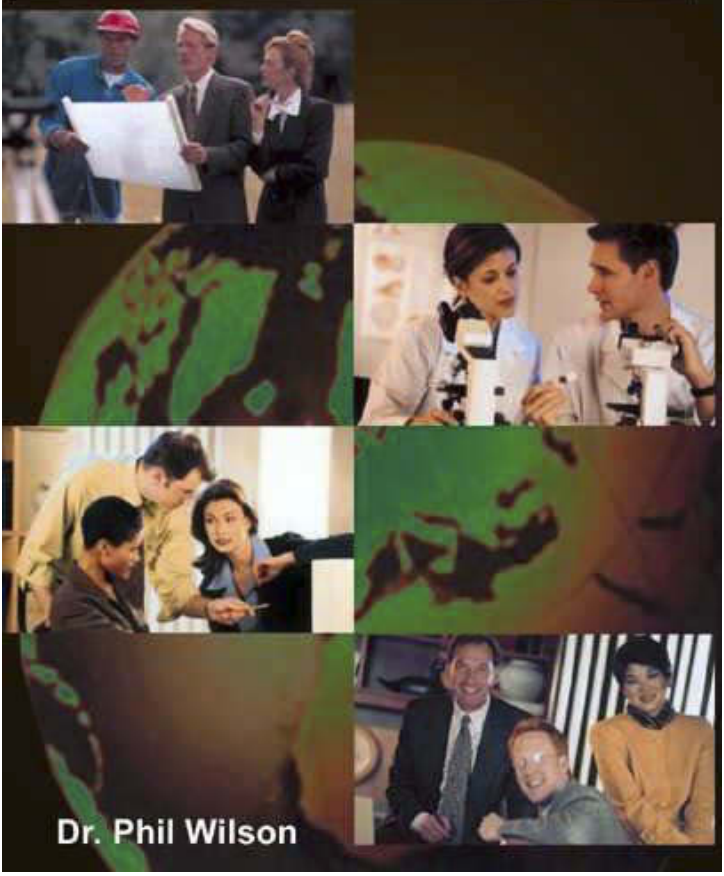
INSPIRED INNOVATIONS

A GUIDE TO HIGHLY EFFICIENT NEW PRODUCT DEVELOPMENT



Dr. Phil Wilson

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A Guide to Highly Efficient New Product Development

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Inspired Innovations

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INSPIRED INNOVATIONS

A Guide to Highly Efficient New Product Development

BY

DR. PHIL WILSON

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Dedication

To my parents, to my wife and children, to Jack Dyer who insisted that I get this published, and to many others who have helped me find my path.

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Foreword

In the 70s, top line growth was one of the leading corporate mantras. This placed a good deal of emphasis on creativity and innovation. The emergence of an emphasis on bottom line growth during the 80s brought with it corporate downsizing, re-engineering and other corporate approaches to "saving themselves rich." This resulted in an emphasis on stewardship of current products. This led to a serious decline in corporate skills and experience at applying techniques for enhancing creativity & innovation. Today, with the re-emergence of top line growth as a recognized requirement for success, the need for an emphasis on creativity and innovation is once again receiving "it's due."

At present, relatively few firms are applying sufficient money, manpower and or motivation for the establishment of integrated, enterprise-wide, new product or new business development processes. They lack the required techniques for enhancing creativity & innovation, thus leaving much of such input to luck. They may employ various stage-gate systems, but relegate their use to a departmentalized approach. There exists only scant linkage of product or service development actions to strategy. More importantly, few organizations have insured that its personnel are trained or equipped, much less skilled, in the use and application of techniques and approaches for creativity & innovation. Again, a reliance on luck!

Now, just in time, Phil Wilson's Inspired Innovations, presents a very practical, user friendly, uncomplicated, brief, step-by-step guide for organizing, planning and actualizing new product developments in any size or type of business. His primer on inspired innovations comes from reality and years of hands-on experience. It is based on very successful decades of leading efforts for creating and commercializing new products at such firms as General Electric, Textron and Magna International.

Phil's own courage, tolerance of mistakes and emphasis on learning from them, coupled with a steadfast persistence throughout his career underpinned his many successes. These life-learned lessons serve as the foundation upon which this brief book is based and appear as examples of the principals, ingredients and techniques for achieving inspired innovations.

Read it today and you'll be energetically applying its teachings and techniques tomorrow!

Jack Dyer
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Jack is a long-time consultant to Fortune 500 clients. He has worked with several consulting groups and is now President of his own firm.

Preface

I had a great chemistry teacher in high school, Jim Lester, who taught me the fundamentals. One of the most important lessons I learned, however, was not to choose a lab partner just because she is beautiful! This became clear after my partner heated a sealed flask of volatile liquid over a Bunsen burner. Such incidents tend to focus one's thought processes. Life is like that; it is often the unexpected occurrences or circumstances that end up shaping our destiny.

I remember wondering when I was in high school what I would do with my life. I was fascinated by chemistry, and by creating complex entities from atoms and small molecules. I liked the old DuPont slogan "Better Living Through Chemistry," and I was drawn to the idea of using chemistry to make useful things. I also realized that if I wanted to make any money, I would need to enter the field of applied chemistry as a chemical engineer.

