IEEE-USA E-Books

Shaping an Engineering Career

Book 1: Responding to Career Challenges—A Personal Journey

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Introduction

The *Shaping an Engineering Career* Series of e-books describes the challenges that practitioners, academics and their managers, in the engineering and related disciplines, face in building their careers. This series will document the personal history of selected engineers and describe their journeys in transitioning from entry-level employees to either technology professionals or managers. Note: Throughout this document, the use of the term *technology professional* includes all people working in the technology related fields; scientists and engineers in all disciplines; hardware and software developers; and all others involved in the implementation of technology to a deliverable product or service.

The fields of interest in which technology professionals and their colleagues work are very broad, and job descriptions and requirements are usually tailored to an organization's needs. As an example, it would be difficult to describe what a project technology professional does, except within the fundamentals of project engineering and management, because it depends on the type of project and the organization. The project requirements to develop 3M's *Post It Notes* requires a different approach than delivering Boeing's 787 *Dreamliner.* The requirements may be quite different for working in organizations like General Mills, INTEL, IBM, APPLE, Caterpillar, the automobile establishment, and Google. Within these organizations, the requirements could also differ markedly from group to group.

The purpose of this series is to identify the different circumstances that technology professionals have encountered in building their careers, and it will provide some guidance to others about what is required to build a successful career in technology, or related disciplines. You'll learn how these engineers and managers faced issues, and how they resolved them. You'll see how organizational culture shaped their careers, and how circumstances shaped them. Their comments are not meant to be "How to" career guides, but opportunities to reflect on, and experiences to learn from. We want to elicit information about who these engineers are, and how their careers developed; who, how, and what inspired them; how they progressed in their careers; their philosophy for building their careers; how they dealt with successes and failures; their vision of a successful career; their various positions (technology specialist or business) as they progressed; how they integrated their work with other colleagues; their perceptions of working with other organizational functions; how the organizational culture affected their performance; how they dealt with non-supportive colleagues and managers; how they dealt with controversy; what fields they worked in and how their interests changed during their careers; and how they met work-family commitments. All of these e-books will conclude with five recommendations for building a successful career. Keep in mind that there may be contradictions among these recommendations—all of the authors possess very different talents and personal characteristics, and they have worked in diverse organizational environments and cultures.

The selected authors will recall their successes and failures; what they learned and unlearned; and how they met their goals as they worked in fields such as research; product development and design; process, engineering and organizational; manufacturing engineering; equipment design; digital technology, hardware and software engineering; multi-disciplinary engineering; systems engineering; consumer and/or industrial products; innovation and entrepreneurship; project management; international assignments and mobility; combinations of fields; and interests beyond engineering.

—Gerard H. (Gus) Gaynor, IEEE Life Fellow
Chair, IEEE-USA E-Book Committee
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Gus Gaynor: A Short History

My roots began in Toledo, Ohio in 1921. I'm part of that Greatest Generation that went through the Great Depression of the 1930s; served three-plus years (1942-1945) in the Signal Corps during WW II; returned home safely from the European Theatre; and then received my BSEE from the University of Michigan at Ann Arbor in 1950.

As a seven-year-old boy, I did not anticipate that my world would be turned upside-down because of the Great Depression in the 1930s and World War II. Life was good—with loving parents and two older brothers; we always took family meals together; explored music and art museums; and held much discussion on all subjects. We had Sunday picnics, and walks with a stop at the ice cream parlor—and the cigar store for my father; and the usual activities that families engaged in, in the 1920s and early 1930s. The Great Depression came, and we moved to a farm. There, we had acres for what's known as *truck gardening*: raising beans, beets, cabbage, carrots, corn, onions, tomatoes, and all the other vegetables. Eventually, we added chickens, and an egg route. That was a definite change in culture from all the benefits of a comfortable city life—to a farm with a water well, a cistern, a pot belly stove, a kerosene cooking stove, and an outdoor toilet.

My interest in becoming an engineer of some kind began at the age of six or seven. I was always mechanically inclined: those alarm clocks must have suffered under my lack of expertise on how to reassemble them. *Popular Mechanics* magazine was my bible from a very early age. Seldom did I build a model airplane according to plan. My own mental model usually took precedence: Why not try something new? In late elementary school, a ten-dollar correspondence course in taxidermy kept me busy; it included mounting squirrels and bats, as well as their skeletons and skinning a variety of snakes. Collecting moss, rocks, and leaves and drawing of countless new automobile concepts occupied the rest of my spare time. I cranked Ford Model Ts, and learned how to fix things very early in life. Two seventh-grade teachers, general science and math, gave me the inspiration to develop my own science projects.

A cousin who had all types of tuned-frequency receivers and a yard filled with antennas cemented my interest in radio. My visits through the vertically integrated Ford Motor Co. operations expanded my interest beyond the electronic. At a recent presentation at an IEEE/Boeing conference, I remarked on my excitement, as I listened on my crystal set to Charles Lindbergh's crossing of the Atlantic in the *Spirit of St. Louis,* in May 1927. That same excitement overwhelmed me, as I witnessed the first public test flight of the Boeing 787 Dreamliner—seven decades later.

Completion of elementary and junior high school was followed by attendance at a couple of high schools. My interests continued in science; math; chemistry; fixing cars (Model "T" and Model "A" Fords), and off-brands like Essex, Whippet, Terraplane, and Willys-Overland; model airplanes; photography; taxidermy; radio club; farming of necessity; general fixer-upper; water wells drilling; cistern maintenance; horses; tractors. And the back-breaking work picking all those vegetables to be sold! I also visited the Ford Motor Company plants, to see glass making, engine block casting, parts manufacturing, and assembly. Watching the *Detroit Free*

Press printing presses roll at high speed further sparked my interest in the potential of technology. I became infected with automation and systems. Since I couldn't afford the time for full-time engineering college, a night school program became the best alternative.

Two high school teachers had a major influence in my future career: a literature teacher, and a Latin teacher. The literature teacher insisted on us "doing the best you can and no less," without any penalty for reworking a paper; and the Latin teacher focused on helping us develop a sense of discipline in our lives. Both defended me on many occasions against a very conservative principal. It was comforting to have two teachers defend my actions to promote a more open educational environment. Interest in my high school radio club led me to becoming an apprentice soundman at WJR Detroit.

My parents had a major influence on me, as both supported higher education, and were self-educated in the arts and history. They provided a foundation in ethical behavior that has served me well throughout my career. My mother, the homemaker and spiritual leader in the Gaynor household, and excellent self-taught pianist, always focused us on doing our best: *All we expect is that you do your best*. My father, as were all fathers in those days, was responsible for "bringing home the bacon." He was somewhat less involved with us than my mother, but he was a voracious student of history and politics, in all their forms. My father also accompanied my mother on the piano, with his self-taught competence on the violin.

