CHAPTER

9 Moving On: The Next Move Is Yours

Do not be too timid and squeamish about your actions.
All life is an experiment.
—Ralph Waldo Emerson, schoolmaster, minister, lecturer, and writer

Objectives:

After studying this chapter, you will be able to:

- Relate the text's purpose and the means used to achieve it
- Analyze the degree to which the book's purpose was fulfilled
- Employ up to eleven tactics for implementing your idea for an improved or new structure, facility, system, product, or process
- Demonstrate that you now have the knowledge and skill to work smarter and be more creative and innovative

9.1 THE END OF THIS TEXT

As my work began on this chapter, I searched for a metaphor to help define and communicate the chapter's message. In fact, I happened to be at a social event at the time, and I explained what I was doing and asked for metaphor ideas. I received none; I was on my own. My first thought was to use a simple stop sign; simple can be good. If you, the reader, made it this far, you're on the last chapter and can soon stop reading and using this book. However, I hope you do not stop reading and thinking about and working with the ideas and tools presented in this book.

The failed stop sign metaphor somewhat naturally led to a traffic signal. We've been on green for eight chapters, and now we see yellow, warning us that change is occurring in the form of slowing down to reflect. This chapter begins on red and ends on green. It stops to reflect on the text's message and then offers you ideas and advice

for where to go next. This chapter is my last chance to influence you to make even better use of that marvel between your ears—to use what we know about it to work smarter, including being more creative and innovative.

9.2 REFLECTING ON THE TEXT'S PURPOSE AND THE MEANS USED TO ACHIEVE IT

The purpose of *Introduction to Creativity and Innovation for Engineers*, as stated in the Preface and summarized in Section 1.1, is to help you acquire creativity/innovation knowledge, skills, and attitudes (KSAs) so that you can work smarter and achieve more individual and organizational success and significance in our rapidly changing world. Those KSAs will enable you to generate and begin to develop ideas for improved or new structures, facilities, systems, products, processes, or services.

I set out to accomplish that purpose for you by performing the following tasks:

- Suggesting six reasons why *you should learn more about creativity and innovation* and describing the *historic and linguistic connections* between engineering and creativity (Chapter 1).
- Providing you with a *brain primer* because understanding brain basics, and then using them to learn and apply whole-brain tools, will empower you and your team to work smarter and be more creative and innovative when you take on technical and nontechnical challenges (Chapter 2).
- Introducing, describing, and illustrating *twenty whole-brain methods* designed to stimulate you and, more powerfully, your group, such as a project, planning, design, research, experimental, marketing, or other team, to think more deeply and widely. For convenience purposes, Table 9.1 presents a summary of the tools covered and their neuroscience foundations. These neuroscience-based methods will help you generate more ideas, analyze them, explore many and varied optional courses of action, and select from among them (Chapters 3, 4, and 7).
- Warning you about the *obstacles* that most of your and your team's creative/innovative efforts will inevitably encounter and offering ideas for how to surmount them (Chapter 5).
- Identifying some *characteristics of creative/innovative individuals*, with the hope that you would see many of them within you or within your reach (Chapter 6).
- Offering more in-depth descriptions of creative/innovative results drawn from seven widely varying engineering specialties. These stories are intended to broaden and deepen your appreciation for how the process works and to inspire you to make similar contributions (Chapter 8).

The preceding eight chapters collectively included three themes: First, an issue, problem, or opportunity (IPO) well-defined is half-solved. Second, that marvelous three-pound entity between your ears works best when you engage all of it. Third, we can learn from and be inspired by the creative/innovative efforts of others. To that end, ninety creative/innovative structures, facilities, systems, products, processes, and approaches were introduced in this book for your possible benefit, with some covered in depth.

Table 9.1 Summary of whole-brain methods and their neuroscience bases.

