. They are accessible to most problem solvers and make fantastic aids for developing solution categories.

Regardless of how they are developed, not every solution category may produce a viable solution. The point is selected solution paths are specific to the given problem, and could yield useful results. That is distinctly different from the *arbitrary* application of well-known problem solving tools (such as substitute, combine, adapt, etc.) It is also different from problem solving methods that attempt to forge solutions by considering random words or unrelated objects.

Phase 3: Ideation

Gather a group and find suitable blocks of time. Begin by stating (not debating) the background and goals. Remember, the stakeholders have all already agreed to the problem statement. Explain that brainstorming will be done within a series of categories. Keep an open mind, but stay on topic. Ask each member to reserve space to capture off-topic ideas without interrupting the session flow.

Often the solution category descriptions are sufficient to generate worthwhile ideas. Other times, provoking the group with a thoughtful example or analogy is helpful. If visual or physical aids are available, be sure to use them. Move on to the next category when the time seems right, especially if a particular category is not productive. Do not forget to schedule in breaks. Ideation is mentally demanding. Strict time limits are unnecessary, and possibly detrimental. But generally speaking, anything longer than two hours without a significant break, or four hours per day, is likely to be unproductive. A fresh start after lunch or a good night's rest will provide more useful results than trying to grind through one more solution category.

As a final step, ask the group for any other ideas after all the categories have been exhausted. Do they have ideas that did not fit any categories? If valid concepts remain, understand why to help refine category development skills.

Benefits of Structured Ideation:

To some, imposing structure on the creative process seems counterintuitive. There are a number of benefits to this approach, especially for those working in corporate environments.

Active Process: Structured ideation is not a passive activity, where one sits around hoping inspiration for strike. There are concrete steps to follow in the pursuit of a new product design. If the initial efforts are unproductive, solvers can readily modify a structured process by varying assumptions.

Solver Morale: While a spoken rule of a brainstorm session is 'all ideas are welcome', the reality is otherwise. Why pretend? By operating within the safety of a requested solution category, solvers can be comfortable their more obscure ideas are still welcome.

Inclusiveness: Creativity is for everyone! Many people mistakenly believe they lack the potential for great ideas because they never learned any creativity techniques. By having a process to follow, analytical thinkers can use their skills to develop creative solutions.

Customization: Many generic tools exist to stimulate creative thought. Each Solution Category is a custom designed problem-solving tool, specific for an individual problem.

Constraint Review: Sometimes the laws of physics maintain the status quo. Other times it is simply a matter of institutional inertia. By seeking out and

questioning constraints, it becomes easy to identify which are self imposed (*hint: most constraints* <u>are</u> *self imposed*!). They may remain, but after a thoughtful decision to do so.

Continuity: When is an open brainstorm session over? After one hour? When ideas stop coming? Complex, real world problems can take time to solve. Solution categories allow solvers to break from ideation at logical points so they can attend to other tasks.

Delegation: Organization of solution paths is another free benefit of this approach. Proposed solutions to a valve actuation problem could be hydraulic, mechanical, electrical, etc. By assigning these methods to multiple individuals, teams can explore pathways in an efficient manner.

Final Thoughts:

The design of many new products is a problem solving exercise. Systematic problem solving tools provide benefits unobtainable with other methods. Many NPD professionals are also talented analytical thinkers. While they may not all be ideation experts, this short introduction will help them quickly see the advantages of these techniques, and add more tools to their creative toolbox.

Further Reading:

There are plenty of excellent resources on creativity and problem solving techniques. These books are especially well suited for NPD professionals and anyone else interested in the practical side of creative problem solving.

Why Not? Barry J. Nalebluff & Ian Ayres, Harvard University Press, 2007.
Thinkertoys. Michael Michalko, Ten Speed Press, 2006.
The Imagineering Workout. Peggy Van Pelt, Disney Enterprises, 2005.
Systematic Innovation: An Introduction to TRIZ. John Terninko, Alla Zusman, & Boris Zlotin, St. Lucie Press, 1998.

Raymond M. Burynski, Jr. is the founder of Tripod Innovation, LLC. He can be reached at 315-735-9807 or ray@tripodinnovation.com.