My wife Shirley, a social studies major with an inherent interest in all that surrounds her, has been my advisor on important life's decisions, and she has influenced my actions toward a satisfying and successful career. Our seven children, each in their own way, have provided us an exciting life—and they now recall the memories of those days of growth from childhood to adulthood.

Events on 7 December 1941 would change my lifestyle. By May 1942, I'd be in the Signal Corps Enlisted Reserve. Nine months later, I'd have crossed the Atlantic, and returned to the United States, after three and a half years in military service. All but nine months was served in Europe. What a learning experience about people—not only people from the United States, but also from the interactions with people of other nations—some our friends, others our enemies. The WWII experience taught me that not all people came from the Midwest with a particular work ethic and set of values; and that living required acceptance of others, with their various personal characteristics and interests.

Back home in August 1945, I applied to the University of Michigan College of Engineering and received a BS in Electrical Engineering, with an Industrial Electronics Option in 1950. Transistors were the dream of some engineers and physicists; ENIAC was becoming a reality with its formal announcement on 14 February,1946. Who knew that today's hand-held device, costing less than $500, would far surpass the ENIAC capabilities?!

My university education was much different than what is offered today in the EE curriculum. Required basic courses for all those enrolled in the electrical engineering program included Engineering Drawing; Descriptive Geometry; Math, including Differential Equations; Alternating and Direct Current Machinery; two semesters of Chemistry; two semesters of Physics; Engineering Materials; Strength of Materials with laboratory work; Statics; Dynamics; Fluid Mechanics; and options in English and Economics. These were obligatory courses. From

thereon, students had a choice of three options: communication, industrial electronics, or power. All EEs were encouraged to take the course in Heat Transfer. This curriculum is quite different from what is offered currently by most universities. The objective then was to develop engineers with a broad-base of engineering fundamentals, as contrasted to today's greater emphasis on specialization. I was fortunate to have worked at the University of Michigan Research Laboratories during my junior and senior years.

Life after graduation was filled with experiences never dreamed of, with responsibilities that made me ask myself: "Why did I get into this?" But I kept continuing to get into the next one… Looking back over my lifetime, I consider myself fortunate to have met many people who inspired me to go beyond what I considered possible, and provided guidance; and others who either directly or indirectly counseled me in various aspects of my career. Today, we look for mentors; in my day, we were expected to recognize the indirect cues from associates and senior members of the organization to guide us. I usually felt I was better able to set my own directions after considering comments from associates, family members, and others. I tried to focus on where the opportunities existed. The eye-candy was not important. So, the following is a synopsis of my experiences over 91 years. From here, I'll give you an idea of the some of the activities that provided me with what I referred to as "indirect cues" from colleagues and senior members of the organization. Today, we might refer to these as *mentoring.*

Painting Storm Sashes

In spite of all the work on the farm, winter months did not require farming. I applied for a job to paint storm sashes and storm doors. An interview with the owner of the shop resulted in an offer of a job at 15 cents per hour. I thought my first day's work was quite good for the first day, but the owner informed me he was not satisfied. The next day, he mentioned that during the interview I had given him the impression that I knew how to paint, but my first day's effort did not indicate that knowledge. He went on, and asked me questions, like who taught me to paint storm sashes and how often and under what circumstances. My responses were not very convincing. He then suggested that if I wanted to keep the job, I'd have to clean all the excess paint from the previous day's effort, and would do it on my own time. The job was important to me, so I agreed. This task may not sound daunting, but keep in mind that the problem is not painting the wood sash—it is painting the 3/8 inch or so of putty that seals the glass to the wood frame—without leaving any paint on the glass.

The owner decided he'd teach me how to paint. After a short session on how to select the proper paint brush, and how to mix the paint, and how to use the paint brush, he demonstrated how to paint one side of a sash without putting a drop of paint on the glass. I appreciated the ease with which he accomplished the task. He then took my hand in his, and we went through the whole process of painting a new sash, without leaving any paint on the glass. After this demonstration, it was my turn to paint a sash without leaving any paint on the glass. Mastering the process took approximately an hour. The owner looked at my work, was well satisfied, informed me that he'd pay me for the day's work, and asked me to continue working for him.

Lesson Learned

1. You need the right tools, to understand the process, and to do it right the first time. No rework!
2. As a manager, you need to establish expectations—and provide guidance as to how to do the job effectively. Managing includes teaching.

Summer Student

Summer jobs for college students come in essentially two types: 1) those where the student becomes the servant to the group without opportunities for developing new skills; and 2) those where the student is involved in a project to develop some level of competence in the practice of engineering. I was fortunate to work for an organization where summer students were expected to provide value through their participation.

Five students that summer worked at the Detroit Edison Company Power Generating Plant. My assignment was to go around the plant and calibrate all thermocouples and resistance bulb thermometers. That's not exactly an exciting job, but it would afford an excellent opportunity to meet with power plant operators, and learn about their jobs and various power plant activities.

It turned out these operators were more than willing to explain and teach, if we were willing to listen. However, the Manager of the Instrumentation and Control Department (MICD), to whom we reported, had greater expectations.

The MICD had special plans for us beyond the somewhat perfunctory activities. Since all of us brought our lunches, he proposed that we take two hours for lunch and focus on solving an engineering problem. There was a problem with accumulation of combustible gases in the superheater section of the boilers. As these gases exploded, they could damage the boilers; but if they could be detected, then controls could be adjusted to prevent the gases from developing. All agreed that solving this problem would provide a good experience.

The first couple of days, the manager gave us a good indoctrination about electrical power generation. He followed up with a discussion of the problem. Then, he and gave us the responsibility of defining the scope of the project, and putting together a plan, so that we could finish the project before each of us went our own way. We not only completed all of the design and concept testing, but we also built the hardware and installed it.

Lessons Learned

1. Summer jobs in engineering need to provide useful experiences for the student, and some benefit to the organization.
2. Managers involved with summer students should provide learning opportunities, guiding them, but not micromanaging them.

University of Michigan Research Laboratories

As a part-time technician, my two years at the University of Michigan Research Labs brought me in contact with a new group of challenges. My first challenge was to reduce the size of an electronic assembly by a factor of about 60 to 1. This attempt was my first at miniaturization, using miniaturized vacuum tubes, resistors, capacitors, etc. This effort not only included the design, but also the environmental tests necessary to meet the operating requirements in the upper atmosphere.