At Ohio University, I met Cindy, and my life changed forever. She was a poor farmer's daughter, working at one of the dining halls and as a dorm receptionist. One year later we were married, she was pregnant, and I had new responsibilities and a new perspective. At Ohio, as a sophomore in chemical engineering, I discovered what would become my life's work: the wonderful world of polymers—long, complex molecules with the potential to change the world.

I received my Ph.D. in Macromolecular Science from Case Western Reserve University. While I was at

Case, Cindy, our daughter Barbara, and I moved to Warrensville Heights, Ohio, where I became an auxiliary police officer and spent many nights as the second man in a patrol car. I learned from dedicated officers like Russ Folisi how to remain calm, and how to work with people in stressful and dangerous situations. Like science, much police work is routine and often boring, but must be done properly and thoroughly.

Many people in different ways have provided the insights, opportunities, and little nudges that helped me to define the path of my life and career—people like my father, Fred Wilson, who is one of the finest people I have ever known, Professor John Collier at Ohio University, and Dr. Eric Baer and Dr. Robert Simha at Case Western. Special thanks to Fred Buggie at Strategic Innovations, Inc. for some of the original concepts that I have built upon in my work.

I learned so many things from these people and many others, but it was an offhand remark from Dr. Ed Bostick, for whom I worked at GE Plastics, that transformed my professional life.

You need to know that I am 6'3" and about three hundred pounds. People used to stop me in the Chicago airport seeking my autograph; they mistook me for the great football player, Dick Butkus. It is an understatement to say that I have a very high energy level. Ed Bostick loved the results I was getting and knew that when I encountered an obstacle, I would climb it, go around it, dig under it, or bust right through it. One day he said to me, "Wilson, you attack problems with a broadsword and you

get great results, but I wonder what you might achieve if you used a rapier instead."

This provocative comment led me to alter my approach and to seek out, develop, and apply combinations of techniques to streamline my innovation process. I share the best of these techniques with you in the following pages. This volume is not a deep, scholarly text. It is a small, practical guide for you to use and share with others.

Many previous attendees of the seminar on which this book is based have claimed it to be the most useful day they have spent in their entire educational experience.

It is not how much a person knows that makes that person valuable. It is how many people benefit from that knowledge that leads to value.

Dr. Phillip S. Wilson
April 10, 2000
www.inspiredinnovations.org

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Chapter One

Getting Started

What follows is my philosophy for finding innovative solutions to problems, some warnings and guidelines, and some personal examples and observations. As simple as these ideas may seem, if you implement them, you will amaze your colleagues and managers. Remember, you do not have to be a genius to be successful. You can just appear to be one!

The first few pages of this book may be all that you need to solve many of the simple problems you will face in your career, and to help you earn a reputation as a creative problem solver.

Creativity

An understanding of creativity is critical to forging an approach to innovation. What is the essence of creativity? The three definitions that I like best are:

- "The ability to produce through the application of imaginative skill."
- "Challenging the status quo."
- "The destruction of existing patterns and the evolution of new patterns."

Any of these definitions may work for you. Posing the right question, or defining a problem correctly, is often the simple breakthrough that leads to a creative solution.

What is the most powerful tool for creativity? A strong and vivid imagination opens the door to creative solutions. Some of you may think that you have been excluded from the creative process because you do not have a strong imagination. This is not so. People are not born with creative genius; they have developed it and nurtured it in themselves.

It is only by challenging the current state of commonly accepted knowledge and destroying existing patterns of thought, that new solutions can be developed. You can nurture your own imaginative skills by using the techniques and advice presented here.

Learning

A wide and all-embracing vision of learning is an integral element of innovation.

Learning allows us to recognize and comprehend existing patterns. A comprehensive understanding of any problem is necessary to formulate a creative solution.

Formal education is only one facet of the learning process. Education is really the process of teaching people how to learn. Observation, information gathering, and listening are critical components. Reading, writing, speech, mathematics, and computers are all tools to give and acquire knowledge.

It is impossible to learn without making mistakes; wisdom comes from remembering lessons taught by mistakes.

One definition of death is ceasing to learn. This is certainly the case in one's professional career. Stop learning and your career is dead.

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Chapter Two

Key Ingredients Of The Innovation Process

There are many factors that make the innovation process successful. Four that I consider essential are necessity, courage, optimism, and persistence.

Necessity

Nothing focuses the mind like the lack of an easy alternative. Find a solution or else! "Else" might be the prospect of personal ruin, corporate bankruptcy or imminent death. Adversity, anxiety, and fear can be great motivators. So can the challenge of a problem, personal ambition, and greed. We all know people who thrive under pressure. They do their best work when facing a deadline or responding to adversity. How often do sports teams play their very best against their toughest opponents?

It is a matter of focusing creative energies. For this reason many managers often create false deadlines to help focus the energy of employees. A variation on this can be used with the most precious group of employees a company

can have: those for whom the greatest challenge is to be told that something can't be done. Get them fired up with an "impossible" challenge and they will focus their creative talents with the intensity of a laser beam. A few months later they will march into your office and announce a solution. An expert manager's job is to admit that he or she was wrong, praise them publicly, and announce that although the group has obviously solved a very difficult problem, there is another that is *clearly* impossible! They will absorb the praise like sunlight and dive into the next challenge with recharged batteries.

