Making a business out of a hobby

Where I'm coming from with this story

I've always been a "builder." I can't remember a time in my life when I sat around with nothing to do and idle thoughts filling my mind. Whether it was school or hobby or job, there was always another technical problem to be solved. Building a business was just like building the boat I built in high school or my latest Sherline accessory. Each has consisted of simply solving a series of problems until the project is complete, then on to the next. Writing this book hasn't been any different, and it has created many new and interesting problems for me.

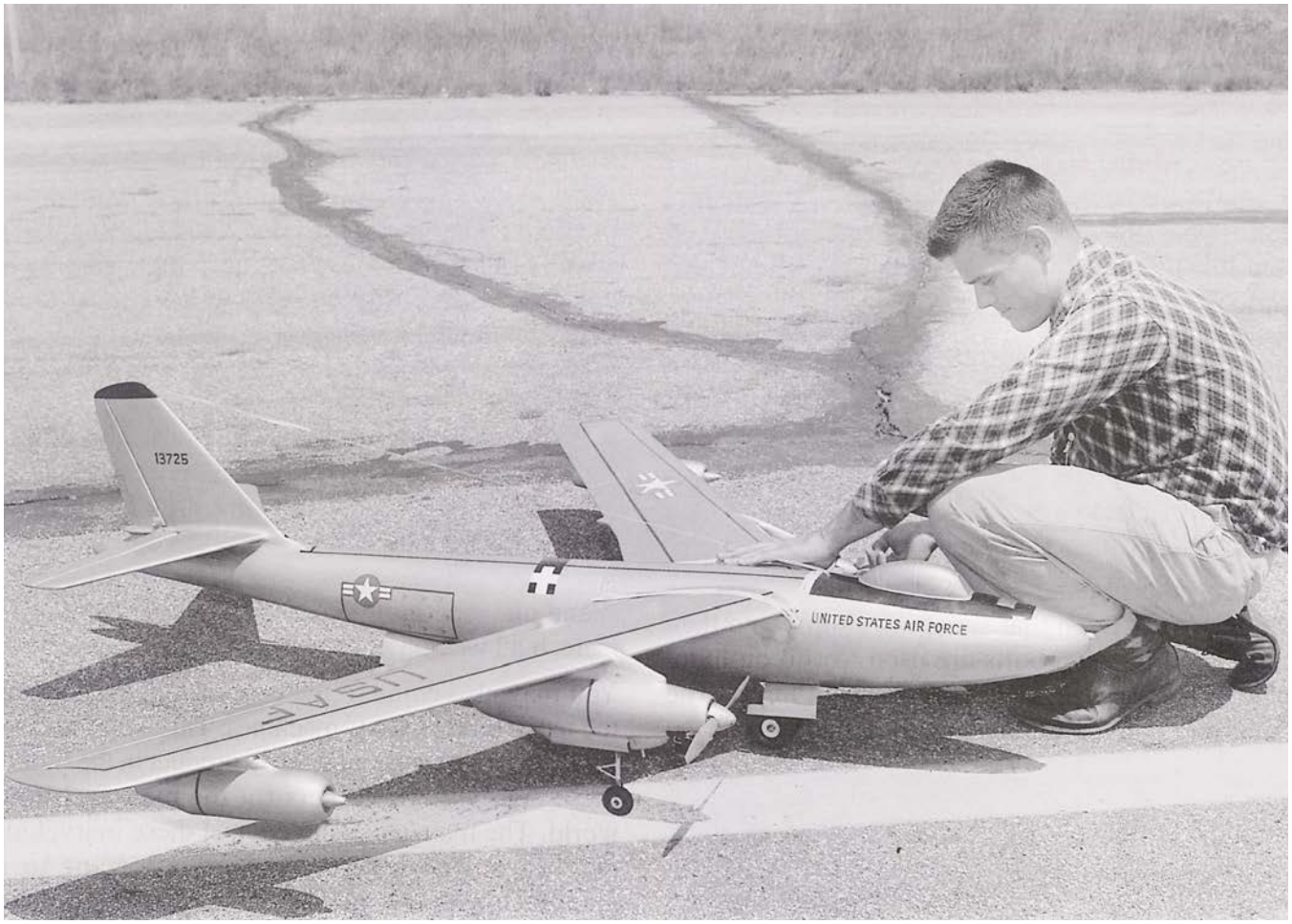
The main problem I'm having with this book is similar to a design that starts out simply and then too many nuts and bolts are used to add on more pieces. This, in turn, makes the design a "loser." The "nuts and bolts" I'm referring to in this story is the word "I." As I read and rewrite this story I can't seem to get rid of it. As I'm trying to explain the problem I keep adding it. I don't want to sound like a bore at a cocktail party, but every sentence I try to put together has the word "I" in it. In thinking about the problem for a while I realized it was the result of simply not having enough money. I'm not talking about money for a better education where I might have learned more about fancy words and proper writing. I'm referring to the money it takes to be able to pay other people to solve problems and do your work for you. I have always had to solve the problems or make the decisions myself. Money to spend on something I could do myself just wasn't there, but I wouldn't have wanted it any other way.

Joe Martin on the cover of a 1964 contest program holding one of the many R/C models he has built.

You may also come to the conclusion that I spend too much time on CNC machines. This isn't the case, for if you wish to manufacture a product in the future, these are the new workers for the manufacturing world. The managers who control these marvelous machines will become more important to a manufacturing company than the managers who control your finances. These will be the machines that will create the profit a company needs to survive. Whether you build the product or "farm the work out," in order to have competent suppliers you must have a general knowledge of the systems available, whatever your endeavors.

Starting a business with little or no money has its advantages

It may surprise you to learn that I believe starting a business without any money can actually be easier because you don't have anything to lose. A lot of the pressure is taken away because the worst thing that can happen to you is you may have to go back to working for someone else again. This is the logic I used when I left my good job at Kraft Systems and started out on my own again. I hope you may find a use for the philosophy I used to create Sherline Products or at least find it interesting. There are still thousands of products that haven't come to market, and the opportunity still exists to start out on your own. However, please don't take on this challenge if your success is going to be achieved at the expense of someone else. There are enough "wheelers and dealers" in this world, and we don't need any more.



Another shot of a very young Joe Martin and his B-47 model from about 1964.

Making good decisions

My story may be useful to someone with a fair amount of skill and intelligence who is willing to work hard, but not to a person who didn't take the time to discover how things work. Standing in front of a mirror convincing yourself that you "can and will" just doesn't cut it in my world. "Feeling good about yourself" doesn't result in success; it results from success. Success comes from making good decisions, and decisions are simply educated compromises. You can't make good decisions without a great deal of knowledge about your subject. Being a self-taught person, I probably suffer from a bit of "tunnel vision," but I've knocked a lot of meat off my knuckles working for other people. I've been on both sides of the fence, and the conclusion I have arrived at is whatever side you're on will be the most difficult. The fence is too high to see the problems on the other side.

Getting an early start with radio control models

After graduating from Cranston High School in Rhode Island in 1953, I started building radio control model aircraft in my spare time. (My full time job was working at the building trades as an asbestos worker.) I had been building model aircraft for some time, and the radio control aspect of modeling excited me to no end. The controls at that time were still rather crude; in fact, transistors hadn't been invented yet, but having the ability to control a plane and land it in the same field from which it took off was like science fiction to me. My job in the building trades required that I travel often, but I still managed to get my models built by taking a week or so off at the end of each job.

A "no excuse" hobby

What was really interesting about the hobby to me was that a good modeler could design, build and fly his creation without help. If all three of these things weren't done correctly the model aircraft would crash. A good model may have had hundreds of hours of labor and many dollars invested, which made the first flight very exciting. Your money and prestige were on the line when a model was released for its maiden flight. A good flight was a win.

Success or failure wasn't a shared experience, and that's the way I liked it. To make it more interesting, you could compete against one another at model aircraft contests. It is as much of a sport as any ball game. You are controlling an object that is traveling at speeds in excess of 100 miles an hour. The timing has to be perfect to execute the maneuvers required. Your aircraft has to be "set up" just like a race car. It is a very difficult hobby and sport because failures are crashes. This teaches you the facts of life when it comes to designing and building anything. Do it wrong and you will crash. What a simple rule. You can't make excuses because you did it all yourself.

A craftsman is accountable for his work

Workers who build things understand this rule, for if you tell a machinist to make a part, it has to be right or he loses his respect as a craftsman. Compare this to the job of a salesman. You sit down and start negotiating on a new car. The salesman makes you so mad you leave and go to another dealer. The salesman screwed up everything so badly that his dealer lost a good customer; however, the salesman can tell everyone that the customer was an idiot who didn't understand automobiles. He has someone else he can blame for his failures. There is no good way to evaluate people in jobs like this. With a craftsman it is simple: the part is either good or bad. I believe this is why I have always preferred to have friends who build things. They don't have time to make excuses. If they don't do it right they crash.

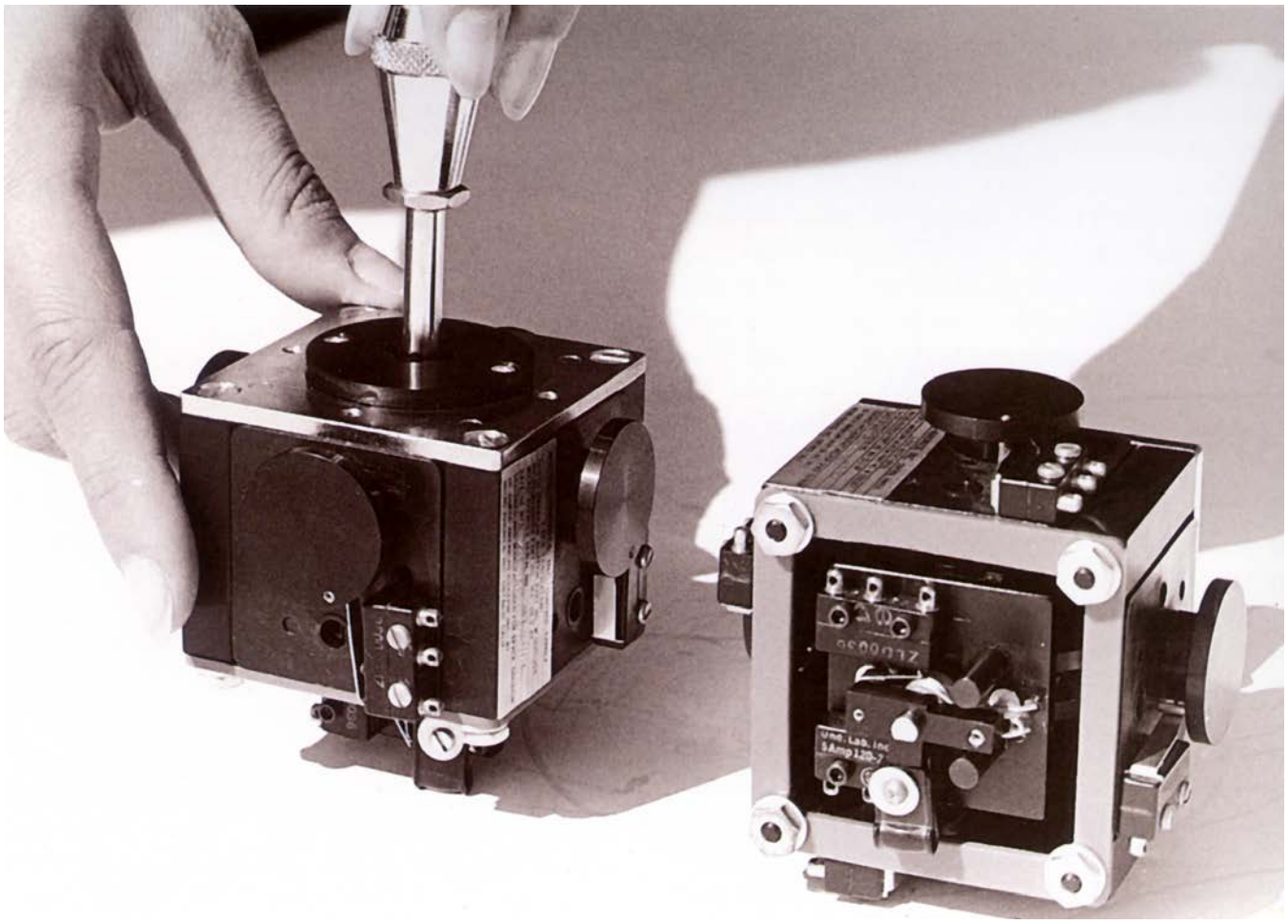
Being a business owner — my fourth best talent