Method	Brain basic(s) applied
1) Ask-Ask-Ask	The interactive and reflective process of asking and answering questions engages both hemispheres. Stimulates the subconscious mind, after the interaction, to elaborate on the questions and the answers.
2) Borrowing Brilliance	If consciously stimulated, by searching broadly, the human mind is likely to make new connections. Energized by possibilities inherent in new connections, the subconscious mind will energetically generate more connections and their potential implications.
3) Brainstorming	A diverse group combined with moderate visual stimulation will generate and exchange ideas. Initiates post-process subconscious thinking and its inevitable benefits.
4) Fishbone Diagramming	Highly visual and non-linear features engage the right hemisphere to complement the left. The subconscious mind generates additional bones and elements of bones if the method is applied in a series of sessions.
5) Medici Effect	Left- and right-brain individuals, who are also different in many other ways, offer widely varying views. Those views, while at time contentious, can produce surprisingly original results.
6) Mind Mapping	Highly visual and nonlinear features, stimulated by the open-ended process, engage both hemispheres. Intense conscious thought engages subconscious minds if used in a series of sessions.
7) Ohno Circle	Capitalizes on vision, the dominant sense. The long time period characteristic of the method stimulates conscious–subconscious interaction.
8) Stream of Consciousness Writing	The time requirement forces the individual to draw on all cognitive resources. The effort may help to offset a person's limited thinking attributed to his or her negativity bias.
9) SWOT (Strengths-Weaknesses-Opportunities-Threats)	Highly visual and partly emotional aspects engages both hemispheres. Generates subconscious activity if applied over multiple sessions. Required balance of positives and negatives stimulates thinking.
10) Taking a Break	The focused conscious mind primes the subconscious mind. The relaxed conscious mind gradually learns from the now stimulated and always active subconscious mind.
11) What If	Frees, at least temporarily, the conscious mind from well-intended left-brain constraints. Explicitly challenges natural negativity bias. Typically unusual ideas prime the subconscious mind to work and then share the resulting expanded ideas.
12) Biomimicry	The focused conscious mind stimulated by nature begins to see new possibilities. The subconscious mind naturally expands on the initial nature-driven ideas.

Table 9.1 (*Continued*)

Method	Brain basic(s) applied
13) Challenges and Ideas Meetings	Brain-numbing routine reporting is diminished. Encourages, via explicit high expectations, creative/innovative conscious and subconscious thinking prior to meetings. Plants a desire to resolve challenges and develop ideas in the subconscious minds of informed participants.
14) Freehand Drawing	Engages the right hemisphere to supplement the left hemisphere out of necessity. Relies heavily on the dominant sense of sight.
15) Music	Leverages the listening sense in that it accesses both hemispheres and the conscious and subconscious minds. Recalls memories that can lead to current and potential applications.
16) Process Diagramming	Highly visual nature enables focused minds to finally see the forest, not just the trees. Enhanced understanding of the system combined with possible subsequent subconscious thought generates improvement ideas.
17) Six Thinking Caps	Group members concentrate serially and collaboratively on each of six often competing thinking functions. Highly visual nature clarifies understanding of a challenge and stimulates thinking about resolving it.
18) Supportive Culture and Physical Environment	Increases productive interaction among very diverse individuals. Employs the dominant visual sense. Engages conscious and subconscious minds, with the latter believing what it sees and hears about expectations.
19) TRIZ (Theory of Inventive Problem Solving)	Systematically draws on the successful creative/innovative approaches of many others. Contradictions and inventive principles provide a broad and deep source of ideas for consideration by conscious and subconscious minds.
20) Taking Time to Think	The focused conscious mind plants seeds in the active subconscious mind. The subconscious mind, which cannot differentiate between what is real and what is imagined, generates ideas in the realm of the latter.

PERSONAL: YOU BE THE JUDGE

You are in the best position to determine the degree to which this text's purpose was accomplished. If you find that *Introduction to Creativity and Innovation for Engineers* is true to its purpose and was and probably will be useful to you, please let me know (stuwalesh@comcast.net). Equally important, if you think that the book fell short of its purpose and/or was of little value, your critique and ideas for improvement would be most welcome.