Positive, public praise and quiet, private discussion of problems—these are worth more to most employees than a ten-percent salary increase. The example these "overachievers" set inspires other employees and raises performance levels.

Courage

It takes courage to find innovative solutions to problems. It takes courage to fight the status quo. It takes courage to try to shake things up. Change is scary to many, but you must embrace it to be successful.

Change will happen. You can resist it, tolerate it, take advantage of it, or embrace it and help to lead it. Keep in mind the first-mover advantages that can come from the courage to innovate: The company that introduces a successful new product generally gains about 70 percent of the total economic rewards a product will ever generate.

Real heroes are those who accept and conquer the challenge of change.

Optimism

It must be hard for a pessimist to get out of bed in the morning. How could someone with a negative attitude ever invent anything? Be positive, optimistic and full of good cheer! You must believe that the ability to succeed is within you!

Will you solve every problem you tackle? Of course not. But you will solve many. With a positive attitude, what you learn from failures will often prove to be the most helpful to you in the future.

Persistence

What are the odds that the first thing you try will work perfectly? Slim. Persistence is the duct tape of the development process. It holds things together until you can find the answers. Be stubborn!

The "eureka experience" often occurs as a result of knowledge gained trying to solve an earlier problem. This enables you to recognize the potential benefits of an unexpected result. A residue found in a pressurized fluorocarbon tank became known as DuPont's Teflon.™ This is the wonderful material used to coat non-stick cookware. An attempt to make a water-soluble polymer created nothing but a yellow, semi-transparent glob. A few

weeks later, a frustrated scientist slammed this glob against a granite countertop. The granite fractured, and General Electric's (GE) Lexan™ polycarbonate was invented. This material is used in safety gear, eliminates dangerous glass bottles and pitchers, and improves passenger safety in car crashes.

Innovation Case Study: Plastics! In *MY* Engine?

In 1979, I was a Project Manager at the General Electric (GE) Plastics Applications Center (PAC). PAC was chartered to introduce plastics technologies into GE businesses to offer new or improved products, improve performance, or reduce costs.

I was convinced that there were innovative applications for molded plastics in jet engines. I thought there would be significant opportunities for weight and cost savings in areas that never became too hot or were not under continuous stress.

It is putting it mildly to say that the materials engineers at the GE Aircraft Engine Business Group (AEBG) were skeptical about my ideas. They practically rolled on the floor laughing at the idea of plastics in their engines. They embarrassed me and they pissed me off. I was determined to show these corroded old characters that they were wrong. I made a list of the potential advantages plastics might offer, but at that time cost and weight savings were the only two that appeared to be significant.

I attacked the problem by going through AEBG's Components Purchasing group. I knew that their performance was partially measured by the cost savings they helped deliver. I prepared sample calculations of the potential cost and weight savings of different plastic parts. I made calls until I found an individual with an open mind who agreed to meet with me. To help my ideas gain acceptance, I proposed using injection-molded, fiber-reinforced engineering thermoplastics that I presented as "thermoplastic composites." These sounded similar to the highly effective but expensive glass and graphite thermoset composites already being used in some aircraft and engine applications.

I selected the CF6 family of jet engines, AEBG's largest engines, where the distance from my plastic parts to hot engine areas would be the greatest. I purposely chose the safest possible applications. In aircraft terminology, an "event" is when an aircraft falls from the sky. I never wanted to be associated with an event. I then prepared detailed estimates of the piece price and weight for each of the target parts.

At the time, all of these parts were produced from aircraft-grade aluminum or titanium. The one-piece, injection molded parts that I proposed yielded a reduction of at least 30 percent in weight and 80 percent in cost. Because of the huge potential savings, Materials Engineering was required to provide written documentation of performance reasons that would exclude the use of my thermoplastic composites. They couldn't.

PAC ended up doing over $1 million per year in development activity for AEBG. I completed 87 different

applications that saved AEBG over 47 pounds of weight and $50,000 per engine. At that time a pound of weight was worth $400 per year in fuel savings. From initial skepticism and resistance, Materials Engineering eventually became a strong ally. We moved into much more challenging applications with higher performance materials. I often found myself having to restrain enthusiastic engineers who wanted to try applications I felt were not suited for thermoplastics.

The key ingredients of innovation were all absolutely necessary to achieve my success. My original necessity came from my frustration over that first meeting. Courage helped me overcome obstacles and challenge the status quo. Optimism fueled my belief that there were opportunities to be discovered. Persistence led me to try and retry different approaches.

Fortunately, I have never received a call about an event involving my parts.

Chapter Three

The Development Process: Don't Shoot Too Soon!

Build a Target

One of the biggest problems people have in the development process comes from the lack of proper preparation.

First, make sure you truly understand the problem. Talk (and listen!) to everyone involved. You need the perspective that comes from looking at a problem in different ways. It is amazing how many times simply asking the people involved results in a quick solution. Who really knows more about manufacturing lines than production workers and line supervisors? Have a problem? Head straight for the trenches! People doing the work—whether they're in the factory, on a sales team, or in the accounting department—often already know the answer.

People who don't do this often shut themselves off from the best sources of knowledge, and end up spending more time and resources. Many employees are not comfortable making suggestions to superiors and wait for

someone to ask them their opinion. Others believe that management doesn't care what they think. Sadly, this can be true.