Starting a business was a natural thing for me to do. My modeling friends were starting all types of businesses to supply this new hobby. I will always consider myself a modeler first, a product designer second, a machinist and toolmaker third and a businessman fourth. Being a business owner is easier if you can do everything yourself as I can, especially when it comes to the tooling. The specialized tooling it takes to manufacture a product at a reasonable cost can be very expensive. I paid for it by working an extraordinary number of hours. Don't think for a moment that I was smarter and learning is easier for me than other people. The difference is I'm persistent. I can remember screwing up a part on a Sunday night after working all weekend on it, going home and catching a little sleep and starting over by six Monday morning. There are very few projects I seriously started on and didn't finish. People who don't finish projects on their own shouldn't start a business unless they have enough money to pay other people to finish what they start. I don't spend much time looking back unless it is for information I can use in a positive way.

The secret to success when it comes to working with people is simply that; you work with your employees more than you have your employees work for you. All you have to be is fair and accept their mistakes as you would accept your own errors. As your company grows your own errors will grow exponentially. The reason for this is that your decisions are only the "tough ones." Your managers will make the easy decisions. You get stuck with "the damned if you do and damned if you don't" type. One of the hardest decisions to make is when to let someone else make a decision. You hear all this crap about micro-managing. These can be buzzwords for people spending other people's money, but when you're spending your own money and you don't have much to spend, it takes a lot of guts to turn your back on anything that could speed you on your way to the poorhouse.

I have a couple of rules at my company that have worked quite well over the years. One is: "You can't tell a worker how to do a job unless you can do that job yourself." I don't mind management people telling workers how many parts to make or when to make the parts. They can suggest a new method, but the craftsman who does this work has the final say unless that manager can show him how to do it better, not just tell him. Another rule I would like to slip in is "If you hired an employee, you fire them if they don't work out." My managers can't leave this nasty task to anyone but themselves. It has to go with the territory they control. Managers who can make this decision too easily are not much better than the ones that can't make it at all. If a company wants employees who "care," a company has to care for employees in a like fashion. Employees have to believe they are more than a machine that runs eight hours a day. Many managers have never learned this because they have never worked at a job where their performance was easy to check. Having a recent engineering graduate with a stopwatch stand behind a worker with twenty years of experience isn't a good way to build unity in a company.

It isn't hard to be a hero in today's business world where BS is king. We just treat customers the way we want a business to treat us. A recommendation from a satisfied customer carries far more weight



Joe's first experience with miniature machine tools was in building these custom joysticks designed for NASA to help learn how to land the lunar module.

to a potential buyer than what could be said in an advertisement. By the same token, a bad word from an unhappy customer can cost you sales. They say a happy customer tells ten other people, but an unhappy customer tells a hundred. Some of our most devoted and loyal customers are not the ones who have never had a problem, but rather ones who have had a problem and had it taken care of promptly and politely. Unfortunately, in today's business climate, good service is becoming more of a rarity, and it is a relatively easy place to stand out from the rest.

A first experience with miniature machine tools

My interest in miniature machine tools started while working for a company called Micro Avionics, which manufactured control systems for model aircraft in the late sixties. At that time we were using better control systems for model aircraft than the military had developed for their own use. I was asked to extensively modify a couple of model airplane joysticks to control a model of the moon lander being developed by NASA. To simulate weightlessness in space they flew a large transport aircraft in a trajectory that temporarily eliminated gravity. For a few minutes at a time they would try to control this contraption with jet nozzles in zero gravity. Micro Avionics had taken the contract for the control electronics without giving much thought to the switches that would control the device. When we found out what they really wanted for joysticks we were in big trouble because we didn't have time to contract out the machining. I worked with mechanical devices at the company so it was my "baby." All we had for tools was an old drill press. Fortunately for me, one of my modeling buddies, Carl Hammons, who would later become my partner, had an old Unimat lathe and let me use it for a few weeks. These miniature lathes came out around 1955 and sold for $99. They were packaged in a nice wooden box and became an immediate hit. They sold thousands. The only machining experience I had prior to that was one year of metal shop in school, but I was a modeler. A good modeler

can accomplish what needs to be done with what he has at hand. Modelers have developed this trait by simply not having enough money to do it any other way. The Unimat wasn't rigid, making it difficult to hold tight tolerances, but it was a lifesaver to me and I got the job done on time.

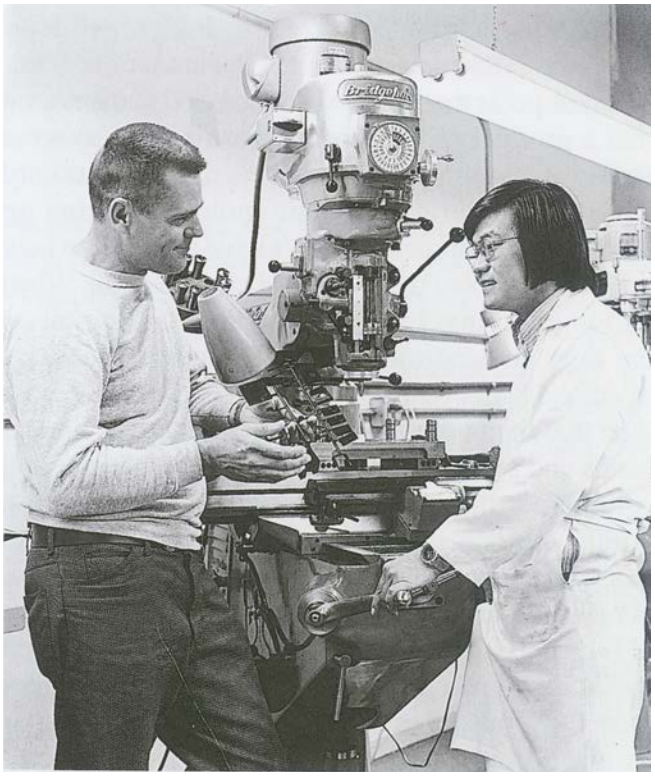
Don Mathes, the owner of Micro Avionics, was typical of some of the real clever designers I met in my life. He drank way too much. I'll never understand why this talented group can find so much happiness in a bottle. Don was supposed to do the electronics on this project and he went on a drunk. With only two weeks to go, he showed up one morning looking like death warmed over. He was shaking so bad that if he were standing on the beach he would have disappeared into the sand. By four in the afternoon Don again took on the appearance of a human. He worked all night and laid out a circuit board with black tape at a scale of four to one. He skipped the component layout completely and laid out a board that had over a hundred components in a very short period of time. This was long before computer programs and multilayer boards. It was a work of art with the components spiraling towards center; in fact, it was so good it appeared on the cover of an electronics magazine. As soon as it was checked out, Don was off again to complete the drunk he started. He came back a couple of weeks later looking good and never mentioning where he had been. Don died long before he should have.

With a partner, I start my first business

My next project in machining came when Carl Hammons and I started a business to manufacture connectors for the radio control industry. Micro Avionics decided they could get along without me because I found it impossible to get along with the owner's girl friend. She had the ability to destroy perfectly good parts faster than we could make them. The straw that broke the camel's back was when she and her girlfriends were assembling servos and a gear shaft had a burr on it. She decided to use a hammer to force the shaft into a plastic gear less than a penny in size. After I showed her how to deburr the shaft and assemble the gear train properly, she reverted back to her hammer and destroyed two trays of parts worth $500.00. I blew my top and got fired. Don and I still remained good friends because I knew he was between the old "rock and a hard place". He soon realized I was the only one who knew how to build their connectors. He offered me an opportunity to start my own business to supply them. I rented a 1500 square foot shop in an industrial area in Upland, California and I was in business.

I didn't need many tools to produce these connectors, and I got started using the modeling tools I had at home. Summer came and I found out how hot a small shop could get. At that time my idea of a successful business was one that could afford air conditioning. I would work long into the night building tooling when it was cool, for I had to build connectors during the day to pay the rent.

In reality, I was just assembling connectors. The existing design was somewhat of a compromise, and I wanted to redesign them and make them properly. Most radio control manufactures at the time were using a connector manufactured in Mexico. Because of the low labor rates in Mexico I had to come up with a way to match their prices and at the same time make it small and easy to use. It would have to be injection molded from plastic. A local mold maker gave me a price. To build a mold for our product would cost over ten thousand dollars! This is where my career with machine tools really starts. We bought an old mill and a lathe from a company that wasn't using them any more. I was informed



Joe with machinist and longtime friend Benny Taguchi examine a molded part at Kraft Systems.

that these were the tools that had been used to start their business. These machines had a sentimental value to the owners, and they sold them to me at a very reasonable price. I believe they were thinking, "Maybe these tools can start one more business before they end up in a junkyard." We rescued them along with an old four-ounce Van Dorn injection-molding machine that Micro Avionics didn't need anymore after firing me.

If you can't afford to hire a toolmaker, become one

There was a mold maker in the area who suggested that I should attempt to build the mold myself. He gave me a general idea of how a plastic mold was made and where to buy components, and I was in the mold making business. Getting me pointed in the right direction at the start was my friend's real contribution, and it would be hard to evaluate how much time he saved me. I have always found if you need help on a project don't ask for too much. I started on the project and didn't ask for help until I really needed it. I read what I could on the subject, but my friend saved me from a many time consuming errors. I consider it an accomplishment that we were even better friends after the mold was completed. You shouldn't attempt to have your teachers do your work, because at that point you start using them. Who wants to help a lazy person?