The University had major contracts with the U.S. Air Force for developing instrumentation for measuring temperature and pressure in the upper atmosphere. All of our devices, electronics, sensors, vacuum systems, power supplies, and related devices had to fit into approximately 1,800 cubic inches, and would be installed in the nose cone of an Aerobee rocket. An excellent project leader brought the team into the total system design, fabrication of the nose cone that included many critical design parameters, and the final assembly and test of a fully-operational system.

Lessons Learned

1. This effort expanded and crystallized my thinking about the need for engineers to focus on total system design: while it was necessary to focus on one's individual assignment and responsibilities, it was not acceptable to disregard the total system requirements. Others depended on your results, and their requirements must also be considered.

2. Understand the real world when working on government related contracts. In my senior year the University, I was offered a full-time a position to continue at the University of Michigan Research Laboratories; but three days before graduation, the Air Force cancelled the contract. In 1950, when a government contract was cancelled, you laid down your tools, so to speak.

Telephone Equipment Supplier

During my pre- and post-military service, I gained a great deal of knowledge and experience working with telephone central office installations, and other communications equipment. My first job after receiving my degree from the University of Michigan involved a 12-week training program in an organization providing telephone hardware. The first two weeks were boring, because the instructors did not present anything new. It was a repetition of my past work experience. I approached the head of the training department, and asked to take all the tests and get to work, rather than continuing. Impossible, I was told, the program must be completed.

Sunday was a good time to scan the employment ads; so by Monday evening, there was an interview; and by Wednesday, an offer. Contacting the training manager resulted in the same previous response: Complete the course. The decision was simple; inform the training manager that I was resigning, and ask if he wanted a formal, two-week notice. He insisted on the two-week notice. Keep in mind, this is 1950, and leaving without a two-week notice could reflect negatively on future employment. I continued for two weeks.

Lessons Learned

1. Rigid thinking, and following the rules (policies and practices), without applying some level of judgment, creates situations that serve neither the employee nor the organization.
2. There is no doubt that policies are essential; but a bit of reflection by the training manager could have led to a different assignment, until the others completed the course.
3. Personal lesson for the future: Make accommodations, when necessary.

The Next Eight Years

After this short stint with the telephone equipment supplier, I joined a small conglomerate, Bowser Inc., in Chicago. Bowser Inc. included approximately 17 companies, of which Bowser was the largest. Sylvanus Freelove Bowser is credited as the inventor of the Kerosene Pump in 1885, and the Self-Measuring Gasoline Storage Pump in 1905. This gravity flow pump may seem primitive today; but like all technology, it was a beginning, and it did manage to fuel automobiles of the day. In later years, Bowser expanded into precision fluid flow measuring; mechanical proportioning systems; water stripping from jet fuels; a scientific research laboratory; administrative management systems; a few screw machine production operations; and other supporting operations. These products were assigned to six or seven different businesses. The Chairman of the Board of this small conglomerate was a lawyer, who had more interest in new technologies and the ability in unearthing them, than many

senior engineering and technology executives. Bowser, Fort Wayne, was a very progressive organization, with meetings in Fort Wayne, Indiana in the early 1900s, the Bowser Bank, a college savings program for employees, and so on.

Johnson Farebox Co. was the second major Bowser Inc. business, and it was engaged in fare collection equipment (those boxes on buses and streetcars and trams where, at one time, you dropped in your fare); coin sorting; counting; and packaging equipment. Keep in mind you need to sort coins at speeds approaching a 1,000 per minute; the technology is more complex than you might imagine. Our government coin designers could have saved us a great deal of grief, if coin dimensions were proportional to value. Before credit cards and various EZPASS systems were installed on major highways, drivers threw their coins in the hopper at various types of toll gates. That mechanism of some 60 years ago continues to be the means for separating and counting coins.

You may consider coin separation and counting as a mundane engineering activity. Perfect coins do not exist. These lots of coins that come to the Federal Reserve include dimes that have been used as screwdrivers; dimes where two thin dimes can equal the thickness of one new dime; and coins with chewing gum, chocolate, adhesive tape, or some kind or other supplemented material that causes problems.

My first assignment at Johnson Farebox Co. in Chicago involved developing an electromagnetic flowmeter. The advantage of the electromagnetic flowmeter included totally uninterrupted flow, with no obstructions of any kind, within a pipe. Basically, two electrodes are located opposite each other, and the pipe is placed in an electromagnetic field. As liquid flows through the pipe, a voltage is generated proportional to the flow. This work was based on the work of Dr. Alexander Kolin, a physicist from the University of Chicago, who did his early experimentation measuring blood-flow in animals. The objective was to develop a flowmeter that met required industrial specifications, based on his patent. Transitioning ideas from a patent to workable industrial equipment requires additional inventions. As I began the project, I realized it would have been impossible for me to carry out the project, without the knowledge of fluid mechanics from my course at the University of Michigan. At the University, I did not think that fluid mechanics had anything to do with becoming an electrical engineer, but here I found it absolutely essential. Fluid mechanics was not exactly my favorite subject. This small epiphany was very early recognition of what it meant to be an engineer. I spent many hours walking the University of Chicago campus, discussing with others various ideas proposed by Dr. Kolin, who focused primarily on applying the principles of physics to solve problems.

Within two years, the Chairman asked me to establish an electronics department, and appointed me Chief Engineer of the Bowser Inc. Electronics Engineering Department. This group became involved in all types of engineering-related work in product design and development, and included all electrical and electronic technologies, working closely with the model shop, considering production requirements, and negotiating with marketing.

A note to engineers about working with the model shop, or other support functions: what engineers design must be reduced to practice, and that reduction to practice involves more than one engineering discipline. At one time, over a series of meetings in the model shop,

I observed a mechanic attempting to develop a complicated chute to move coins from the coin depository of the farebox to the appropriate section about 18 inches below. This chute was convoluted and complicated, as there was no way to make it a straight line chute without any angles. On one of my visits, I suggested that the mechanic make a development of the chute. He didn't know what the word development meant. The cut and try work continued. One day, he agreed to give me the details for this coin chute; and I proposed doing the development over the weekend, to give to him on Monday morning, and he reluctantly agreed. On Monday morning, he received the layout, and he continued to have his doubts. By late afternoon, he called me to see him in the model shop. The development worked perfectly, and everyone was wondering how it was so easy. What did spending some hours over the weekend on my own time bring me? It yielded me exceptionally high priority in the model shop, and any help I ever needed from then on. Building relationships continues to be critical in the path for meeting commitments.