My success in developing new material formulations for GE Plastics came from this approach. To understand production, I worked each of the plant shifts. I followed material streams through production stages. I spent time with the shift technicians to get to know them, to understand what they did, and to listen to the problems they experienced.

When I developed new formulations that were ready for trials, I met with the operation and shift leads. I made sure that they knew what I was trying to achieve and the market that was targeted. I gave them an estimate of the potential value to the company. I discussed the production difficulties they might encounter. They also had my home phone number and knew to call me no matter what time my trial came up on the production schedule. I wanted to be there to observe. (The first time you make this offer, your product *will* run in the middle of the night. Once word gets around that you showed up cheerfully, your trials will run at more reasonable times.)

In manufacturing, it is often the procedures and problems you can observe at 3 a.m. that lead to mysterious product inconsistencies detected on the first shift. Things are different on the third shift. Employees may take shortcuts. They may have less experience, be recent hires, and they may be tired. They may not fully understand the rationale behind procedures, or the effects that changes may cause. However, this does not mean that the product

from the third shift is of lower quality. Often it is the third shift that finds the shortcuts and innovations that save money and improve the product. They are not bothered by the distractions of wandering management or plant visitors. They can concentrate on the processes and equipment and are less inhibited when they want to experiment. They are also often motivated to do well so that they can move to another shift as soon as possible.

Many consultants make a very good living, charging large sums of money to talk to your employees and colleagues and then issue summary reports. In my experience, most consultants don't add value. It is much more efficient and can be much more fun to get to know the people who really make your company work and to figure out the problem internally.

Get a Scope

Once you have a better understanding of the problem, you can plan your approach and identify the most useful development tools.

First, get a perspective on the size and the type of problem you are going to attack. Is it a new problem, or is it one that has resisted many prior solution attempts? Is it a problem that you can solve with your own knowledge, or will a team be needed? What technical skills or experiences are likely to be useful in solving this problem?

Next, determine the process you are going to use to attack the problem. Always try the simplest, fastest, and least expensive method available. Go to complex methods

or costly outside resources only if these easier methods don't work.

Buy Some Bullets

Once you understand the true nature of the problem and you have identified both the technical skills you need and the approach you are going to use, you can organize the effort.

Review with your supervisor your understanding of the problem, your technical plan, and the people you would like to involve. Your supervisor will be able to help you select a team and facilitate your work. This will also enable him or her to take partial credit for success. (This is important! One of the best ways to get promoted is to get your boss promoted; one of the easiest ways to get fired is to not keep your boss informed.)

If you are going to use a team, it will be necessary to present information you have gathered in a form that can be communicated efficiently to team members.

Let Fly!

You have defined the problem. You have identified the tools and planned your attack. You have gathered and prepared a team. You have involved your supervisor. You are ready!

Chapter Four

Working To Win

Executing these ideas and strategies in the marketplace requires dedicated teamwork and a mind that is open to new possibilities.

Seek Lots of Possibilities

Don't look for *the* answer. Instead, seek many potential solutions. You can then assess the relative merits of each, and feel comfortable that the one you select will be sustainable. This is critical if you are going to maintain a competitive advantage. If you don't consider enough ideas, you are likely to miss the best solution.

If you waste your resources pursuing an "ideal" solution that is not currently achievable, your competition can surge ahead with an "acceptable" solution. There will always be limited development resources; those who most effectively utilize these resources will win.

Be a Team Player!

It is nearly impossible for one person to be exposed to every aspect of a scientific field. You must work with others to be successful. Being a team player almost always results in a better solution.

Thirty-odd years of marriage and raising three kids have helped to convince me that it is impossible to know *everything* about *anything*.

Most scientists and engineers never get a single patent during their careers. Thomas Edison had over one thousand patents. He was a try-and-try-again experimentalist, inventing via the mass-production, assembly-line methods of his friend, Henry Ford. He could not survive with these methods in today's fast-paced development environment.

The best and fastest way to get solutions is to put a creative team together. Of my first thirty-five patents, I am the sole inventor on only two. It costs you nothing to give people the opportunity to share in the successes. I prefer to plant the seeds of ideas in those working for me, and watch those seeds become fruitful for them, too.

Chapter Five

Problem Solving

Verbalize the Problem

To solve a problem, you must first thoroughly understand it and be able to communicate it to others. Organizing your thoughts often enables you to visualize the problem more clearly.

Create a Multidisciplinary Team

The best way to solve complex problems is to bring together a team of 6 to 12 open-minded people for a two-day innovation session. They should have a variety of educational, technical, and business backgrounds and minimal knowledge of the specific problem.

The team may include people from development, plant support, design, marketing, sales, production, industrial engineering, technical support, purchasing, safety, or human resources. Pick from groups that are most

relevant to the problem, and find individuals that are most interested.

If a person with an ideal background is not interested and cheerfully willing, pick someone else. This should be a stimulating, invigorating, fun process. Bad attitudes destroy team spirit and the openness needed for success.

Brainstorm the Problem

Bring your team together in a quiet place that is free of distractions, and present the problem in concise terms. Explain the issues and the current manufacturing processes, customer requirements, consumer needs, etc., related to the problem.

Product samples, process-flow diagrams or appropriate audio-visual aids may be useful. You may answer any questions concerning the current status, but do not discuss previous attempts to solve the problem.