Production machinist vs. toolmaker

Another point that should be discussed is the notion that a production machinist doesn't have to be as skilled as a toolmaker. These were my thoughts until I went from building plastic molds to setting up production equipment. I didn't have a clue as to how little I knew about the process of cutting metal. When building tooling, I would put a little cutting oil on the work and control speed and feed by the amount of smoke I was generating. You have to know more than that to cut metal in a production environment. Gears, cams, and computers that don't allow for errors, control feeds and speeds. If you are drilling one hole in a piece of tooling it doesn't make much difference whether it takes one minute or two, but if you have 10,000 holes to drill that difference will cost 10,000 more minutes, which is an extra 167 hours of machine time. When you consider that most CNC machines cost over $60 an hour (a dollar a minute) to operate, that extra minute you wasted drilling a hole comes out to $10,000 lost.

Minor irritations in working with hand-me-down tools

The milling machine we purchased would "drive me up a wall" when I started building tooling for plastic molds. The handwheel for the table turned in the opposite direction from the way it should. Normally, if you turn a handwheel clockwise on any machine tool, the slide will move away from you. This may seem simple, but when you have a cutter in a mold cavity that you have been working on for a week, you take the chance of ruining it by turning the handwheel in the wrong direction. Just thinking about it would make me break out in a cold sweat. Also, if you allow a cutter to run in a corner too long it may chatter and undercut the cavity. This wouldn't ruin the job but it could take countless hours to get rid of the flaw with polishing stones. This backwards handwheel never came naturally to me, and it was like trying to drive a car that had the steering reversed.

A few doors away from my shop there was a machine shop that allowed me to use a surface grinder to put the finishing touches on my mold. Each time I used it I would clean the grinder up to show my appreciation. Since then, I have helped several people in the same way and let them use the equipment in my shop when they were in a bind; however, I never seem to find my machine any cleaner when they are done.

It took about three months to complete my connector mold, and I was quite proud of it. It was what is called a "family" mold, which means a complete group of parts is produced at every cycle. When the mold closed, 180 pins had to mate with the opposite side, and the diameter of many of these pins was only 1/32" (0.8mm). Now I had to teach myself how to operate an injection molder. The injection molder we purchased was old, and old machines had a plunger-type injection system which left much to be desired and didn't have any instructions; however, I didn't know enough about it to realize how much of a problem they could be. Setting up this machine was a big deal for me because it was my first experience with an automatic piece of equipment. This fascinated me because it could be doing work without me standing over it. It took about four hours to get a good "shot," and soon the machine was producing good parts at a rate of 90 cycles per hour. I sat in the office with a big smile on my face listening to the old molding machine make good parts. You would think that now, after thirty

years of owning and operating automatic machines, they would have lost their fascination to me, but they haven't.

The contacts for the connector would have to be made on a Swiss type screw machine. It is a specialty type machine, and I didn't have the skill or the time to produce these parts myself. It was by chance that I contacted a company called Screwamatic, which was listed in the Yellow Pages. I could never have found a better source. The Yellow Pages have been very useful over the years, and it is where I usually start looking for something new. The next choice at that time was the Thomas Register, which is a collection of books that lists manufacturers of most everything. Today I use the World Wide Web or the Internet to help locate new sources, but sometimes I still start with the telephone directory. Many companies will refer you to another if they can't help you. We started with orders for 25,000 pins and worked our way up to ordering a million pins at a time. Their quality was 100% and it inspired me to improve every project I have worked on since then.

Each new tool I acquired was treated like a treasure in my shop. They were always used and somewhat worn out, but I could usually find a way to get them running and put them to good use. I soon had enough tools and skill to build simple plastic molds and did a small amount of contract work. How I wished I could have afforded the time to work for a mold shop for a couple have years where I could have properly learned the mold making trade. I really liked that type of work. I found it exciting to test a new mold I built and see if I didn't make any errors.

Looking back at it I often wondered whether I would have been better off buying one new machine rather than buying several used machines. I could have contracted out the work that required these specialized machines and concentrated on only doing basic machining. In some cases learning to operate some of these specialized machines was, in fact, learning a new trade. As I think about it, the main thing I learned was how to teach myself how to do different things without a teacher. On the other hand, each time I contracted out work, I would end up with problems with their delivery dates or price. At least I had control over my old equipment, and I found it less frustrating to fix a machine than argue with a supplier.

Our next project was a servo for RC aircraft. At that time, it was to be the smallest servo on the market.

PHOTO: GEOFF O'GALLAGHAN

The Australian factory of Ron Sher Pty. Ltd. where the first Sherline machines were produced. Loose production tolerances of the early machines caused assembly to be a time consuming "mix and match" process.

Injection plastic molds were a lot harder to build at that time because EDM machines (electrical discharge machine) were not available to small shops. To build a new mold and keep the doors open at the same time with only two employees took great effort on my part. It could take over 500 hours to build the mold. I usually worked on it when I was alone after hours. Twelve-hour, seven-day weeks were normal. A vacation was going to Los Angeles to a machine tool auction.

Kraft Systems takes control of my company

We started selling our connectors, but we weren't surviving financially. Carl, my partner, was still working at General Dynamics as an engineer, and the business was more of a hobby to him. Carl might come up with a few hundred dollars to by an interesting machine, but when it was necessary to pay the thousand dollars of bills for rent, labor and supplies, he wasn't interested. I would have to go without a paycheck. Phil Kraft, owner of Kraft Systems Inc., offered to buy me out and start another company to manufacture our connectors for his company. We would also supply connectors to "Heath Kit" for their radio control kits. I would be a 25% owner and Carl would be a 10% owner of this new corporation that would be called Multicon Corp. At this time, Kraft Systems was rapidly becoming the largest manufacturer of radio control products in the world.

This YAG laser gives Sherline the capability to engrave its own parts in-house. Doing as many jobs as possible in-house not only helps you control your own schedule and costs, it also gives you an excuse to buy more neat machines. If you look closely, the small bright spot of light in the green window on the door to the laser enclosure is the point of the laser beam actually burning numbers into a part.

My job would be to integrate our connectors into their products and develop products for the model aircraft industry. The servo Carl and I developed would be turned over to another division. I wasn't too happy about this arrangement but realized it could create problems if I marketed it. We had hundreds of hours of labor and design in this project and were only paid for the outside cost we had spent. Unfortunately I wasn't in a position to argue this point. Kraft Systems sold over one hundred thousand of these servos, and it pleased me that our design was accepted, but the fact that Carl and I never made a penny on it always bothered me.

Kraft Systems was profitable and could afford to pursue new ideas. A division was also formed to manufacture a model aircraft engine. I sat in on an early meeting to discuss this project and lost faith in its success when we were told to the penny what it would take to build an engine. It would be impossible to predict costs this accurately, and I don't trust people that BS me. Roger proved me wrong about having the skill to build an engine but also proved I was right when it came to anticipating cost, which was off by 100%. We beat our brains out trying to build an engine that could be sold at a retail cost of under $100.00. The biggest error we made was not realizing how much the future modelers would pay for a good product. We should have been trying to build a $300.00 engine that was really better than any model engine currently on the market.

Phil Kraft, the sole owner of Kraft Systems Inc., was an interesting person to be around because of his many interests. He started in business by designing a small, single-channel radio control receiver that would fit into the plastic case that nickel cadmium batteries were sold in at that time. Transistors and nickel cadmium were new to the market at that time, and modelers were putting both to good use. Phil even put the box to good use. It was one of the few receivers that actually worked, and it gave Phil a good name in this new industry. It wasn't long before Kraft Systems was a leader in producing new radio control equipment. A spin-off business that became successful was manufacturing the joysticks we used to control our models. One of our first customers for joysticks was a manufacturer of electric wheelchairs. Then, the computer people found a use for joysticks and sales took off. They became the major part of sales for Kraft Systems after Phil left his company.

The fact that Phil was a serious contender at any R/C contest and even won the world championship was of great value. I remember a photo session taken outside of the Kraft building in Vista where all the modelers (aircraft) who worked for Phil Kraft lined up with the trophies they had won on the ground in front of them. This picture wasn't rigged, and we had so many trophies on the ground we couldn't put them all in the picture. How I wish I could have had the advantage of all this input into my own company. In thirty years of business I've only had two employees take an interest in hobbies that would use the equipment we manufacture. The reason could be that it isn't a diversion for people who work with machine tools for a living. Never pass up a potential employee who takes an interest in the products you manufacture.

Phil was also buying expensive sports cars and aerobatic aircraft at the same time. I'm sure you have heard the expression "He who dies with the most toys wins." Phil was and still is a serious contender in this event.

Valuable lessons learned

I was becoming a mold maker who could make molds for my own products but was not really good enough to make molds for industrial customers. This didn't particularly bother me, because I wanted only to make molds for my own products, not do contract work. I made several other products, such

as a joystick and a retractable landing system for the R/C industry at Kraft Systems. I learned a lot while doing it. Phil wanted me to develop a ready-to-fly R/C aircraft, and I was working diligently on the project until he told me he wanted a retail selling price under $100 with a 45% discount to dealers. It became an impossible mission because I had over $30 in outside cost. It wouldn't be worth the effort financially because it left only $25 to build, package, advertise and sell it. I couldn't work on the project without an attainable goal and wanted out.

All and all, I learned about good design, tooling, packaging, advertising and the value of good instructions while there. All of what I learned would come in handy later. As I look back at my stay at Kraft Systems it was good for me, and I believe it was good for Kraft Systems as well.

My first look at a Sherline lathe

Kraft Systems owned part of a company in Australia that assembled and distributed Kraft products in the South Pacific. They sent us a Sherline lathe, which was built in Australia, for evaluation. It was of interested to me because of the experience I had with the Unimat working on the NASA project. The Sherline design was far more rigid and had some other features that were superior to the Unimat. My love of tools told me there was a market for a small lathe such as this. At about the same time Phil Kraft decided to sell Kraft Systems Inc. to Carlisle Corp. There wasn't any interest in the Sherline lathe at Kraft because radio control and joystick sales were growing rapidly, and with the new owners taking over, the lathe was forgotten by everyone but me.

I stayed on at Kraft for a year or so but the interest in the job I had before the sale just wasn't there any more. This fact was brought to my attention when another partner, Chuck Hayes, asked me during a conversation at lunch, "If you're so dammed smart, why in the hell are you working here?" I thought about that for about five minutes and gave my two-week notice that afternoon. I was a person who needed to have more control than I could have while working for someone else. It was very difficult to work on a project I didn't believe in, and I wanted to make my own way. Chuck only brought this fact to the surface, and I didn't leave because I didn't like the people I was working with.