9.3 IMPLEMENTATION: THE OTHER PART

As noted in Section 9.2, this text focuses on creativity/innovation KSAs and the resulting generation of ideas for improved or new structures, facilities, systems, products, or processes. In the engineering world, idea generation and initial development must be followed by implementation. Potentially fruitful thoughts must be

executed if they are to have practical value. Implementation of creative or innovative ideas is frequently alluded to and sometimes discussed in this text. For example:

- Electrical engineer de Mestral's ten-year effort to commercialize Velcro (Section 1.3.2)
- Goodyear devoting ten years to experimentation and other tasks to obtain his vulcanization patent (Section 3.6.2)
- The twenty-six-year effort initiated by Bernard Silver to operationalize the bar code (Section 4.11.2)
- The three-decade, on-again, off-again engineering and construction project culminating in the 1914 opening of the Panama Canal (Section 4.12.5)
- Joseph Strauss's two-decade effort, in the face of widespread skepticism, to plan, design, finance, and build the iconic Golden Gate Bridge (Section 6.4.1)
- NASA's nine-year effort to land the Curiosity rover on Mars (Section 8.2)

The preceding examples represent major implementation efforts, requiring many of the personal characteristics described in Chapter 6 and ongoing creativity and innovation. However, this is not an idea-implementation text. That topic, as important as it is, goes beyond this text's scope and is treated in other books, such as the entrepreneurship book by Lumsdaine and Binks (2007) and the creative problem-solving strategies book by Fogler, LeBlanc, and Rizzo (2014).

HISTORIC NOTE: DA VINCI'S POOR IMPLEMENTATION RECORD

As a student and admirer of da Vinci, I have extolled the creative and innovative ideas flowing from this marvelous Renaissance man, a remarkable artist, scientist, and engineer (Section 6.3.2). However, one of his faults was that he often did not implement his ideas, which we engineers must do if our creative/innovative efforts are to have practical value. As one of his biographers (Wallace 1966) explains, "Leonardo always seemed to go on to other things before he took the final step of bringing his projects to concrete, functioning reality." We too can fall into that trap.

Bringing projects to "concrete, functioning reality" is what engineering is all about. As I've elaborated on elsewhere (Walesh 2012), design, which may be creative and innovative, is the root of engineering; the fruit that grows from that root is a useful structure, facility, system, product, or process. I hope you will be somewhat like da Vinci by being creative and innovative. In contrast, I hope that you will be unlike him in that you and your team will see your ideas through to implementation. May you set down some roots and then see them bear fruit.

If the message and content of *Introduction to Creativity and Innovation for Engineers* engaged you, then you are likely to be interested in implementation. To be helpful, at least in a modest, get-you-started way, I am offering some preliminary idea-implementation suggestions. This confidently assumes that you and maybe a core group of colleagues have or someday will have a creative or innovative idea for an improved or new structure, facility, system, product, or process. Your idea, which may be technical or nontechnical, appears to have great potential. You have begun

to engineer, test, and otherwise develop it, and now want to move to full implementation. Eleven implementation-oriented tactics follow:

- Perform an *overall reality check* by answering the twenty questions listed in Section 5.10. Among other things, you'll be advocating change, which is usually challenging, so make sure you are doing the right things for the right reasons.
- From a commercial perspective, ask and answer the following three *specific reality check* questions (Section 5.8.2): 1) Who do we serve? Every organization serves someone, otherwise it would not exist. 2) What is the greatest current or near-future unmet need among those we serve and would like to serve? 3) How will we meet that need?

  Then, get on with applying the concepts and tools in this text to proactively, and hopefully creatively/innovatively, meet that need. However, recognize (as presumptuous as it may sound) that maybe those you serve don't know what they need or want, but you think you do and want to go in that direction. When asked after making a presentation about a potential project if market research should be used to determine what customers want, Apple's Jobs said, "No, because customers don't know what they want until we've shown them" (Isaacson 2011).
- Consistent with the Medici Effect (Section 4.6), if you don't have a *diverse team*, then evolve one. You may have developed a brilliant idea on your own, but you are unlikely to implement it alone. The variety of complex technical and nontechnical tasks typically required for implementation requires the KSAs of many diverse individuals. As you assemble or augment your team, be guided in part by the characteristics of creative/innovative individuals, as described in Chapter 6.
- Work at developing *intra-team trust*; with *diversity* and *shared vision*, together they are three qualities that lead to productive collaboration. As discussed in Section 6.7.3, each team member must earn the trust of the others, mainly by practicing honesty and integrity.
- Learn about and know how to selectively use the *legal means* available to protect and advance your creative/innovative idea, such as copyright, trademark, and patent.
- Prepare a *business plan* as appropriate that describes your structure, facility, system, product, or process and indicates how it will be prototyped, tested, legally protected, financed, and marketed. Indicate if a patentability search and opinion will be needed and how that will be accomplished (Keefe 2012; Witters 2010).
- As you move forward with various implementation steps, be open to frequently applying the Chapters 4 and 7 *whole-brain tools* to those steps. Don't limit use of those tools to initial definition of the motivating issue, problem, or opportunity (IPO) or to potential resolutions of it; continue to use the tools during implementation. For example, invoke Ask-Ask-Ask during many of the steps, thoroughly assess various attributes of your idea with SWOT, identify possible marketing approaches using Borrowing Brilliance and Mind Mapping, and apply Process Diagramming to develop the overall implementation process.
- Revisit the seven *obstacles to creativity and innovation* described in Chapter 5, recall the possible remedies offered, and prepare to use some of them if needed. Expect resistance because creativity/innovation and change are two sides of the same coin. Both sides mean new directions, suggest uncertainty and risk, and raise anxiety and fear. That coin may eventually lead to joy, excitement, celebration, and many other benefits that, unfortunately, may not be evident at this point in the implementation process (Adams 1986).