The Bowser Inc. Chairman believed that senior level engineers and managers need to look at the final deliverables, and not just their own limited work effort. It wasn't enough just to do your job; what you did must be integrated with the work of others, so they could use with confidence what you have designed or built. This Chairman also insisted that engineers participate in trade shows to hear the concerns about product performance and reliability directly from the customers. Hearing complaints directly from customers changes the mindset about product design; it tells you more about the audience for whom are you designing.

Lessons Learned

1. Joining Bowser Inc. provided opportunities that no large organization could have provided. Opportunities abounded for those who chose to take them, in spite of the risks involved. Failure was part of the process of learning, but not failure because of a lack of discipline.
2. My first manager at Bowser had an interesting way of evaluating performance—*now*—*when the action took place*. I asked him after about six months whether the company had an employee appraisal system. His response was simple and to the point, every time we meet you're being appraised. It wasn't necessary to wait for the formal appraisal to know how your performance would be rated.
3. There appears to be some level of conflict between engineering and marketing in most organizations. The Chairman summed up his thinking at a meeting of engineering and marketing executives, and senior engineers and marketers: "Gentlemen, we have apples to sell today—red ones, green ones and yellow ones. We're not interested in orders for oranges, as we have no oranges to sell. If you think there's a market opportunity in oranges, send in your proposal and we'll discuss it; but until then, sell our apples." What a lesson in focus.
4. After a couple of years, part of the electronics laboratory was moved to Fort Wayne, where better test facilities were available for the electromagnetic flowmeter. This environment was new for me, and afforded me the opportunity to give a monthly lecture at Indiana Technical University. It was extra work on my part, but I had a choice: either yes or no, no one was forcing me to do it. What an opportunity to look for future engineering candidates.

5. Dr. Kolin suggested that we submit a paper for the American Institute of Physics on my findings related to the electromagnetic flowmeter project. Dr. Kolin not only taught me how to write a technical paper, but also how to get up before a group of physicists and make a presentation. Dr. Kolin's recommendation was very simple: "When you get to the podium take three deep breadths, look at the audience," and remember that you know more about your topic than anyone else in the audience. This thought process was not to indicate any kind of arrogance, but to establish your mindset for dealing with questions.
6. With my newly minted diploma in electrical engineering with the industrial electronics option, I concluded that electronics would solve the world's problems, and I had no qualms about preaching "the gospel." The Chairman once suggested to me that eventually every electronic action somehow converts to a mechanical motion. Wisdom!
7. The opportunity to become involved in defending the Kolin patent gave me an opportunity to spar with some lawyers over several months. Such an assignment may not be ideal to everyone, but the experience of making arguments with non-technical lawyers before a judge, brought me some personal satisfaction and experience.

A Personal Entrepreneurial Venture

After nine years, it was time to seek other opportunities. The Lessons Learned from past experiences gave me confidence that I could succeed as an entrepreneur. My wife and I were willing to accept the risks involved in pursuing this career change. Since most of my engineering experience involved measurements, instrumentation and process controls, I decided to continue in that field. Our customers included the U.S. Air Force, NASA, Ford Motor Co., Hotpoint (a manufacturer of automotive test equipment), and others. I have memories of making many trips from Chicago to the East Coast cities in the engine compartment of the B&O trains—monitoring the equipment used for maintaining the proper level of chromates in the cooling systems of diesel engines.

The early days of an entrepreneurial venture often present an opportunity that might be rejected by an established organization. One of the Hotpoint projects presented such an opportunity: To what degree does the kettle temperature need to be controlled to make consistently excellent hollandaise sauce? The specification included developing a kettle where the temperature throughout the kettle did not deviate more than one-tenth degree Fahrenheit. Our job was to develop the control system. I could never tell the difference between hollandaise sauce made the traditional way, or in the super-temperature-controlled kettle. But then, my palate may not be that sensitive. To the best of my memory, the kettle never came to the consumer market. Some units were sold to up-scale restaurants.

Most of our work related to control of solutions in vats of all sizes, and often in excess of 800 cubic feet. This work involved developing the appropriate measurement, instrumentation and control systems for feeding the appropriate level of chemicals for various types of metal cleaning and treating processes. We supplemented these activities with designing and building commercial photographic processing equipment and developing automotive engine testing equipment.

Lessons Learned

1. Moving from the safety of an organization to a self-financed entrepreneurial venture certainly presents its personal and business challenges. Before the key can be put into the door, one becomes involved with all types of federal, state and local government requirements and bureaucracy.
2. Regardless of past experiences, the entrepreneur now becomes not only the final decision-maker on practically all issues, but also the implementer of those decisions. Entrepreneurs do not begin with a staff.
3. As an entrepreneur, you wear many different hats. Engineering or scientific knowledge is not sufficient for success. In essence, you become the CEO, Marketing and Sales Director, Financial Chair, and fulfill all other organizational functions—until there's sufficient revenue to shed some of those responsibilities.
4. Establishing not only a bank account, but also finding a bank that supports small business, and a banker with whom you develop a confidential business relationship poses some challenges. Sooner or later, you'll probably take out a second mortgage on your home. We developed that relationship with a supportive banker, but later found ourselves repeating the process, when he died unexpectedly. Obtaining a line of credit, even a small one, simplifies the management of cash flow.
5. This venture also afforded the opportunity to act as an expert witness for a client who was struck by lightning, and severely injured, while speaking on the telephone. The court ruled in our client's favor and awarded damages.
6. As an entrepreneur, you learn quickly what it means to meet a payroll. Payroll checks must be issued on time to employees, and those withheld government deductions must be posted according to schedule; funds must be in the bank account. Meeting the payroll quickly changes the orientation from technology related, to products and processes, to the business—and provides the best experience to take on a business mindset. That mindset does not reject the role of technology, but recognizes that pursuing those new products or services through technological innovation can only be successful, if approached from a business system perspective.
7. Entrepreneurial ventures go through several stages. An individual or small group may begin with minimal investment and become very successful. As the venture expands, it takes on new obligations that may become its demise. More time is spent dealing with financial issues than on managing the business. The financial director of a large successful company related the story of how his organization, over its history, needed to analyze the complete organization's practices, as it grew in gross sales in the $500 million range to $1 billion. Keep in mind this is 1960. He related this experience as we set out on a major growth program. In our case, our modus operandi would change, as using part-time services would require full-time employees generating significant additional overhead.