Once I had made up my mind to leave I was fascinated by how fast I lost all interest in the company. Until then, I would wake up in the morning thinking of the days, weeks or year's task to perform at my job. Suddenly the interest was gone. It was as if someone flushed all the problems from my mind. I slept like a baby even though I wasn't sure where I was headed. It was obvious that this was a good decision for me.

My friends and family thought it was a very bad decision and wasted a lot of time trying to talk me out of it. I didn't get any help from any of the contacts I made while I was at Kraft Systems but I didn't expect any. My biggest loss was not having the time to be a real modeler anymore and drifting away from my modeling friends.

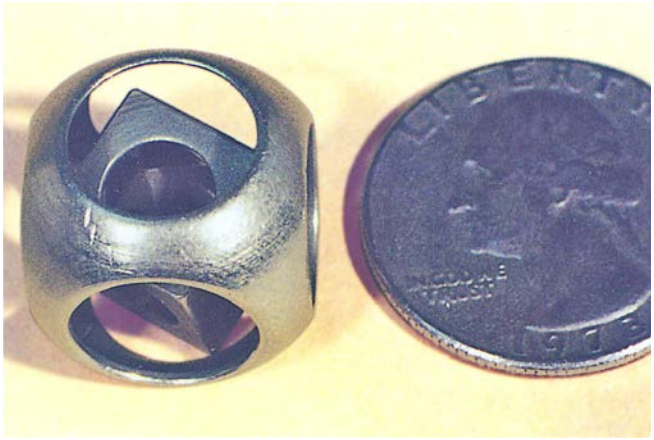
The next venture: a great hobby knife that didn't sell

I took the money from my portion of the sale, $40,000 after taxes, and started another company. Carl, my old partner and friend stayed at Kraft while I started Martin Enterprises. I contacted Ron Sher, the manufacturer of the Sherline lathe in Australia, and told him that I had left Kraft and was interested in marketing his products in the United States. Ron needed someone to represent him in this country and, at that time, I don't believe he had too many choices. We agreed to take this to the next level, and I ordered a few machines to start the venture.

A catalog sheet for the E•Z•Loc knife...a "better mousetrap" that had no one beating a path to the door.

I had lots of time while waiting for the first machines and started thinking about a new product I could make. I wasn't lacking ideas, but the product had to be one that could be produced with limited funds. The first product I chose was a hobby knife that locked from the back end. I had used tools like this for years, and what I disliked about them was the blade would come loose if you turned the handle counterclockwise when the blade was taking a heavy cut. I had given myself a nasty cut because of this flaw, so I designed one that would eliminate this defect and use the standard blades available. I had a screw machine shop make me the parts for two sizes. I didn't know enough about manufacturing at the time and added too many costs to the product with my inexperience. It never sold well enough to make it worth the effort. The money to be made on products of this type has to made producing the components or purchasing them in such large quantities that a reasonable retail price is attainable.

From this venture I learned that if you build a better product, the world would not beat a path to your door unless a distributor can make more money on your product than he is presently making on the similar product he is now marketing. The first question usually asked by distributors was, "What's the discount?" If they didn't like the discount they wouldn't even listen to your sales pitch. It makes more sense to me now that I realize sales organizations are more interested in selling the products they already have on the shelves than they are in selling yours. They will stock something new only when they are forced to by consumer demand. I also learned that if you advertise your product and it isn't on the shelves in the appropriate retail market, you might end up selling your competitor's product. The storekeeper is going to try to sell what is on his shelves first. In other words, if a Sherline ad inspires you to purchase a lathe and you go to your local hobby shop where they have an old Unimat on the shelves, that is what they will try to sell you.



Here's a project that was made strictly for fun, not function. This cube within a cube within a cube is an interesting conversation piece. Made from one solid piece, the cubes will not fit through the holes. How would you make it? This very small example was made by Dick Saunders.

Australian Trade Office gets help in contract with Sears

Before Ron Sher and I had any agreement, the Australian Consulate in Chicago had Sears interested in selling the Sherline lathe, and for Sears to sell the lathes they needed to deal with a U.S. representative. We met in Chicago at the Sears Tower. A representative from the local Australian trade office had arranged the meeting. A representative of Sherline Australia, a buyer for Sears and I were there. We all knew what the other party was going to pay for the product and charge for the product as it passed through our companies. It still took another trip to Chicago to get the order. The buyer was very apologetic and informed me the sample machine we had sent them was stolen. Jokingly I told him that our product was so good people will steal it if they can't buy it. Actually I was glad it was missing, because I never had a chance to go through it, and from what I had seen of the quality so far, I was worried. Sears gave us an order to produce the lathe with a "Craftsman" label, but I'll always wonder if we got that order out of sympathy because they lost our machine. I was in business again. The main problem for my family and I was eating regularly until these orders materialized.

An expensive first fifty machines

It was never my intention to manufacture this product. I only wanted to import and service the machines and possibly make a few accessories for it. The first fifty machines were supposed to have been air freighted in time for an upcoming trade show in Toledo, Ohio. They didn't make it in time for the show, but I still sold around twenty machines. At the time, air cargo rates to the South Pacific were very expensive, about $30 for each lathe. The shipment to me was late, so they were delivered to the customers by UPS air to keep them happy. Now I had $50 in each machine just in shipping. The machines were also sold at a very reasonable price to get the product introduced. It worked out

that $40 per machine was lost even if overhead and my labor weren't included. In addition, the quality of the product as it came from Australia just wasn't good enough for the American market, and I had to rework the machines by matching parts and had to cannibalize several machines for parts. Not too good a way to start a new business.

On the other hand, there are few products that can be manufactured and be financially successful on the first go-around. The profit in manufacturing comes from low manufacturing cost, and this isn't possible at the introduction of a new product. There are only two ways to lower production cost. You have a choice of higher quantities or better "tooling". Consider another advantage of CNC machines that lowers nonrefundable tooling cost. The machines may seem expensive, but these machines also hold their value. Compare that with a special machine designed to produce a special part that may take a year to be built and cost more than a standard CNC machine. You'll be lucky to get one cent on the dollar for it if your product bombs out. I would never recommend going for higher quantities as you could end up without any money and with a lot of product that was worthless if it didn't sell. It would be better to take a loss as I did on the first machines to see if the product will sell than to have thousands of dollars in parts left over. Price the product so it reflects a price that could be charged if it becomes successful.

Bigger holes won't solve the problem

The biggest problem I had with the quality of the Australian-made machines was sloppy tolerances. A good example to explain this type of problem would be two holes drilled and tapped in a plate. Now you have second plate you want to bolt onto that plate using the tapped holes. You go to assemble the two plates and the holes don't quite line up. Now you have two choices; either start over with tighter tolerances or drill larger clearance holes in the second plate. If you are dealing with production parts and you make a choice to drill bigger holes you will find out why Henry Ford succeeded when others failed. It becomes impossible to profitably manufacture a product that doesn't have tight enough tolerances. When the tolerances get sloppy it takes your best and highest paid employees to assemble that product, because they have to "mix and match" parts. Never get into the habit of drilling larger holes.

Problems with the Sears contract shifts production to the USA

My name was on the contract with Sears, and I knew I was in trouble if I couldn't get the quality improved. The amount of profit I would receive from a sale wouldn't allow me to spend time reworking the machines. Before going on with this venture I decided to visit Ron in Australia. It is important to realize that by this time I was running out of money at an alarming rate. The visit with Ron Sher and his staff gave me more confidence in his organization. I believed we solved a couple of technical problems and I returned home. I had about four months to get ready for my first shipments to Sears when I got a telegram from Australia. I can still remember it as if it were yesterday. It said, "Dear Joe, losing our bloody ass down here. As of today the products will cost $____." The problem was the new cost to me would amount to a $50 loss on each machine Sears would buy even if I didn't have to do any work on them. Ron wasn't totally to blame because things were changing rapidly in Australia, and he was a victim of circumstances. However, it was my name on the contract with Sears. In reality, I didn't have anything to lose because I was flat broke, but I'd be dammed if I would fail and not live up to what I agreed to. Ron agreed to help me set up production of the Sherline lathe in the USA. I had a Bridgeport mill and an old lathe in my garage and I started making parts. Sherline Australia would send me the parts I couldn't manufacture such as the die-castings. They were very helpful, and I will always appreciate how Ron Sher and his staff handled this matter. I found a motor in the Grainger catalog that I could purchase in production quantities and built a simple speed control. Sherline lathes were now "Made in the USA."

It's "make it or break it" time

I was on my own and had to do it all myself. The first major change I made was to grind the lathe bed. I found an old surface grinder for a $1000, repaired it and put it to work. The imported machine used an extruded brass bed that wasn't very straight. Extrusions are not perfectly straight and have tolerances that allow 0.010° twist per foot. This was unacceptable for any machine tool. The twist and

"I am a great believer in luck, and I find the harder I work the more I have of it."
—Thomas Jefferson

size variation would also cause too many assembly problems, but what was more important was the fact that American customers wouldn't accept a metal lathe that wasn't accurate.

I wasn't even sure I could grind brass. I built a couple of fixtures to hold the bed, but my first attempt was a disaster because the grinding wheel loaded up so fast. I thought I had taken on an impossible task. I added coolant and changed coolant but still no success. What eventually made it work was a new type of grinding wheel that had just become available that was very porous. This worked like a charm, and we only had to "dress" the wheel a couple times a day. Grinding the bed turned out to be the most expensive machine operation in building the lathe then and now, but it was necessary. A tool has to perform the work it was intended to do no matter how low the selling price.

An interesting problem arose later over the angle I chose to grind the bed dovetail. When I built the tooling to hold the bed for grinding, I simply copied the existing angle using an indicator so it would match the associated parts. I never accurately checked the actual angle. I wished at that time that it were a standard dovetail angle because I wouldn't have to make special cutters that we matched to a gauge. I later measured the angle and it turned out to be 55.5°. Twenty years later I was accused of using that angle because it couldn't be easily copied. When I found it being discussed on the Internet and few believed me I began to understand how politicians feel when these complex conspiracy theories are laid in their laps.

At the same time I was looking for and found an extrusion company to produce the basic lathe parts needed. There wasn't any other way to produce the machine at a reasonable cost. Customers sometime believe that we could produce a machine with heat-treated and ground steel slides for just a few dollars more. The truth is, it could easily cost twenty times more. I believe the choices we have made give the customer the most "bang for the buck."

The method Sherline Australia was using for a gib (the adjustable piece used to remove "slop" in machine dovetails) was unsatisfactory. It was hard to adjust and keep in adjustment because of the setscrews used. I had to come up with something different. I just couldn't stop and wait until I came up with a better idea. We had to go full speed ahead on all the parts that I knew how to make. The design for a gib I preferred was used on many machine tools. The gib was a wedge shaped piece adjusted from the end; however, a corresponding angle had to be machined in one section of the dovetail. A gib of this type would be difficult and time consuming to produce. It was on a Thursday when I realized that I could build a simple injection mold to produce this part. I immediately set to work and had the mold completed by Sunday night. A friend allowed me to run a batch of parts on his injection-molding machine to help me get started, and I had another major problem solved in an inexpensive manner.