- Assess your group's *communication resources*—namely, which person or persons are most adept at listening, writing, speaking, and using visuals—and make optimum use of them. If you don't have at least one good to great communicator, add one to your team.
- Your creative/innovative structure, facility, system, product, or process will move forward only if you effectively impart its various features, with emphasis on benefits, to stakeholders. The most exciting vision, the most thoughtful insights, or the most elegant resolution of an IPO are all for naught unless they are communicated. Communicating to make things happen is a broad and deep subject, and one that has long interested me. If you are looking for advice, refer to my book *Engineering Your Future* (Walesh 2012) for a pragmatic treatment of listening, writing, and speaking.
- View your implementation effort as a formal project—that is, a temporary effort that must satisfy deliverable, schedule, and budget requirements. Apply proven *project management fundamentals* (e.g., see Walesh 2012) to enhance the probability of success.

PERSONAL: COMMUNICATE IN A CREATIVE/INNOVATIVE MANNER

As you move forward to implement your creative/innovative structure, facility, system, product, or process, communicate creatively and innovatively. We don't always have to use PowerPoint! I've used white boards, newsprint, and props.

Consider props. I've spoken to professional society and student groups on topics such as "Engineering Your Future in a Down Economy: Ten Tips" and "Ten Tips for Success and Significance." These are some of what I call my Ten Tips presentations, and I use a specific set of ten props for each presentation.

After I'm introduced, I place a plain-looking box, as shown in Figure 9.1, on a table in front of the audience while stating that I welcome the opportunity to offer ten tips for consideration. Then, one at a time, I pull out items like those shown in Figure 9.1 and use each to stress a tip. After I've offered all of the tips, the props remain on the table in front of the audience. As part of my summary, I pick them up, one at a time, and place them back in the box. While doing that, I ask what tip each prop represents and always get accurate answers quickly.

Having done about a half-dozen variations on these Ten Tips presentations using props, I offer the following observations: 1) The box gets the audience's attention; audience members seem to welcome something other than another PowerPoint presentation. 2) The audience members stay connected because they wonder, "what will he pull out next?" 3) Participants get the message, as evidenced by the quick recall of the meaning of each prop near the end of my talk as I put them back in the box.

Try prop-based or other creative/innovative presentations to advance the implementation of your creative/innovative idea. As you prepare your oral and written presentation, keep in mind the neuroscience observation presented in Section 2.4.2: "Vision trumps all other senses."