3M Company

I spent the last 25 years of my formal career at 3M Co. If you are not familiar with 3M, please visit their Website (www.3M.com). I'm including some 3M history to put the one-hundred+ year company in perspective. 3M, then known as Minnesota Mining and Manufacturing, was founded on a mistake in 1902. It began mining corundum in Crystal Bay, Minnesota. Corundum was considered an excellent material for making grit used on sandpaper. The 3M founders also thought it could be mined and used for making grinding wheels. They quickly realized that corundum was not suitable for abrasive applications. The story is told that by the end of 1904, a share of 3M stock would not buy a shot of whiskey. Today 3M is a $30 billion corporation, with a global clientele for its thousands of products.

3M's operating philosophy was established in 1948, when then CEO and President William McKnight challenged management with the following statement:

> *"As our business grows, it becomes increasingly necessary to delegate responsibility and to encourage men and women to exercise their initiative. This requires considerable tolerance. Those men and women, to whom we delegate authority and responsibility, if they are good people, are going to want to do their jobs in their own way. These are characteristics we want, and people should be encouraged, as long as their way conforms to our general pattern of operations. Mistakes will be made, but if a person is essentially right, the mistakes he or she makes are not to tell those under its authority exactly how to do their jobs. Management that is destructively critical when mistakes are made kills initiative, and it is essential that we have many people with initiative, if we are to continue to grow."*

Mr. McKnight was an accountant by profession, and the fact that he included men and women in this statement set that stage for 3M's growth. He put this statement forth in 1948.

The 3M management philosophy continued. In 1979, Lew Lehr, 3M CEO and president from 1978 to 1986, in a presentation at the University of Pennsylvania noted:

> *"As befits a company that was founded on a mistake, we have continued to accept mistakes as a normal part of running a business. Every single one of my colleagues in senior management has backed a few losers along the way. It's important to add, however, we expect our mistakes to have originality. We can afford almost any mistake once."*

Mr. Lehr's statement should be taken seriously by all managers and executives. We can argue the absurdities about learning by making mistakes; but unfortunately, that's the real world. If you doubt the statement, reflect on your career. But as Mr. Lehr mentioned, mistakes must be original—and can be made only once.

3M provides opportunities for those willing to accept the challenge. Giving orders to others is usually frowned upon. A former Research Vice President never told laboratory directors where to focus their research. However, after receiving several references to articles related to future technologies, common sense suggested it might be a good idea to investigate the topic. This example demonstrates a culture that operated more from the bottom-up than top-down. This philosophy does not suggest that the executives were not involved, but they and managers realized that to develop new products at the rate where 25 percent of sales in any one year came from products, that did not exist in the previous five years, requires expanding opportunities for exercising personal initiative. Personal initiative was, and still is, promoted and stressed. Freedom with discipline abounds. Well-intentioned failure, as previously mentioned,

is an accepted means for driving innovation. The 3M culture fostered innovation guided by its 15 percent rule: engineers and scientists and others had the right to spend 15 percent of their time on projects of their own making.

As a 3M Senior Specialist

3M hired me as a senior specialist as it was 3M policy at the time not to hire people at the supervisory or management level positions. This policy was somewhat academic, since within just over a year, 3M appointed me as Supervisor of the Instrumentation Group. My engineering work at 3M began as a specialist involved in developing dual beam x ray technology for measuring coatings of organic and inorganic materials, and in single and multiple layer combinations. We also developed nuclear measuring technologies for particular types of coatings. Coating thickness needs to be measured accurately, not only for product performance, but also as a major contributor to product cost. With the multi-millions of square feet of coated products that 3M produces, a difference of a couple of percent in coating thickness amounts to significant added cost.

Next time you purchase sandpaper, keep in mind that the grains on the sandpaper do not just occur at random. Those grains have abrasive material oriented according to a predetermined pattern to meet the requirements of that particular type of sandpaper. As you drive on the highways and see those reflective road signs, keep in mind that complex technologies are involved in those reflective glass beads. The manufacturing technologies and processes related to 3M's Post It Notes likewise involve instrumentation and control systems to guarantee just the right amount of adhesive. Photographic products of all types require the utmost precision in providing multiple coatings simultaneously of silver-halide and various inter-level coatings. All of these products involve various levels of precision to maintain product consistency. These technologies would govern my work life, in one form or another, for the next 25 years.

Supervisor of the Instrumentation Group

During this time, the fields of measurement, instrumentation and control systems were going through a metamorphosis. Measuring sensors and their related instrumentation required greater accuracies, and control systems theory advanced to new levels. Many of 3M's products involve applying a solution to various types of substrates. Those machines apply various coatings, often multiple, with ever-increasing precision.

My role then changed from being an engineer to managing the activities of a group of engineers. You have often heard the statement *managing* people, please remember that when being responsible for the activities of other technology professional specialists, you do not manage them, you manage their activities. These positions included managing the activities of technical groups involved in product development; design engineering; process development; plant engineering; developing technology strategic directions related to new product innovation; auditing innovation and product and technology programs in R&D and their management; proposing and obtaining approval for product-related investments; integrating technology requirements for a multiplicity of product lines for 3M divisions; making the proposal and taking a leadership role in the turnaround of a major subsidiary; and meeting the technology expectations from a business operational perspective. I'll comment on a few of my assignments.

As Supervisor, the Instrumentation Group included 11 people, some of whom could not meet the requirements; and further, were not interested in learning the latest on control systems. I made arrangements with a University of Minnesota professor to teach a fundamental course in process control. Many refused to participate, because they lacked the interest and background. There was only one solution, find them positions where they could be more productive. Fortunately, it was not difficult to provide other opportunities at 3M. Most led successful careers. This move was calculated, on my part—3M required engineers who could meet current and future technical needs. When a step function change in requirements becomes apparent, it cannot be resolved with a staff without the educational background and experience. The engineers hired as replacements with the required backgrounds eventually became managers and directors of various 3M technical operations.

Working with a new manager can create situations that need to be handled cautiously. I submitted a proposal to my manager for a non-budgeted expense/investment. After some discussion, and involvement by other supervisors, he suggested that we prepare a formal proposal. He would sign it, and pass it on to other signatories. Shortly thereafter, the engineering vice president requested that I meet with him for a general discussion of the proposal; out-of budget items usually required such discussions. After asking many questions, the vice president approved the program.

My manager then insisted that we prepare a requisition for another person. We did not agree. My position was that we did not need an additional person—as another project was in the final stages of completion—and those engineers had the required competencies. He insisted that we submit a requisition. The requisition went through the usual stages and ended up on the engineering vice president's desk. His secretary called me to make an appointment for another meeting. At the meeting, the VP noted that he agreed for the funding of the non-budgeted program, because a good case was made for its future benefits to 3M. He then asked what programs could be eliminated, because of their marginal value, or may no longer be required. What could I say in such a situation? My manager insisted on another engineer, probably not a good idea to say that I objected, and he insisted. My response: "We'll make the necessary arrangements." My manager was not particularly happy, but he withdrew the request for an additional engineer. What is interesting about this situation is that in interchanges of this type, this VP always contacted the submitter of a proposal, and not the manager. His basic policy, go to the source of the proposal, and discuss with the one responsible for performance.