Building the first machines wasn't that hard unless you wanted to make a profit. The parts are relatively easy to make, and having machines on the shelves was my only interest. The main effort had to be getting production machines running if we were going to last beyond our first shipment. CNC machines were not available, and it took many operations to produce some parts. Each operation would increase the chances for errors. "Scrap" was a word that took on a new meaning. We had to walk a very narrow line. If we scrapped out every part that wasn't perfect we couldn't ship anything. If we used every part that wasn't perfect, we would produce junk. My job became very difficult. I started to learn about the tolerances we could manufacture parts to as well as the tolerances the product needed to work properly. This was a lot more difficult than one would think, and many hours were spent reworking parts. The main problem then and now is we are trying to hold tighter tolerances than the process allows. Successful companies all work within these constraints. If it were easy, everyone would do it.

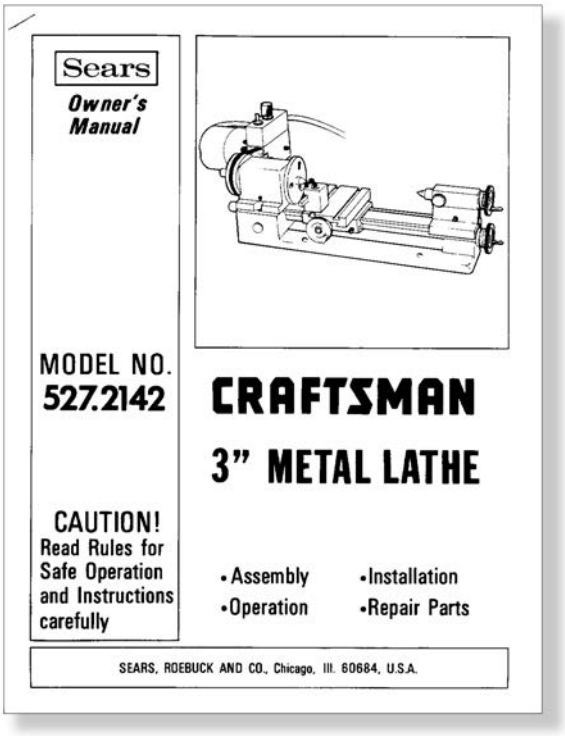
Dealing with Sears

The buyer from Sears, who later went on to become marketing director for my main competitor Unimat, encouraged me and was amazingly understanding of my plight. In later years, I enjoyed seeing him at trade shows and never felt as if I were betrayed. It was just business. The space allowed for my products in the Sears catalog kept getting smaller and our sales dropped proportionally. Sears eventually dropped our product line, and their new policy was to sell only the most popular items. Every similar company took the same approach and they all started selling the same products. This has hurt Sears because successful merchants meet the needs of all their customers, not just most of them. Just think where Sears could have been today if

they had "hung in there" with their catalog sales and complemented them with Internet marketing.

Sears is actually a very nice company to deal with if you produce a product their customers like. I'm sure you have heard the same horror stories I heard when people found I was going to sell to Sears. "They will take you over after they order more parts than you can produce." This was not the case, and I have nothing but good things to say about Sears even though they no longer sell our products.

On the other hand, losing Sears as a distributor wasn't as important to me as you may think, because I had several ways to market the product other than Sears. I always make sure I don't have "all my eggs in one basket." Sears was always asking for special reports and could be a pain at times. If you sold 10 or 10,000 you still had to abide by the same rules. One time when I went to Chicago for a meeting, the buyer didn't have any interest or knowledge in tools. She should have been buying fur coats not power tools. I always had the feeling that a horn could blow at any time during the day and all the buyers could have moved to a different office, like a game of "musical chairs," and picked up the conversation without missing a word. What really impressed me



The high standards required by Sears in their instruction manuals established a precedent for all Sherline instructions which would follow.

PHOTO: BRENT

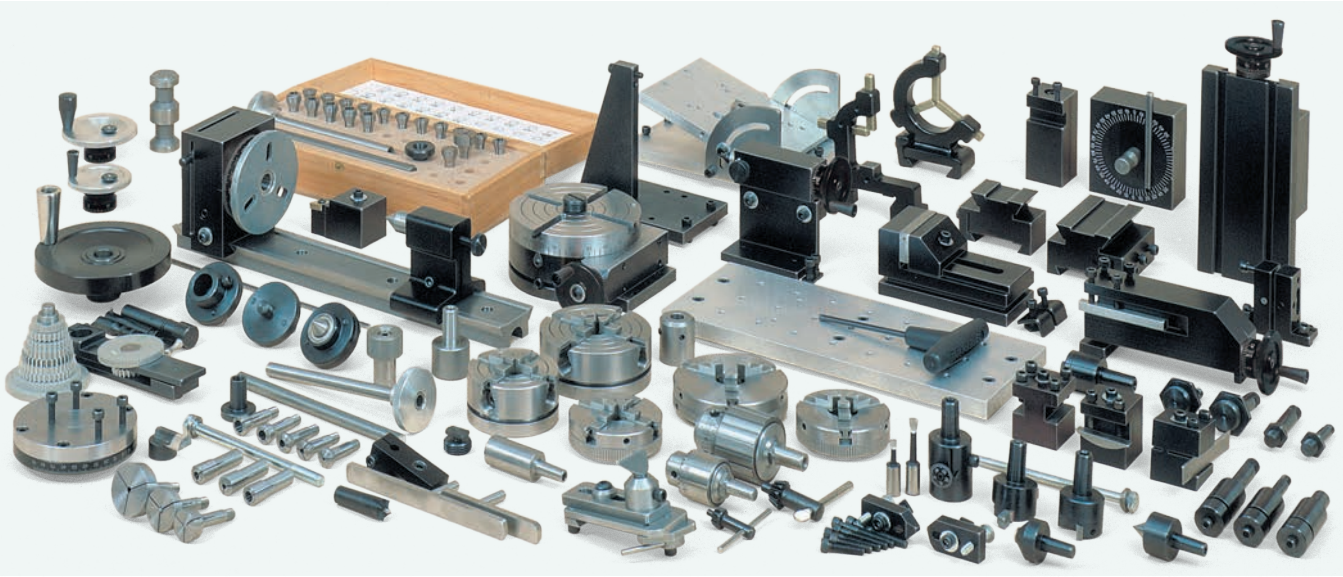
When the Department of Engineering at Texas Christian University in Ft. Worth, Texas decided that students and teachers needed to get some "hands-on" experience to better understand the machining process as it relates to manufacturing engineering, they chose Sherline tools for their shop. They also use the tools to teach an "Introduction to Fabrication" course to high school students.

at the Sears Tower was a gold plated radial arm saw in the office. It was the one millionth manufactured. Think about the warehouse area that it takes to store products used in these incredible amounts.

An American company's place in the world market

American manufacturers are at a disadvantage when it comes to selling throughout the rest of the world. The U.S. market is the largest market in the world, and we now have a great distribution method to get products to the consumer with very little markup. The discount chain stores have such a large buying power it allows them to deal directly with manufacturers throughout the world. Products are shipped directly to their warehouses with no middleman markups. This is a great deal for consumers, but it makes for tough competition for an American manufacturer.

This distribution system isn't available to an American manufacturer wishing to sell a product outside the United States. Outside the U.S., a broker may import a product and sell it to a distributor who sells it to retail stores, and finally it is sold to the consumer. The problem is that everyone wants to make 40% when they handle it. A U.S. product gets marked up so many times that it is no longer a good buy, but it isn't the fault of the manufacturer. Import duty also can add to the cost of the product. I have had complaints from Japan, for example, where someone thinks our $1500 lathe should be more accurate for the price. I can only tell them



A complete accessory line takes a long time to design and produce, but it is one of the things that gives a prospective buyer confidence in the basic product. No matter what you may want to attempt with your machine down the line, an accessory is available to help make the job easier. Despite the small size of the machines, the sheer number of custom accessories makes Sherline able to claim "the most complete tool line in the world, regardless of size." This photo only shows the smaller accessories. Larger ones like the vertical milling column, horizontal milling conversion, etc. are not shown here.

that it is very accurate for a $460 lathe, but I have no control over all the markups between here and there that turned it into a $1500 lathe. Unfortunately, middlemen contribute to increasing the price with no corresponding increase in the quality of the product.

To make matters worse, U.S. manufacturers must compete with companies that sell products here that don't have to deal with the higher safety and environmental standards set by OSHA and the EPA. I'm not suggesting we should do away with these agencies, for I believe they are needed to protect our workers and citizens. I'm only reminding you of some of the problems that face U.S. manufacturers.

Good instructions make things easy for everyone

Being self taught made me appreciate good instructions, for I'm sure I have spent at least a thousand hours trying to sort out the incomplete instructions that came with some very expensive machines. I have tried to write instructions that would be useful and give a novice some insight as to not only "how" but also "why" you would want to use an accessory. Once the customer understands this, their imagination takes over and they may use an accessory in a fashion I never dreamed of. Sears once complained that my instructions were too "folksy." I asked them how many customers have called with a question about that particular instruction and who they had available to answer such a question if one were asked. Sears decided that my instructions weren't so bad after all.

Sherline's customers are intelligent people who just don't happen to know too much about machining, so I don't have to write everything in a style that an idiot could understand. The more you know about a subject, the more you know there is always an exception to a rule. This can make for very boring and cumbersome instructions if all these variations are included. Most manufactures of tools solve the problem of instructions by not giving any except assembly and safety rules. They do this primarily to cover themselves in case of a lawsuit. The instructions also read as if they were written by a lawyer—which they probably were.

I also know that the longer the instructions, the less likely they will be read. The trick is to make instructions for a difficult task short enough so that they will be read but long enough to get across all the important information. By carefully choosing my words I can avoid writing about all these variations and still be accurate. Craig Libuse then takes my writing and arranges it with some of his marvelous drawings and photographs, which he takes himself in our own in-house studio. The

process has been simplified since we purchased a digital camera. This book, for instance, will go to the printer on a single CD that will be used to directly make the printing plates. No more time consuming typesetting, pasting and stripping. When we are done, we have a book, sales literature or instructions that we are proud of.

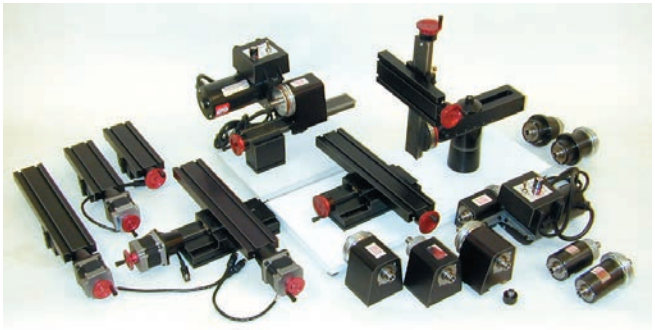
For me the fact that all the work, except printing, has been done "in house" is great. It gives me complete control over the entire process. I can be my own publisher; however, I do lose the marvelous marketing capabilities of large publishing houses. I am fortunate to have the resources now to publish the book myself, because I don't have the time or the desire to go from publisher to publisher begging to get my book printed.