This should take no more than an hour. If you cannot define the problem and answer the team's questions in that time, you are insufficiently prepared to proceed. Rehearse your opening remarks before the meeting.

To be most effective, start the session first thing in the morning. Avoid interruptions. To achieve results, participants must immerse themselves completely in the problem.

Record All Ideas

Do not trust your memory. It is best to record the ideas both on large sheets of paper (so that they remain visible to the team and can stimulate new ideas) and directly into a laptop computer. You will need one or two people to assist you.

Identify all ideas with the initials of the person involved. This helps for clarification questions later and to define potential inventors. I recommend putting a large name placard in front of each participant and videotaping the session.

A U-shaped seating arrangement with the facilitator and any product samples in the middle works best. This way people can see each other and communicate freely as they start to build on the ideas of others or ask questions.

No discussion of the merits of ideas is permitted. There are no bad ideas. Often the most off-the-wall ideas are the ones that stimulate people the most.

Typically you will be able to generate 120 – 180 ideas in a few hours. Keep going until each person has no more to add or until no one is eager to contribute to the list. Break for lunch.

Encourage team members to discuss the problem, but not to share knowledge of past attempts at solution.

After the break, ask each person for new ideas or additions to earlier ideas. Often, a key new idea will pop up.

During the break, print the list of ideas. Cut the list into strips with one idea per strip. Do the same with new ideas generated after the break.

Idea Classification

Place the idea strips on a table that the team can easily gather around. Instruct the team to silently sort the ideas into similar groups.

This is a period of silent contemplation. Silence may be broken only by an occasional clarifying question to the originator of an idea.

The strips will quickly end up in about ten groups with a few strips that don't seem to fit. Strips will be moved often by different people, but a silent consensus will usually be reached within an hour.

Read the ideas in each group to the team and lead a discussion on why each idea is in that group and whether that is most appropriate. Next, lead a discussion on the ideas not in a group to see if a consensus can be reached about where each belongs.

Some of the wilder ideas will be discarded at this point, but be careful! Do not discard an idea just because it does not fit into one of the groups. If the consensus is that it might be a useful idea, it can be carried forward to the idea-assessment stage on its own.

The team should define the fundamental concept(s) in each group of ideas and establish a name for that concept. When this is done, end for the day, planning to

reassemble the next morning to conduct an idea-assessment session.

Ask the team to think about the problem that evening and just before they go to sleep to permit their minds to work on a solution. They should be prepared to ask questions and to offer new ideas at the beginning of the next day's session.

Idea Analysis: Using the Pugh Process

The second day of the innovation session is devoted to assessing ideas gathered the previous day.

The objective is to identify the potential solutions with the greatest benefits and likelihood of success, while at the same time assessing the risks and likelihood of failure. To do this I recommend Pugh analysis—a simple, effective, analytic tool pioneered by Professor Stuart Pugh of Loughborough University of Technology in Great Britain. A Pugh analysis will almost always lead to a better solution than using the brainstorming process alone.

Make a list of every significant item or requirement related to the problem. For a product, this would include items such as cycle time, capital investment, energy requirements, safety or environmental issues, labor content, tooling costs, product performance requirements, profit margin potential, and marketing costs.

Review this list of requirements with the team and add or delete items before starting the assessment.

Make columns for each of these requirements, and then make rows for each of the idea groups from the previous day. Place the problem under investigation in the first row. This row serves as the datum to which all ideas will be referenced. If you are considering the development of a product that is new to your company, you may need to do a benchmarking study of competitive products to determine the appropriate datum.

For each requirement, the team rates each of the new ideas versus the datum. By consensus, the team assigns relative ratings that range from ++ for an idea that is much better than the datum, to + for one somewhat better, 0 for about the same, - for slightly worse and to - - for those much worse.

As the evaluation proceeds, it will become clear what aspects of the various ideas offer advantages and where there are concerns. This will lead to the development of hybrid new ideas that combine the positive aspects of earlier suggestions and avoid the negatives. Add rows for these hybrid ideas and include them in the assessment. Be sure that you record the initials of who conceived them because they are likely to be the ideas you will want to patent.

For each idea you tally the number of +s, the number of –s and the net total. The ideas with the most positives and the least negatives merit further review. It is very important to look carefully at the negatives of each of the best ideas. An idea may receive a negative or reduced rating just because the team does not have a good understanding of it at this stage.

The beauty of Pugh analysis is that it exposes potential critical flaws from the outset. Technical people and managers alike can get so excited about potential benefits and payouts that they launch projects with critical flaws. It is very easy to waste millions of dollars and many years of effort. I call this the "love is blind" trap. It is easy to fall into.

Watch out for a critical unknown in an idea that otherwise appears terrific. Commit only those resources necessary to answer that specific question. Once you are successful in answering the critical question, you can feel confident in allocating more resources. There may be more than one critical question or unknown. Do not proceed until they are all resolved.

In 1987, our development group used Pugh analysis to create deployment systems for vehicle passenger-side airbags. We were contending with multiple design and aesthetic issues: visual appeal, fit, finish, performance, materials requirements, color, texture, and ultraviolet and thermal exposure. Using Pugh analysis, we assessed positive and negative aspects of many ideas, and quickly identified two concepts—integral and invisible airbag doors—as superior. These have subsequently become the industry standard.