Instrumentation Research Laboratory

The research laboratory created new and different challenges to find ways for achieving the measurement standards required of 3M products. That work effort included developing highly sensitive sensors for measuring coating thickness in real time. While commercial equipment was available, it could not provide the levels of accuracy required. This group of highly educated engineers enjoyed their work, and integrated their activities in a spirit of collaboration.

As the Manager of the Laboratory, I invited the 3M CEO, Harry Heltzer, to visit our small lab of about 25 people, and show him our projects in measuring coating thickness of light sensitive materials, such as photographic emulsions. He accepted, and the date and time were agreed upon. He arrived promptly at 8:00 a.m. After introduction of staff and discussion, the project

manager demonstrated the equipment, and a general discussion followed. Harry, as he was known to all of us, then asked what else we were doing; and he remained with us for the next two hours. He called his secretary, and cancelled his other appointments. There was no doubt that we had a breakthrough, but it's difficult to conceive of a CEO in today's business climate taking the time to focus on discussion of new technologies, and what they could do for the organization.

Director of the Contract Research Laboratory

The next move gave me the opportunity to become Director of the Contract Research Laboratory, where my focus on measurements and control systems changed to polymer chemistry research. This laboratory did some government research on solid fuels, contract work for other 3M laboratories, and a group of projects that had no particular home assignment. My responsibilities included determining the viability of the laboratory as a continuing operation. After approximately two years, we concluded that the functions of the laboratory we wished to preserve could be transferred to other laboratories, and made the necessary accommodations.

This experience also provided an opportunity to review many projects, and determine their future value to 3M. Some continued for years without significant progress, but with significant investment of resources. One cancelled project included warnings from many staff that it was the CEO's favorite project. I canceled the project. The CEO called me within a couple of weeks for an explanation; I provided my reasons, end of conversion, thank you. If there's a logical reason to terminate a project, there's no reason to fear repercussions. If you're so fearful of expressing your thoughts in a culture that fears openness, perhaps it's time to seek employment elsewhere, unless you prefer such an environment.

Manager of the Instrumentation and Control Systems Department

The manager of this group was being reassigned to a different position and the Executive Director of Engineering asked to become its manager. This large group was composed of more than 150 engineers, designers and technicians.

After several weeks, I realized that the supervisors (before the days of grade inflation) did not understand what supervision involves. The answer: approach a noted university professor in management to begin a development program. The professor agreed, but the proposal was rejected, because of the economic situation at the time. Meeting budgets was a requirement at 3M. My solution: Select seven books related to fundamentals of supervision and assign one book to each supervisor. Each supervisor would read the assigned book, review the book with the group, and discuss relevance of material to *the organization's work*. The supervisors viewed my assignments as a dumb idea, and carrying out this task included significant grumbling. This approach really challenged the supervisors. These books were not novels. Exploring behavioral issues was a challenge, but they had no choice but to comply.

Results of the first meeting brought out many issues: no lack of technical competence, but a total lack of understanding of what it takes to meet project requirements, when more than one group is involved. The first session was moderately successful. Some *real work* issues came forward that demonstrated the problems within the department. After seven weeks of

intensive Monday morning discussions, the mindset of the group began to change. Within three years, we developed a cohesive working group of engineers and supervisors. At my retirement, several of these supervisors—now managers—approached me, and noted that this assignment was the best development program in which they had ever participated; it dealt with real problems, their problems.

After three years, my workload could be completed within an hour or two every morning. Micromanaging the supervisors was an option, but not very beneficial either for supervisors, the organization, or me; on the contrary, micromanaging would undercut the supervisors and their lead people.

Chief Engineer Ferrania Photographic

Moving to Italy as Chief Engineer of Ferrania Photographic began seven years of foreign service, and presented the greatest challenges of my career. Ferrania Film was well known in Italy, when 3M made the acquisition in 1962. It was an organization of approximately 5,000 people, with engineering responsible for about 1,000 people; engineering included all engineering, process engineering, plant engineering and maintenance. The operation included its own power plant, production facilities, research laboratories, woodshops, glass-blowing operations, and more. It was a fully integrated operation. If window frames were decaying and needed replacement, we made our own window frames; if new doors were required we made the doors. Dismantling some of these operations required a bit more patience, since changes required negotiations with three different unions.

My predecessors came to 3M headquarters with plans requesting millions of dollars to essentially begin systematically scrapping the current facilities, and rebuilding a totally new operation across the river, which flowed through the site. Their proposals were rejected on every occasion for lack of financial justification. There was no doubt that the production equipment did not meet requirements, but parts of the plant could be used with some improvements or modifications. The power plant could be updated very easily at minimal cost. After several months, we put together a plan to begin the discussion. The naysayers raised all the previous issues about lack of justification; the impossibility of reducing personnel; and that thinking of reaching agreement with three unions was irrational. The 3M Italy Managing Director made the decision: Finance would be responsible for financial justification; Human Resources for union negotiations; Research, Manufacturing, Marketing and Engineering to put together the plan to move current and new products to the marketplace; and Engineering would be responsible for putting together the final plan. We established a reporting schedule. Within nine months, we met 3M's financial and major project requirements; satisfied the three unions met the Italian Government's conditions; and developed solid plans for research, engineering, manufacturing, and marketing and sales. The 3M Board in St. Paul, Minnesota approved the program, and now the Ferrania staff had the responsibility to make it happen.

Eight months after the approval, the 3M Italy Managing Director called me, and said that the 3M VP of Engineering wanted me to become Director of Engineering for 3M Europe. I declined the promotion; and within two days, I received a call from 3M's CEO. The call was followed by a trip to St. Paul, a short meeting with the CEO, VP International Operations, and VP Engineering. My decision: I'll become 3M Director of Engineering Europe, and maintain my position as Chief Engineer Ferrania.

Director of Engineering 3M Europe

This position offered a totally different experience. Responsibility for the engineering function of fifteen European Countries presents totally different challenges from those of a single country. In essence, one operates in fifteen different cultures, each of which operates within 3M policies and procedures, but with accommodations for individual country needs. As an example, 3M did not allow swimming pools or saunas in the U.S. office buildings. However, when building a new administration building in Finland, a pool and sauna were included, even though St. Paul Engineering objected strongly.