I look at instructions the same as tooling to build the product. The better the instructions, the lower the overall costs. We constantly update our instructions to try and eliminate confusion. All our instructions can be found on our website (https://sherline.com) and can be downloaded for free for your own personal use. I can't understand why more companies don't use the Internet in this fashion. Most of the rules for cutting metal remain the same whether your machine tools are full size or miniature like Sherline tools. Many amateur machinists, whether customers or not, find the information we provide there useful. They appreciate this and we gain by their kind words and referrals.

Good instructions also have another key function. Customers usually ask questions that can only be answered by the most important and costly people in the organization. This keeps them from doing the work you had hired them for. Good instructions allow these key people to do their jobs without constant interruptions with questions that should have been answered in the instructions in the first place.

We never misrepresent our products

One thing we try to never do is misrepresent the capabilities of our machines. If anyone has ever called Sherline to ask, we answer honestly, and they know we never try to sell a machine to anyone when it wouldn't be appropriate for their projects. I don't want to waste time on the phone explaining to an unsatisfied customer why you can't make a tool steel shaft three inches in diameter on a three-inch lathe.



Over the years we have seen many Sherline tools used in production setups. Sometimes only parts of them, such as the slides or motor and speed control are used, because it is cheaper to buy a whole Sherline lathe or mill than to buy or build a specialized industrial component. In 1998 I introduced a line of small manual and CNC-ready industrial slides based on our machine components to address this market. Sometimes a small change is all that is required to adapt a product to meet the needs of an entirely new market.

Actually, I am sometimes amazed at some of the projects that are built on Sherline equipment, not only because of the complexity of the project, but also because of the size. I have seen projects done that really were too big for the machine, but the job was completed because the builder worked with what he had. Working with what you have is what it's all about with hobby projects. Time is not money when working for enjoyment in your home workshop. Being a hobbyist myself, I've been asked many times how I have the patience to spend so many hours working on a model aircraft that could crash. My answer has always been that it doesn't take any. If you are doing something you enjoy it doesn't take patience. What takes patience is working at a job or for a boss you don't like just to keep food on the table for your family. Non-hobbyists believe it takes patience to do small, precise work only because they don't enjoy doing work like that themselves.

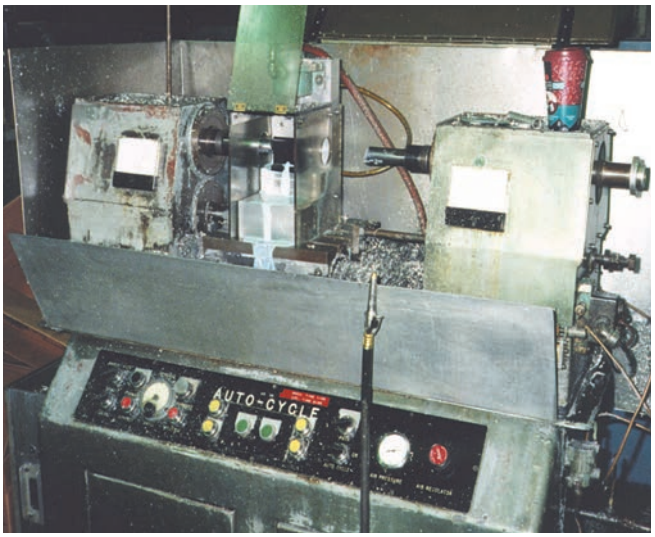
A vision for miniature machining

You can spend quite a bit of time and scale down a set of plans to fit miniature tools, and I believe you'll have a better model because of it. In the future, I can see plans for hobby projects being sold on a disk that includes a drafting program. After deciding the size you want to build the project, the program will print out a set of dimensioned drawings in the scale you choose. Actually you

could do this today with AutoCad®, but no one is yet selling plans in this format. The problem with this at the present time is that you can't scale off-the-shelf items such as screws, and the model would be very difficult to build with non-standard fasteners and threads. It will happen eventually though, because it is a better way. This will make scaling things down to smaller sizes easier. Throughout the ages, miniatures have always had a fascination all their own. Miniature models are treated like jewelry. Their appeal is based in part on their size alone, and that helps make them attractive to people who might otherwise have no interest in the subject of the model itself.

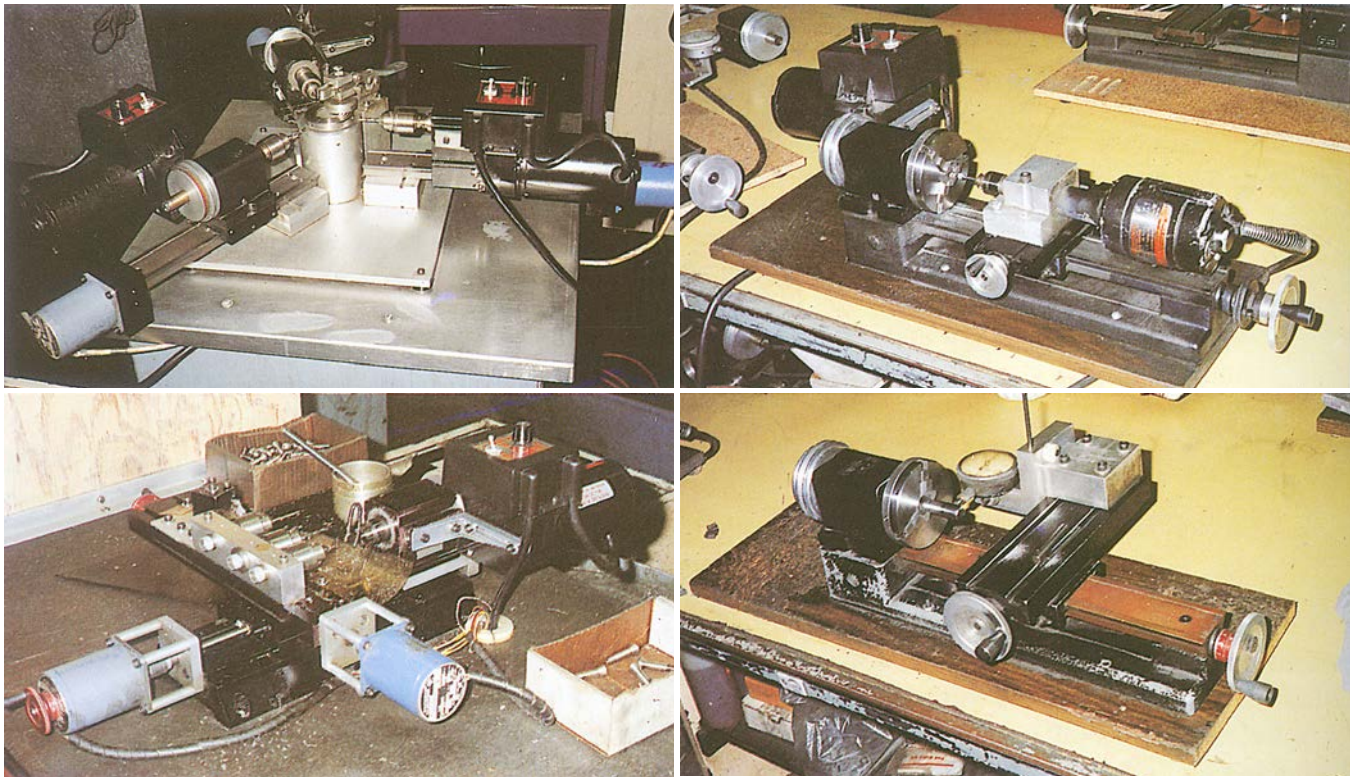
Wheelin' and dealin' for production tools

When I originally imported the lathe from Australia, the only accessories that were available for the Model 4000 lathe were three and four-jaw chucks, steady rest, live center and a screw cutting attachment. This represented about ten percent of what was needed for a good accessory line. For me to take on producing these machines was a monumental task without considering the accessories. Fortunately, I just wasn't smart enough at the time to realize it.



The Sherline bearing journal boring machine is still going strong after over 25 years. It has turned out to be one of Joe's all-time best machine buys.

I knew I would need machine tools to produce the parts I needed and this gave me an excuse to start buying machine tools. This is the part I loved. I would go to South Santa Fe Street in Los Angeles and look for bargains. One machine I came across had two opposing spindles that would be perfect



Sherline uses some of their own tools for small jobs in their production line. Shown here are a number of special tools used for making chucks and collets. Clockwise from top left: Drilling tommy bar holes, grinding inside of chuck jaws, checking chuck runout and a setup to center drill, drill, ream and face collets.

to bore the headstock for the bearings. It would require little modification. There were three of them. The only problem was they wanted $8,000 for each machine. This was a bargain when you considered that they cost over $20,000 new, but I couldn't afford even $2,000. I bored my first run on my Bridgeport and kept a quiet eye on these machines. Machinery sales were terrible at this time and the price was falling. I made my move right before Christmas when I believed that dealer, like everyone else, would need money the most. I offered $1,500 for one of them. We negotiated for a while and I ended up paying $1,700. Every mill or lathe I have sold since then has had its bearing journals bored on that machine. I think I made a pretty good deal.

Making chucks turns into quite a challenge

Manufacturing the three-jaw chuck was my biggest problem, as it was not a straightforward machining problem. At the time you couldn't just program a CNC machine to cut the spiral scroll, so a special machine had to be designed and built to do the job. I ended up milling the spiral using a rotary table that was geared to the table feed at the correct ratio. The rotary table, an item that I rescued from a pile of junk, was driven by an adjustable speed drive that I found in a junkyard where I also purchased the limit switches I needed. I ended up spending less than $300 and three days on the project. It took three and one half minutes to machine the scroll, but the actual labor was only the time to load the part. It turned itself off automatically. I shudder to think what it would cost to do a similar project in my own shop today.

With modern CNC machines I can now produce all the parts for this chuck in 15 machine operations, which is less than 50% of the operations of our first attempts and 33% of the time. The quality also improved by 200%. Another reason that I love CNC machines.

To cut the teeth on the chuck jaws I used a suggestion from the Sherline shop foreman in Australia. It wasn't the way they were generating the teeth at the time, but he told me if he had it to do over again he would try his idea. I bought my first electronically controlled machine to accomplish this and cut the teeth. It worked great and we still machine them that way. It took every penny I had to get the chuck into production because I had to also purchase a large screw machine to make the chuck bodies. We kept trying different methods to improve the accuracy. It took many secondary operations to improve the three-jaw chucks a couple percentage points. Many people are still surprised that we manufacture our own chucks. After going through the learning curve, I can see why others might not want to take it on such a project.