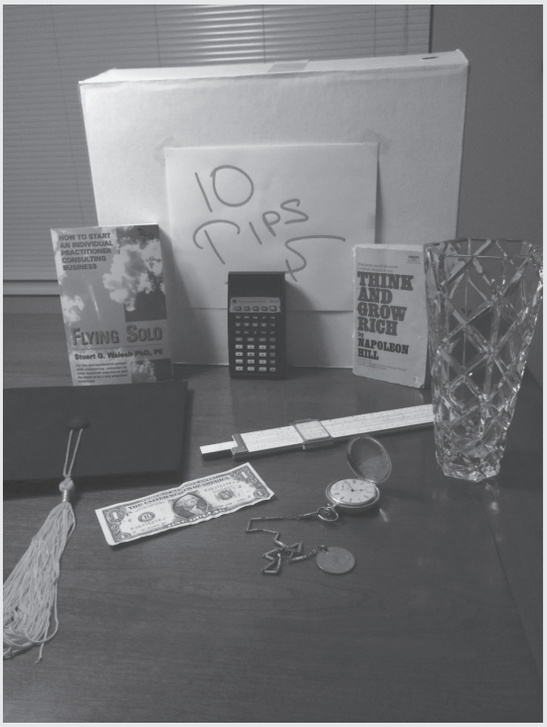

Figure 9.1
The box and examples of props used in Ten Tips presentations.
(Stuart Walesh)

9.4 MY HOPE FOR YOU

Perhaps you read this far into the text and this chapter at least partly because you wanted to. The content, themes, and flavors resonated with you and with the levels of success and significance (Section 1.2) you want to achieve professionally and beyond. Whether a student or practitioner, you see connections between this text and realizing your career and life goals. If these assumptions are at least roughly correct, allow me to offer the following thoughts that may help you continue to move forward:

- Practice good stewardship with the intellectual and work ethic edge you are likely to possess as an engineering student or practitioner (Section 1.4.5).
- Proactively and continuously apply this text's brain basics and whole-brain tools, or at least frequently experiment with them, in your career and beyond.
- Continue, whether formally or on your own, to study the human brain, and use that knowledge to work smarter and be more creative and innovative. Keep up with what will be a continuously expanding body of practical neuroscience knowledge.

Best wishes for achieving success and significance.

> Far better it is to dare mighty things, to win glorious triumphs, even
> though checkered by failure, than to take rank with those poor spirits
> who neither enjoy much nor suffer much, because they
> live in the gray twilight that knows not victory nor defeat.
> —*Theodore Roosevelt, twenty-sixth US president*

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EXERCISES

Notes:

1. The goal of the exercises is to provide students, sometimes working alone and sometimes as teams, the opportunity to think about and use the ideas, principles, and information offered in this chapter.
2. However, many circumstances and corresponding teaching/learning opportunities may arise. For example, a stated situation may be altered to meet specific concerns or needs. Such variations are encouraged, subject to the concurrence or direction of the instructor.

9.1 IMPLEMENTATION CASE STUDY: Select, as an individual or a team, a creative or innovative structure, facility, system, product, or process that interests you. Research, describe, and document the process used to implement it. Include contact (face-to-face or otherwise) with the leader of the effort or a key player. Ask about setbacks and how they were managed, and summarize what you learn. Determine the dominant characteristics of the leader/principal player and describe them. Identify and describe creative/innovative tactics used to move forward with implementation.

9.2 LEGAL MEANS FOR PROTECTING YOUR IDEA: Take one of your creative ideas and research three means of protecting it: copyrights, patents, and trademarks. Describe how and where each can be used for the protection of your idea.

9.3 PRIORI SEARCH FOR PATENT: Before applying for a patent, you need to find all existing, "priori", to your idea. For the idea used above, do a priori search and document the results. On which exact features can you apply for a patent?

9.4 COMMERCIAL BENEFIT CALCULATION: Conduct a simple Excel-based calculation for your idea using the following heads: cost of manufacturing, assembly, transportation, advertisement, servicing and disposal.

9.5 BUSINESS PLAN SEMINAR: Assemble, in a manner that embraces the Medici Effect (Section 4.6), a diverse team that includes one or more business students. Prepare presentation notes, visuals, and handouts for a seminar that your team will present to students who are interested in implementing their creative/innovative ideas. Your team will be the experts in the seminar, and participants will look to you for facts and guidance. Therefore, be prepared to identify and describe each part of a business plan and to provide examples of actual business plans. Select presenters, practice the presentation, and then deliver it.

9.6 CROWDFUNDING: *Crowdfunding* means raising funds to finance a project by using the Internet to obtain contributions from a large number of people. Perhaps crowdfunding could be used to finance your current or future creative/innovative idea. With that possibility in mind, study crowdfunding and write a brief report that explains how the process works and describes its positive and negative features.