Little by little, it became obvious to me that there was no need for maintaining an engineering staff in Brussels— those activities could be handled by the Executive Director of International Engineering, who resides in St. Paul. In a short time, that function was transferred to St. Paul; and I moved to Milan, Italy, as Director of Engineering for 3M Italy. There, I became a member of the 3M Italy Board of Directors and Executive Committee.

Director of Engineering 3M Italy

Returning to Italy gave me an opportunity to focus considerably more time on Phase II and Phase III of transitioning the Ferrania operations into fully computerized operations. This achievement went beyond all expectations. It was successful, not because of engineering's success, but because it became a business team that included all the functions involved in such a venture.

Recommending a new approach always finds the naysayers. Here is an example: Major investments, even though included in budgets, involve significant financial analysis prior to approval. That analysis usually takes place after a plan has been submitted for approval. It's at this time that all interested parties begin raising new issues, presenting new information, or seriously objecting to sections of the proposal. The time from which the plan is presented to the time every function signs off on the plan, before going to some committee or board for approval, can require months. There must be a better way.

Bringing product research, engineering, manufacturing, marketing and sales, and finance into the program in the early stages provides a better alternative. Each of these functions has a stake in the outcome. Preparing a plan, and then asking the finance department to approve it, may extend approval by months, under traditional methods. By bringing in an organizational controller as part of the team, finance gives its approval the day the plan is completed.

Director of Worldwide Engineering; Graphic Technologies Sector

After seven years of residence in Europe, I became the Director of Worldwide Engineering for the Graphic Technologies Sector, which included about one-fourth of total 3M sales. The mindset changes once again. Now, it is not just about Europe, but the worldwide engineering-related operations.

In these 3M positions, I have avoided discussing specific projects. As you might surmise, there were many projects ranging from minor yet important, to those that involved major investments in new and proprietary technologies. Much of the information is confidential, and goes beyond the scope of this e-book.

Lessons Learned

3M provided me an opportunity to go beyond the mundane, explore the future, introduce new technologies and processes, and actively participate in the business. The requirements were simple: projects must add value, provide a benefit to the users, and justify the investment. What did I learn at 3M?

1. Throughout my 25-year career at 3M, I was afforded the freedom to go far beyond my job description in initiating cross-disciplinary activities. However, that freedom to explore was guided by financial discipline.
2. Freedom to explore an idea, with 3M's *well-intentioned failure* approach, requires discipline and dedication. It is not about generating the idea of the day. It does require proposing an idea, and then pursuing it to a conclusion.
3. Building a track record that shows sticking your neck out, taking calculated risks and sometimes not so calculated, accepting the failures with the same assurance and grace as the successes, and demonstrating collegiality when working with others, paves the way for future opportunities. This strategy applies equally to technology professionals and managers.
4. 3M is known for its emphasis on innovation. While ideas come from individuals, successful implementation comes from bringing the necessary talent and resources together to function collegially.
5. Creating dissonance is not frowned upon, it's essential to developing understanding. Nodding a yes or no does not imply understanding. Ideas are argued to obtain clarity and often vehemently, but not personally.
6. Selling an idea requires the competence to define the idea within the context of the organization's resources and infrastructure.
7. Doing what you said you'd do, and taking on projects with considerable risks, builds a track record—and greatly enhances opportunities for gaining future project approval. Knowing the decision-makers, and giving them a pre-sale opportunity, further enhances your opportunities and builds relationships.

In Retirement

After retiring from 3M in 1987, I organized G. H. Gaynor and Associates—concentrating on *managing technology and innovation* from a business perspective. Retirement also included designation as a Senior Fulbright Scholar in Management of Technology (MOT) on two occasions; lecturer at the University of Minnesota Center for Development of Technological Leadership graduate program in MOT, Adjunct Professor at St. Thomas University in St. Paul, Minnesota in MOT; and editorial boards of the *Journal of Engineering and Technology Management*; *Managing Technology Today*; and *The Academy of Management Executive*.

My primary IEEE society activities involve the Engineering Management Society (EMS) and the Technology Management Council (TMC). Chair of the EMS Strategic Planning Committee.; Chair Review of the *Engineering Management Review*; Chair, Professional Development Committee; Society President; Executive Vice President; Vice President Publications; Newsletter Editor; Chair of the Transition Committee for transitioning EMS to TMC; TMC President; and TMC Vice President Publications; Engineering Management Society to the IEEE Technology Management Council; President of the Technology Management Council; and others.

Participating in IEEE galactic came about after a chance meeting, where I voiced my concerns about how little IEEE was doing in professional development for its members; that interchange resulted in being asked to take on the development of a new IEEE magazine on professional development that would become *Today's Engineer*. I became the Founding Editor and Editor-in-Chief of *Today's Engineer*; it was published as a quarterly, 48-page, color magazine that won accolades for editorial content and presentation. *Today's Engineer* now comes monthly to IEEE members electronically. Other committees included: Publications Services Products Board (PSPB); PSPB Strategic Planning Committee; Technical Activities Board (TAB); IEEE New Initiatives Committee; Tellers Committee; Career Services Committee Chair; TAB Finance Committee; TAB Society Review Committee; TAB Strategic Planning Committee; TAB/PSPB Products Services Committee (PSC); PSC Conference Publications Committee Chair; IEEE-USA Business Development Committee Chair; IEEE-USA E-book Committee Chair; and the IEEE-USA Communications Committee.

My publications include about 40 papers on management of innovation, technology management, entrepreneurship, and making a transition to management; and many keynote addresses. McGraw-Hill published: *Achieving the Competitive Edge Through Integrated Technology Management*; *Exploiting Cycle Time in Technology Management, U.S. Edition*; Exploiting Cycle *Time in Technology Management, Chinese Edition*; *Handbook of Technology Management*; and *Handbook of Technology Management, Spanish Edition*. The American Management Association published: *Innovation by Design, U.S. Edition*; *Innovation by Design, Chinese Edition*; *What Every New Manager Needs to Know, U.S. Edition*; *What Every New Manager Needs to Know, Chinese Edition*; and *What Every New Manager Needs to Know, Korean Edition*. Also, IEEE-USA published the following E-Books: *Doing Innovation – Creating Economic Value* (a series of four e-books); *Leadership in Managing Engineering and Technology* (a series of four e-books); and the *Management of Technology*, e-book.

Parting Thoughts for Pursuing a Career

Developing a career is a personal journey; it is different than looking for a job. It's very difficult to counsel on career opportunities. My career came about under different circumstances than most technology professionals face today. It was guided by the circumstances in which I found myself, and the knowledge of the generation that preceded me, a generation that witnessed the importance of technology in lifting many of mankind's physical burdens. That prior generation that preceded me provided insights into the future of technology.