First new Sherline accessory—a new screw cutting attachment

The first accessory I decided to build was a replacement for the Australian screw cutting attachment. At this time the thought of producing the entire product line wasn't even considered, and I was just "fooling around." The Australian screw cutting attachment was limited and did not have enough gear combinations. I wanted to cut more threads in right- and left-hand leads. Most common threads are cut with taps and dies. You don't cut threads on a lathe unless you have to. It is a slow and costly. The threads you may have to cut are unique, and taps and dies either can't be purchased or are very expensive. To be worthwhile, a complete range of threads was needed. The present system didn't have enough combinations to be useful. To build this accessory, gears would be needed. Contract gear makers could cut the gears but the cost would be around two dollars each in relatively high quantity. I had to cut them myself in order to keep the price low enough to have a customer for this product. A machinery dealer, who didn't ask for a commission, found me a dirty old gear hobber with a complete set of gears for less than a thousand dollars. I cleaned it up and painted it. It worked great and has cut every gear since. If you are just starting out and are willing to work, it is amazing how much help is out there if you are not looking just for money.

An apparent step backward becomes a step forward

After cutting a set of gears for my attachment I knew I had solved only one of my problems. To cut the expanded range of threads, you couldn't disconnect the spindle from the lead screw without losing your place. I wanted to check out my gear combinations; so I took the motor and speed control off and put a crank handle on the rear of the spindle. I set up the gears for twenty-eight threads per inch. I planned to make a 1/4-inch diameter, 28 threads per inch bolt (abbreviated as 1/4-28). I figured that would be a good size because there were hex nuts of that size around my shop I could use to check the thread. I engaged the lead screw and took my first pass (cut) by cranking the spindle by hand. I stopped cranking when I got to the head of the bolt, backed out the crosslide, and cranked the spindle backwards until I was at my starting point. The crosslide was returned to a position that would take the second cut, and I cranked the spindle and took the second cut. It was as easy as tapping a hole with a hand tap. You could stop close to a shoulder without worrying about "crashing." I realized it would be perfect for a novice machinist. This was going to be a tough item to sell, as hand cranking might appear to be a step in the wrong direction, but it really worked well. I decided to put it into production.

Personalizing the Instructions

I think it is also worth noting that this is when I decided the style of instructions I would write. The only thing I did change later was to put my name at the end of these instructions. At that time I didn't believe my name had any value, and I was trying to establish a value for the "Sherline" brand name. About ten years later I began to realize that customers took an interest in what I wrote. I added "Joe Martin, president and owner" to all the instructions I had written and still do. I enjoy the fact that people are finding what I write worth remembering.

Carl Hammons comes aboard again and the business grows

Carl, my friend and ex-partner, joined forces with me again in Martin Enterprise. There aren't too many people who have been partners twice, but we worked well together. I had acquired a surprising amount of operating machinery, and Carl's job would be to find contract machining jobs. Carl wouldn't own any Sherline stock because this corporation was already formed and Sherline

When going from miniature machine tools to full-size shop tools, the costs go up dramatically. Just moving them can be expensive, so do a lot of homework before you buy. Sherline's shop represents over a million dollars in tool purchases over the years.

Australia was part owner. Carl called Hewlett Packard on a day that they were looking for a new shop to do some contract machining, and before we knew it we had 35 of our 55 employees doing outside contract work. Our main customer became Hewlett Packard.

A simple agreement

I was too far along with Sherline and unwilling to give up any ownership to Carl. This was my "baby" and I wanted complete control. I had been working at the new business for three years when Carl and I joined forces again and had spent $90,000 for equipment; therefore, I felt Carl should invest $45,000 in additional machine tools and work one year without wages for one-third ownership in a new company dedicated to doing contract machining. Carl agreed and we became partners in Martin Enterprises. I was now flat-ass broke, and to survive I had to make a profit from this time forward.

Business is great!

I had two major mail order companies selling our machines within a year of starting: Sears and Brookstone. Both were good customers and paid their bills within 30 days. A major point I'd like to emphasize at this time is that when you're dealing with large selling organizations they will always be more interested in their customers than in your well being. They are being ethical to their customers when doing this and not being unfair to you. Don't expect them to cover your mistakes and risk their good name. Don't expect them to not go to another supplier who offers better quality at the same price or the same quality at lower prices. It is possible to make a great deal of money dealing only with a single organization like Sears, but you have to remember where their loyalty lies.

Sherline had about 25 employees at this time and we were cruising. I had three rented 2000 square foot shops next to one another. Darrell, my shop foreman was doing a good job, and every now and then I began to feel a twinge of success.

More work means new and bigger problems

The new contract machining work became a nightmare for me. The problems I had to solve were no longer just my own. We would be overly optimistic bidding jobs and lose our ass doing them. Most of the problems were caused by inexperience in holding tight tolerances. Customers would be late on payment, and I would have to dig into Sherline

An operator takes advantage of the CNC controls that can be added to a newer Bridgeport mill. Regardless of size, if you plan to buy equipment to do machining, buy the best mill you can afford. Most of the deficiencies of a worn out lathe can be overcome by good technique, but it is almost impossible to make good parts on a worn out mill.

funds to make payroll. If a customer had made an error on their drawing and we had already run their part, they would try to find a way to reject it and not pay us. We were doing over $400,000 a year in contract machining and I gave all up.

What brought this about was my hand got caught in a screw machine that was running HP parts. I was trapped for 30 minutes before an employee found me. The machine had to be taken apart to free me. The reason I was running this machine was the screw machine setup man was out on another drunk and HP wanted their parts. My hand was squashed but not broken, and while I was sitting in the office recovering, the buyer from HP called and threatened to go elsewhere with their work if I didn't quote on a job that I believed had tolerances that were impossible to hold. Of course, the buyer didn't know that I had just squashed my hand making HP parts, and I wasn't in any mood to take any crap from anyone, but it happened. I retaliated by increasing their prices by 20%, and guess how

Chips from this CNC lathe are carried off by a conveyor belt as metal is removed at a rate of over two pounds a minute. Despite this huge capacity and the ability to make rapid tool changes, the level of accuracy it can produce is astounding.

much work I was doing for them the following year? You've got it - $0. This is one case where we both won.

I never did learn how to bid work and I didn't own the new machine tools it takes to do the work that pays well. I should be writing a book called "How to lose your ass doing contract machining." I guess we weren't very good at contract work because nobody seemed to miss us. I tried to be a hero and find work for my existing employees and lost about $75,000 in six weeks. Everyone slowed down because there wasn't much work around at the time, and the layoff that should have happened six weeks before finally happened. I vowed that I would never make that mistake again. It would be hard for the average person to realize just how hard it was to come up with the $100,000 working capital I had. To waste it on employees who would rather be collecting unemployment was inexcusable.

We kept our best employees and everyone worked in a more relaxed atmosphere. I found out that just getting "shop time" doesn't make you any money no matter what the overall sales may be. We ended up with a lot of specialized machinery to make unique parts for other companies. I traded all this specialized equipment for a couple of new CNC machines. We would learn to use these new machines to build Sherline parts. The most interesting thing was rather than going broke, Sherline started having money left in the checking account when I stopped doing contract machining.

A new home for Sherline

I started the business in my garage and then moved into an industrial complex. The first unit rented had 2000 square feet and was quickly filled it up. Each time a neighboring unit would become available I would rent it. Having enough room for employees to work efficiently was important. The end result was I ended up with five units and had a considerable rent payment each month. A Realtor stopped by one day and offered me an opportunity to buy some industrial land. It looked pretty good so I offered the price that was asked. I waited for several weeks for an answer. I then found out that my Realtor didn't have any agreement with the seller. He was trying to get that agreement with the seller before making my offer. Maybe this is why I avoid dealing with Realtors to this day. By this time, however, I had convinced myself I needed my own building. The salesman succeeded in whetting my appetite to own a building and encouraged my tendency to not believe salesmen at the same time.

Looking for some land to build on

I remembered a couple longtime model aircraft friends, Granger and Larry Williams, who had some industrial land for sale. Their agreement had just ended with a Realtor who had their property listed over two years without a sale. They agreed to discount the Realtor's commission and offered me the land to me for $36,000. I agreed on the spot. I would worry how to pay for it later. The best part came later when I was informed that they didn't want the money in one lump sum for tax reasons. I didn't think it could get any better than this but it did. I learned a whole new term at our next meeting: "subordinate." What it meant is that they would allow me to build on the property before it was completely paid for. I still didn't fully understand the implication but started looking for a contractor. Lusardi Construction was building most of the

When I moved into my first building at 170 Navajo Street, I had so much room to spare that I considered renting a section out. After much soul searching I decided I didn't want to be a landlord and soon filled the remaining space with machines producing parts for contract customers.

industrial buildings in our area so I approached them. They had a design-and-build plan that would be perfect for a business like mine. I had a modest building in mind that I thought we could afford. Lusardi looked over the property and came back with their suggestions. They proposed a building design that was twice the size we had asked for. It was also three times the amount of money we could come up with for a down payment.

Good fortune keeps smiling on us

I was banking with the Bank of America at the time and I knew Bernie Koston, the president of the local branch, quite well. I had made and paid back several small loans to convince him I was a man of my word and could be trusted. Bernie and my contractor had a meeting. This is when I found out how important subordination was. The bank considered the land to be completely paid for because the land had been subordinated. The bank felt the lot was worth $55,000 even though we only had $9,000 in it. This gave us the $55,000 down payment we needed. We found out later that we had purchased the last reasonably priced land in the area. Bruce, the representative from Lusardi Construction, convinced my banker that it would be foolish to build a small building on such a good lot. Carl and I took a break from this meeting and we both agreed we were getting in over our heads. We looked over at Bruce and Bernie making plans for payment schedules for the construction loan. I finally said, "Carl, let's just keep nodding our heads until someone says we can't do it." Before long, the bulldozers were tearing up our lot and our 18,000 square foot building was started. Carl and I couldn't believe it, for we still only had $9,000 in the project at that time. I had worked in the building trades for 13 years after high school and it taught me how to get a job done. Although I wasn't a carpenter or an electrician, I hired a carpenter and, with his help, built the interior of the building myself to save money. We were going to need it.

Stretching to grab the brass ring as opportunity passes by

I believe a person goes through life and has opportunities pass by. The opportunities are there but you have to "stretch" to grab them. Most of the population let these opportunities pass on by and then complain about the opportunities that got away. Getting our building started and finished was a perfect example of "stretching". When opportunity knocks, answer the door...don't just sit in your chair and yell, "Who's there?" Opportunity drops by now and then, but it doesn't wait around long.

CNC equipment brings us to a new level of quality

When we bought our first CNC lathe it eliminated many operations and improved the quality of the parts at the same time. I couldn't believe the accuracy that could be attained with these machines. It was love at first cut. I immediately started looking for a NC mill with a tool changer and ended up purchasing a CNC mill. The difference between NC (numerical control) and CNC (computer numerical control) is that to edit the program on a NC machine you had to change the paper tape that controlled the electronics. On CNC machines you could edit the program that was contained within the computer. The tool path was generated directly from the software as the machine cut.