Some judge you are doing well if 10 percent of development projects are successful. I believe that this number is totally unacceptable. By using these techniques, my groups have been successful on closer to 70 percent of projects.

The Pugh Advantage

Pugh analysis is a dynamic, flexible analytical model that can be used to achieve significant competitive advantage.

The process is extremely flexible, and can be easily tailored to take into account specific business needs such as a lack of skilled labor, space constraints, or tight capital-spending requirements.

Variables specific to particular industries, businesses or customers can also be factored in and given multipliers depending upon their significance. In this way, the process can help achieve customization to meet specific customer or business needs. For example, one customer may place greater importance on certain product features; this difference can sometimes be exploited to obtain higher profit margins.

If energy or transportation costs vary significantly at production sites, Pugh analysis can help optimize processes and systems to increase profit margins.

Once the Pugh analysis has been done, results can easily be reassessed if business conditions change. Additional criteria not considered in the original session can quickly be added. It is advisable to return to the analysis regularly as the project proceeds. Each piece of new information can be used to change ratings that were originally influenced by a lack of knowledge. Reviewing the original analysis may also lead you to consider further improvements. However, if reviews are leading you to a

major change, reconvene the original team to obtain consensus on any proposed project changes.

Finally, the Pugh analysis serves as a historical document, recording the genesis of a project or idea and documenting the decision processes that were involved. With this as a resource, future employees can quickly become familiar with project histories.

Summary:
Problem-Solving Methods

1. The more ideas you consider, the better chance you'll have of finding a superior and lasting solution.

2. A multidisciplinary team gives different ways of looking at the problem. Often, viewing the problem from a different perspective leads to a truly creative solution.

3. An objective method to assess ideas must be used. Otherwise, costly and even career-ending failures caused by flawed concepts can result.

4. Early recognition of a critical flaw or unknown that must be resolved is crucial to success.

5. The use of a proper assessment technique can result in hybrid concepts that are far superior to original ideas.

6. Being a team player has major benefits and will almost always result in a better solution.

7. A simple, two-day effort by a well-organized team is a very efficient process to optimize allocation of limited development resources. (It can also be fun and extremely educational.)

When All Else Fails…

To attack entrenched problems with long histories, I set up innovation sessions with students that are a variation on the process described above.

My goal is to create a team that has very limited information, that does not know what is impossible, and that has no idea of failed past attempts to solve the problem.

To do this, I recruit seniors and graduate students from a local university. I conduct telephone interviews and then select three or four students each from disciplines relevant to the problem. I plan a weekend session, pay them with a crisp $100 bill, and feed them.

Follow the regular, two-day, innovation session format described above. Expect students to propose in the first two hours nearly every approach that has already been

tried. They will not be looking at the problem with the blinders that come from familiarity, and may indeed come up with a unique solution. They may also see something new that leads to a totally different approach or that makes feasible an earlier attempt that failed. Their questions could lead you to consider the problem from a perspective that lets you suddenly see the solution.

These sessions are very useful and quite inexpensive to run. You may not get a new solution, but they do not cost much or take a lot of effort, and the results can be impressive. It is also fun and can be very invigorating. This student-team approach is very useful for generating ideas for totally new product concepts.

These weekend sessions are also a wonderful, real-world interview process. Can students apply the principles they have been taught? Can they communicate and defend their ideas? Can they work as part of a team? It will be obvious which participants would make good future employees.

Some logistical suggestions may be useful. Get approval to have postings put up in the targeted departments at the university. These should describe the type of participants you are interested in having, the agenda, and the purpose of the sessions, but not the specific problem. If you mention the topic, some of them will research it; this may introduce the same biases you are trying to eliminate.

Prepare a simple non-disclosure agreement that gives your company the rights to ideas that are generated. Arrange for transportation to and from the session site or

use a room at the school. Tell the caterers to plan on 50 percent more food per person; free food on a weekend means something to students. I have always given the money to the students at the end of the first day, and have never had a student fail to return for the second session. Many participants have claimed that this was the most useful experience they had in college.

Chapter Six

Key Principles Of Innovation

There are a handful of principles that are critical to the innovation process.

A Good Idea is a Good Idea, Whatever the Source

Cast a wide net. Judge ideas on their own merits. If you are receptive, solutions can sometimes come from the unlikeliest of sources. Don't be afraid to draw on ideas from other disciplines or fields.

Not Invented Here

It is impossible to know everything about a topic. To succeed, we must be able to accept good ideas from other sources, even in our area of expertise. Nevertheless, "not invented here"—a tendency to reject ideas and input from other sources—is a common problem. This is a

dragon that must be slain, and a quest that will continue throughout your career.

Throw Off the Blinders

It's not what we don't know—it's what we know that really isn't so. Think about that a minute. It is one of the scariest statements you will ever read. We cannot assume that generally accepted truths are, in fact, correct. Remember: It is often better to choose a team from people who do not have a deep understanding of the specific problem.

Gestate

Think about the problem before you go to sleep. Let your brain work on a solution during off-peak hours.

I always keep a pen and a pad of paper on the nightstand next to the bed to record ideas if they come in the middle of the night. (It's also handy if you need to write down emergency information from one of those late-night calls your kids tend to generate.)