A career requires describing one's purpose, taking into consideration personal aspirations, interests, competencies and capabilities, attitudes, and physical characteristics. In my own case, repetitive work was anathema, and opportunities offered over a lifetime allowed me fulfill my aspirations. There was too much exciting new technology out there to limit myself to a narrow field. As I later became involved in technical management, I needed to look beyond my own discipline and focus on integration of multiple technologies: bringing a new product to the marketplace required integration of many technologies, and interaction with many other organizational functions and disciplines. I was privileged to share a vocation and an avocation: that makes a great combination, but may not be available to everyone. But in the final analysis, it's necessary to recognize the opportunities to further your career, as you describe them.

1. First, and you already know this: absolute integrity, respect for people, dedication to work and colleagues, appropriate energy levels, persistence in failure, realistic level of self-confidence, courage to raise the critical issues, and a sense of personal security are essential for a successful career. Don't demand for perfection, or expect some unachievable ideal; but when people stray from the fundamentals of acceptable human behavior, the consequences often create conditions that prevent recovering the spirit for creating opportunities. It may take a long time to build a sense of collegiality, but that collegiality can be destroyed with a single thoughtless act or statement. There are anomalies where bullies have been very successful, but that's their choice.

2. We define success in our own terms. Success in any organization involves interaction with others and much depends on the attitude with which we approach working relationships. Here is a list in alphabetical order of attitudes that make a difference: being agile, committed, flexible, focused, proactive, reliable, self-confident, and sensitive to situation requirements. The dilemma we face is to determine the appropriate level of application. As examples: 1) focus is essential, but there are times when focusing through a wide-angle lens is absolutely essential; and 2) being flexible in working with colleagues builds collegiality, but will acceptance of too much flexibility lead to acceptance of groupthink. Decisions need to be guided by judgment.

3. Know and understand your limitations. You know your strengths, so use them and continue to develop them. We know that, all except for a few, long-term career success involves a combination of competencies. We know that multiple competencies build personal, as well as organizational, capability. Competence in technology only is

no longer sufficient. In 1997, Joseph Bordogna, then acting Deputy Director of the National Science Foundation writing in the *IEEE Institute* reminded the technical community that:

> *"The future belongs to those who can make sense of the complex, to those who can take an idea from conception through the functional integration of many complex technologies and disciplines to product realization, to those who can put complex products out the door."*

Norm Augustine, at the time the retired CEO of Lockheed Martin Corporation, reminded engineers:

> *"In my career, I've seen engineers do a beautiful piece of work, and then make it sound like garbage when they write it up."*

Bob Lutz, the former Chrysler Vice Chair, in response to the question: What competencies beyond the technical should engineers have, replied:

> *"Engineers need to be, like anybody else in business, proactive and somewhat outgoing. And they need to reach outside specific technical areas. Mainly, engineers need to be good communicators, because there is no point in achieving an engineering breakthrough, having a new idea, or coming up with a new material, if you can't get your colleagues excited about it."*

4. Leadership! Who provides leadership? Leadership is not limited to the executive and management levels in the organization. It includes the technology professionals, and colleagues in other organizational functions and disciplines. Technical professionals today perform the management function, because of their input to the decision-making process. So the distinction between managing and leading quickly loses its significance. A manager who cannot lead is not a manager, and a leader who cannot manage is not a leader. Managing and leading are opposite sides of the same coin. But the manager/leader takes on serious responsibilities. Henry Mintzberg reminds us:

   > *"No job is more vital to our society than that of the manager. It is the manager who determines whether our social institutions serve us well, or whether they squander our talents and resources."*

   We have all witnessed situations where talents and resources have been squandered and resulted in negative consequences for individuals, as well as the organization.

   Instead of leadership I prefer to use the term "taking the lead," because no one manages or leads 24/7; there are many opportunities to lead, and those opportunities involve all segments of the organization. Advances in technology have changed the role of technology professionals who now become major contributors to the organization's decision-making process. The organization's CEO and senior executives did not provide the technology input for developing Boeing's 747 Dreamliner; this information came from many levels of Boeing's technical community. In smaller organizations, the technical professionals have an opportunity to proactively take the lead in promoting new technologies, products and processes.

Taking the lead involves accepting responsibility and accountability; making judgments on available facts plus intuition (algorithms do not take all issues into account; making the complex simple, obsolete the present before its time, develop a proactive business philosophy, promote a positive attitude, and follow through with clear decisions. These items are not "to-do's," but actions that define what it means to take the lead.

5. Whether we're technology professionals, managers, executives, customers, or suppliers, we work with people—and those people relations determine long-term success. Organizations do not reflect utopia, there will be conflict of ideas, and conflict among personalities and a successful career requires finding a way of dealing with them, without compromising one's basic principles and values. Conflict in considering ideas or decisions must be devoid of personalities. Once personalities become involved, it may be best to end the conversation. Over the years, I have heard technical professionals argue to the *nth* degree on some point; and in the process, destroy relationships with those involved, without gaining any major benefit. I have heard senior managers and executives argue irrationally, only to find myself responsible for resolving their disagreements. But my personal credo was simple: get agreement on eighty-percent; in the end I'll get the other twenty-percent, if that twenty-percent is important. Compromise is not a pejorative word, but essential to go forward. Recognize the differences among people, their cultures, and their modus operandi—and respect those differences. But once a decision has been made, everyone needs to focus on the objective.

Personal Endnote

As you can see from this history, changing jobs and locations came with my assignments, seven major relocations. During my generation, if you were asked to move, you generally accepted the move. Changing location is more complicated today, when both parents are working. Over the years, opportunities were presented that allowed me to develop multi-disciplinary competencies—both as related to engineering and management. But, those experiences occurred over many years, by accepting challenging and risky projects when they were available. There is no doubt that at times these projects solely garnered my curiosity, and many pieces to the solution were missing. Did I get into trouble occasionally? Yes, definitely—but if I got into trouble, I put in whatever effort was required to solve the problem. The solution often not only involved personally working around the clock for days, and what seemed like months, but also searching for any knowledge and resources from others. There is a significant difference between doing things with the knowledge and experience you have, and doing things that force you to stretch. It's the stretching that builds successful careers.

This is my story. This is the way I did it. You can't duplicate it, because you're not me. Keep in mind that it's *your* career. Learn what you can from the experiences of others. Every experience is a learning opportunity. And good luck in meeting your future career aspirations.

—Gerard H. (Gus) Gaynor

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