Embrace the Unexpected

Many significant discoveries come from escaping the constraints of the problem and from being able to recognize the value of an unexpected outcome.

Iterate

Don't be afraid to do it all over again. Review notes from idea generation and assessment sessions often. This may generate a new idea, and it will certainly keep you in a state of readiness for unexpected insights or outcomes.

Quit

You will not solve every problem that you study. You will, however, gain significant knowledge and better insight into why earlier attempts failed. Nothing is lost. Months, or even years later, your work may enable you to solve another problem or recognize a solution.

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Chapter Seven

Know Your Customers

Who are your customers? Product development groups often make the mistake of thinking that the end user of their company's product, the consumer, is their ultimate customer.

The truth is that their real customer is often the production division that will make the product. It is easy to get focused on a product's features and ignore the people that need to make it. The interests of the ultimate consumers can only be served if your production team can successfully and economically produce the product.

Your customer is the one paying your bills. If you forget this, you can get into trouble fast. When I ran development groups that supported multiple production divisions, the development groups had to sell their project ideas to the production divisions to get funding. This kept the development people focused on their proper customer. It also provided a source of creative tension to keep groups focused.

Often customers take your company's product and convert it or incorporate it into their finished product. This is always true for materials suppliers. Even consumers do things with products that manufacturers and marketing people do not anticipate. Knowing your customer and understanding the final use of the products you develop can be critical. A molder once purchased transparent polycarbonate from GE Plastics. He would not tell them about his final product. A few months later, GE received a phone call from the California Highway Patrol.

The customer produced visors for motorcycle helmets. Dyes in clear plastics filter out certain colors. In this case, the visor was filtering red. To a motorcyclist, it appeared that a red traffic signal was not working. No accidents were reported, but it took several cases of bikers running red lights before the source of the problem was discovered.

A traffic light now hangs in the corner of the lab where colors are formulated for GE Plastics. One of the routine checks for proposed new transparent formulations is to look at this traffic light through a small plaque of the molded material.

Chapter Eight

Plan Your Experiments

This chapter is for people seeking innovative approaches to optimizing processes.

Once you have decided on a technical approach, you need to conduct screening experiments to identify key factors affecting your product or process. Many trials are then required to define the interactions of important factors and to optimize the process.

The critical issue is to minimize the work involved in solving complex problems; if the experimental design process is inordinately complex, most engineers will chose to ignore the potential benefits.

A useful approach to experimental design is the response surface analysis method. This is cheap, easy to learn, versatile and extremely effective. With this method, instead of analyzing tables of numbers, you look at two- or three-dimensional computer contour plots. Simultaneously viewing the effects of different factors upon performance helps people to quickly understand critical relationships in complex systems.

This visual method is superior to mathematical solutions, such as the Taguchi methods, that require expert knowledge and a truly profound understanding of the problem. Using response surface software, the problem becomes obvious. You are always looking for the combination of factors that yields a maximum or minimum on a response surface. Any solution that is at the very peak of a mountain or at the bottom of a deep well is inherently unstable. Each is a balance of several, often competing, factors, and it takes only a slight variation in the key parameters to move far from the optimum result. You can visualize this as "falling off the mountain." Thus, it is much better to pick a solution that is in the middle of a high plateau or broad valley. In this case, normal process variation will cause only minor product variations.

Of course, there are some situations where you must try to run your process at one of the mountain peaks. This occurs when the product must be exactly uniform, as in the manufacture of pharmaceuticals or of atomic weapons. In these situations, you can clearly demonstrate the need for investment in better process control equipment and the potentially catastrophic consequences of inadequate process control.

The response surface experimental design software I have been using since 1986 is called ECHIP™ (short for "expert on a chip"). It is inexpensive and easy to learn and the company is extremely customer friendly. Other response surface design software packages are also available.

Chapter Nine

Implementation Of New Technologies

If the innovative solution you have discovered involves a significant change in a manufacturing process or requires a new process entirely, there may be many obstacles to successful implementation.

It is imperative that those who will implement your solution be involved as early as possible. I have found that the most effective approach to improve the introduction of new technology is to form co-located teams. The key personnel who will implement the technology should move in with the development group to become an integral part of the development team during the last six to twelve months of the development process. This allows for rapid communication and resolution of issues. It also builds team spirit and keeps the group focused. This could also apply to any type of cross-functional team.

Co-location is an excellent educational opportunity for all involved. People from manufacturing learn

experimental design and analysis tools used in the development process. Development people gain greater insights into the intricacies of manufacturing operations.

One of the toughest problems that new technology implementation teams face is dealing with management. Often, management will want to reduce capital investments to minimum levels and will reject requests by development teams to include more versatility in production equipment.

This kind of shortsightedness can cost dearly. I had an experience with an innovative new product that was to be introduced into an existing facility. The processes involved were totally different from those in current use. Although the original capital budget was $9.6 million, this was reduced to about $6 million through several rounds of tweaking.

The last $600,000 reduction removed the versatility to adjust several key pieces of equipment. That lack of ability to modify the equipment to accommodate process and material variations cost over $6.5 million in the first year of production. The equipment could not be retrofitted while running production. Because of the high levels of scrap, continuing overtime was required just to meet current production commitments. Though the product won several international awards, the hemorrhaging of money continued and the product line was discontinued.

Brainstorming of what might go wrong during startup and possible solutions before you finalize capital equipment can save many headaches later.

Chapter Ten

Wilson's Rules For Success

Read Constantly

Reading stimulates your thought processes. I prefer science fiction because it stretches my imagination the most. Mysteries and espionage novels do almost as well. A strong and vivid imagination opens the door to creative solutions.

A speed-reading course can be very useful to help you scan technical and business journals. However, don't speed read for pleasure; that defeats the purpose.

I read each day instead of going out to lunch. I always take a book to the restroom. I read just before going to sleep each night, while waiting in airports and while traveling.

Develop Your Communication Skills

Whether writing or speaking, you must be able to present and defend your ideas. You might be the most

brilliant person in the world, but if you cannot communicate effectively, you are doomed to failure.

I have always supported university courses that require team projects and public presentations. Speech courses, dramatic clubs, joke clubs, and social groups that require public speaking are all valuable.

Jack Welch, the brilliant leader of GE, had a very serious stuttering problem. He has worked very hard to overcome it. It used to be said that the one sure way to get fired was to get Jack so upset in a meeting that he would stutter.

Duplicate Success

Pick a successful person and copy what he or she does well. Copying two or three people who have strengths in different areas is even better. Imagine yourself as a composite of the strengths and virtues that you most admire in others.

Enjoy Your Work, or Get Another Job

Life is too short to be stuck in an unhappy situation. Success comes from being happy and being good at your job. If you are not happy, it is hard to perform well.

If you are unhappy, tell your company. They have invested time and money in acquiring your services, and in

your formal or informal training. Give them a chance to improve the situation.

If this is not successful, find another job. Regardless of salary or title, it is not worth it if you have to force yourself out of bed to go to work each day. You will be miserable and you will make your family and friends miserable.

Be Visible and Observant

Keep on the move. Understand the various jobs, operations and processes within your company. Observe and listen. Questions are okay. Most people are happy and often flattered to be asked questions about what they do well.

Share Credit and Take Responsibility

Share credit for your successes with as many people as possible. Take full responsibility for your mistakes. Don't blame others.

I have tried to stress the importance of working in teams. Nothing will destroy your reputation and your ability to work with others faster than stealing the glory for successes and passing blame onto others. The truth will always eventually become known.

There are some people that make a career of changing positions every two or three years just so that

their mistakes never catch up to them. They tend to be jerks and can lead companies to ruin. Don't become one of these.

Hard Work Brings Good Luck

Being in the right place at the right time is rarely a matter of luck. It is a result of being in many different places at many different times, and being prepared to recognize an opportunity when it occurs.

Practice Positive Optimism

Be a positive person. Be optimistic that things will work out. Look for good lessons to be found in everyday life, even in failure.

It is impossible to learn without making mistakes. Don't let obstacles deter you. Some challenges are just bigger than others.

Be of good cheer! You might as well have fun, and others are more likely to enjoy having you around. You get better results when you and your colleagues make a pleasant, hardworking team.

Always Strive to Deliver Value

The company you work for has invested in you. They pay your salary and provide you with benefits. It is your duty to return fair value for what you receive.

I am always loyal to the company or client for whom I am working.

If you deliver value, you can always find a good job.

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Chapter Eleven

Can Is A Word Of Power!

Successful innovation is one of the most enjoyable activities that humans experience. The flow of creative energies is almost poetic in its nature. Therefore, I am going to close with my favorite poem.

I do not know the author. It was published in the *Cleveland Plain Dealer* while I was attending graduate school at Case Western Reserve University in the early 1970s. I tore it out of the paper and carried it in my wallet for many years.

When I first became responsible for managing groups of technical people, I put it on company stationary and posted it on my office wall. I have also distributed it to my employees and colleagues and given copies to customers. It is a positive message of the joy of the innovative spirit.

Good luck and good hunting!

DID	IS A WORD OF ACHIEVEMENT.
WON'T	IS A WORD OF RETREAT.
MIGHT	IS A WORD OF BEREAVEMENT.
CAN'T	IS A WORD OF DEFEAT.
OUGHT	IS A WORD OF DUTY
TRY	IS A WORD OF EACH HOUR.
WILL	IS A WORD OF BEAUTY
CAN	IS A WORD OF POWER!

About the Author

Dr. Wilson has BS/MS Degrees in Chemical Engineering from Ohio University and a Ph.D. in Macromolecular Science from Case Western Reserve University. He has nearly thirty years of experience in industrial technology management and is the inventor of over fifty issued or pending patents on polymer materials, processes, and applications.

Dr. Wilson received the 1985 Society of Plastics Engineers (SPE) International Unique and Useful Industrial Product Award. Development groups led by Dr. Wilson won four SPE Automotive Division Most Innovative New Material or Process Awards, and an American Product Excellence Award.

He has more than twelve years of experience with General Electric, where he ended as Manager of Technology Applications at the GE Plastics Applications Center. Dr. Wilson also spent over ten years with the Textron Automotive Company as Vice President of Technology, and three years as Chief Technologist for Magna International, Inc.

Dr. Wilson is also the author of *"NANO-COMPOSITE POLYMERS - An Introduction to This New Class of Engineered Materials and A Guide to Successful Commercial Applications."* He is President of Inspired Innovations, L.L.C., an innovation and creative problem-solving consulting firm.

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