As an example, consider cutting an angle on a CNC milling machine. The machine must move both the X-axis and Y-axis in unison to generate an angle. A CNC machine would calculate the amount of movement as it was cutting and could cut at over 100 inches a minute. This fact would change the way metal parts would be made in the future, for no longer would you have to use special cutters and operations to make complex parts. You could cut a complex shape at the same speed as you cut a straight line. In most cases you could generate shapes with standard cutting tools using just a

few lines of code. This allowed me to design parts the way I really wanted them. You no longer had to work within the old constraints of what was possible.

Ball lead screws make precision CNC cutting possible

The lead screws used on these machines should be mentioned. They are the interface between the computers and the mechanics. The problem of backlash was solved with "ball lead screws". These screws have recirculating balls that roll in a groove ground into a shaft at a pitch of two tenths of an inch. The pitch on these screws has increased over the years to achieve speeds over 1000 inches (25 meters) per minute. At a pitch of .200" (5mm), a lead screw would have to turn at 5000 RPM to accomplish this speed and is why ball lead screws have as high as one inch in pitch. Even more amazing was the fact that they improved the accuracy as they increased the pitch. You can make a .0001" (.025mm) correction on a good CNC lathe. Think about that. A slide will accelerate to a speed of over 1000 inches a minute in less than a second, move a short distance and decelerate, stop and still be accurate to one ten thousandth of an inch. The ball screws must be very precise because a lead screw would be useless if it had any backlash (the amount you have to rotate a lead screw before the slide moves). Ball lead screws are very difficult to make which makes them quite expensive; several thousand dollars for each axis. The people who solved the lead screw problem should be commended as much as the electronic geniuses that came up with the computer controls. At Sherline, we have machines that have been running over ten years and still don't have any noticeable backlash.

Coolant and chips fly and coat the windows inside this Mazak H400N machining center. Since you can't see what is going on, you had better be sure you know exactly what is going to happen before you push the "cycle start" button Surprises are usually unpleasant.

Machines sometimes pay for themselves in one part run

In many cases, I could buy an old machine, fix it up, make my parts and have it cost me less money than I would have spent on a single production run of parts from an outside source. I also had control of when they were run. At Sherline, we make all our own parts in house. I only contract out plating, painting and a few screw machine products. Even these I could make if I had to. This has given us an independence that few companies with a complex product line have.

Cutting speed vs. tool wear and deflection

In order to drill this hole in the most efficient manner you need to know the correct feed and RPM, but it's still not that simple. At one feed rate you can drill a thousand holes before the drill will get dull and start drilling oversize. A faster feed rate may save 15 seconds per hole but the drill will have to be changed every 200 parts. I'm sure you are thinking, "What is so hard about that?" It isn't until you consider the other machining operations that are also being done to this part at the same time, each with its own set of problems, then you can see how complicated it can get.

For example, end mills deflect or bend according to the load, diameter, and sharpness of these cutters. A long end mill can deflect over ten percent of its diameter at the cutting end. This is always changing; therefore programs must be created that allow cutters to get dull while still keeping the part in tolerance. We very seldom write a program that will make a good part efficiently on the first try. It usually takes three or four tries until we are satisfied.

Production equipment runs parts inside the machine. The part is deluged with coolant so it is hard to see what is going on, yet you have to know. If you stuck your head in there to see what was going on you might lose it. Setting up CNC machines today is like test flying a new aircraft each time you check out a new program. You will never appreciate how far these machines will go to try and please you until you put in an offset that is off by one decimal place (a number entered into a CNC machines to offset the actual diameter and tool length), and you get to watch your machine try to mill your $1000

vise off the table! When I first started programming NC machines (machines that were controlled by a 1-inch wide paper tape with holes punched in it) I would write programs that would rapid feed up to within 1/10" of the part and then start feeding at a programmed rate. We soon learned that if the machine failed, you wouldn't have time to push the "stop" button before it crashed even if the rapid feed was shut down two inches from the part. With nothing to lose but time, we switched to bringing the tool as close in as possible.

Push the button and hold your breath

We now bring tools to within 1/100" (2.5mm) of the part at a feed rate of over 1000 inches (25 meters) a minute. When you consider that on a lathe these cutting tools may also be aimed at a three-jaw chuck turning at 3000 RPM, it takes a lot of faith to watch it happen without flinching. This is how modern machine tools operate. Spindle gears have been replaced by elaborate electronic drives that will work in unison with a computer to keep constant surface cutting speeds on a lathe even as the diameter changes. Complicated gearboxes have been replaced by a servo drive system that works in unison with the spindle to cut threads or tap holes at spindle speeds considered impossible a few years ago. Manufacturers can take a CNC machine and turn it into a very sophisticated device to build their product out of metal in one day. That process could have taken years to accomplish 25 years ago.

Corporate "logic" is sometimes hard to explain

I can never understand the logic large corporations use today where they avoid making their own parts. They come up with "just in time" suppliers that must anticipate that corporation's future needs. Instead of having craftsman, they have purchasing agents. Instead of machines, they have computers to control the flow of these products from outside vendors. Without considering costs, I believe we would have more people working for us if we contracted out the parts we use. If we run out of a part, we can put it into production that day if needed. A purchasing agent may spend three days trying to find a new supplier who could deliver the part in three weeks. Many times I can produce this part with less labor than the agent would spend finding a new supplier. I believe the corporations have chosen this path because it gives managers a method of shifting the blame when ideas fail. Of course, when quantities get into the hundreds of thousands it could be more

Labor is another factor in product cost that is not necessarily related to part size. Often greater skill and more attention to detail is required when dealing with smaller parts.

economical to farm the work out. The type of person I'm trying to advise isn't the large corporation that buys in these quantities, but an individual starting out without enough money. My product couldn't be competitive if parts were purchased from outside suppliers. The costs involved would eliminate our product line because there is a limit to what customers will pay.

How our company makes money

I always try to make money by having automatic machines running. I design products that can be manufactured on the machines we have. This gives me control of the costs needed to produce these parts. I have the choice whether to use shop time or just an employee's direct wages to make a part. This is very important; because I have to produce a product at a price a customer will pay. Odd as it might sound, prices can actually be raised easier than they can be lowered. Lowering prices without coming out with a new and better model will irritate customers who paid the higher price and dealers that already have this product on their shelves. I usually put off arriving at a final price until I have produced a small production run of parts.

I always start by deciding on a projected selling price for a new product that should get me in the "ballpark." I take away the discounts I must give in order to sell it to a dealer. This leaves the amount I have available for designing, manufacturing, advertising and selling this product. From this I can figure the amount I have left to spend on manufacturing. I never add my design cost and

These tailstock extrusions would take no longer to cut off if they were twice as long or ten times as long. Small parts often require just as much or more labor than larger parts.

tooling to the final selling price of a new Sherline product. I plan for these products to be sold for a very long time. With this being the case, this cost becomes insignificant to an individual sale if you amortize it over a long period. You don't have to make money on every product as long as you can make money on the complete product line. You have to know your customers to accomplish this. It would be difficult to be a success at a new business if you have to hire people to give you this information. In other words, "If you want to lose your ass, get involved financially in something you know little about."

Build to succeed, not to "not fail"

When I became committed to building the Sherline tool line, I never considered the possibility of failure. That helped me make a very important decision as to how many parts to build. If you build too many, you may run out of money and your creditors will put you out of business. Banks only want to lend money to companies that don't need it. On the other hand, if you don't make enough parts, you'll lose your customers by not being able to deliver what you promised. What I did was not make a batch of say, two hundred lathes. The logic I used was that after I sold the two hundred machines I would be in exactly the same situation...out of machines. I was somewhat broke, so I built a thousand or so of the parts that didn't have any expensive material and down to a hundred of the parts that were high in labor or materials. This kept me from running out of everything on the same day.

Today's problems are more important than tomorrow's

We always take care of today's business first. These are problems you can solve and customers will be happy. The marketplace is too complex for long-term planning. We should spend as much time as it takes to keep our product quality high. Profit has to be secondary for long-term success. I have always kept a list of things other companies have done to me that could be considered irritating. I make sure we don't make the same mistakes. For example, you won't talk to an answering machine when you telephone Sherline Products. Sometimes people seem amazed when they call us and an actual person answers the phone. Long voice mail menus are almost universally hated, yet most big companies use them anyway. This is a perfect example of a company that thinks their own time is more important than that of their customers, and that is not the message I want to send to people trying to call my company.

Accessory line developed to augment the machines' capabilities

After putting the Sherline lathe into production in the United States my ambition was to come up with accessories that would allow my customers to make very complex parts on their "kitchen table." One of the problems of manufacturing machines of this size is you can't use accessories from other manufacturers. Manufacturers of full-size machines have the advantage of not having to build all the accessories and attachments for them. We didn't have that "advantage," and I've always looked at this as a plus. The market is simply too small for someone to produce an accessory that will just fit one machine, leaving the market for Sherline accessories to me. The average vise we use in our plant costs more than any machine I sell, so you can see why no one else is interested in building accessories that sell for less than $100 to a very limited market. I started out by producing the most popular accessories and have made new accessories available every year. I keep thinking I have finally finished when I get a telephone call from a customer with a particular problem. This, in turn, gives me an idea for another accessory. Not all are big sellers, but they give a certain group of customers the ability to build that very complex part on their "kitchen tables". It has finally worked out because now the accessories actually represent a high percentage of our sales.

One of the problems I have is dealing with is the

ideas that come in from customers. If I look at it and tell them it is something I'm planning to manufacture I'm sure they will be very skeptical. Ideas can be easy to come up with on a product such as this. All I have to do is look in a catalog and make what they make for full-size machines. The real problem is coming up with a way of manufacturing them at a cost that we believe the customer will pay. I have made arrangements to pay royalties on a few occasions to people who have put a special effort into their idea. I don't copy other people's products, but some things are so basic that there is only one way to build them. These items will always look the same.

The Martin-Hammons Carburetor

Carl and I came up with a carburetor for model airplane engine for which we received a patent. Carl came up with the basic idea, which was a variable venturi, and I came up with a fuel metering system to control the speed. The prototype worked reasonably well, and we applied for a patent. I was busy doing contract machining, and Carl put it into production. It turned out to be a disaster. We just didn't have the skill or the correct production tools to make the low cost, highly accurate parts needed for this type of product. Carl was spending a great deal of time working on the patent. When I took a closer look I found out that various similar patents had been awarded on carburetors of this type, and the patent that Carl had been working on was only for the slot that controlled the rate the cone was raised or lowered. To me the patent was worthless and the parts we made over and over again weren't much better. Carl salvaged enough parts to put about 500 together and they lasted for more years than I care to remember. I think it was too different to be successful.

The M-H variable venturi carburetor for model aircraft engines earned a patent of limited value.

The dubious value of a patent

What if someone does decide to steal your design? Even if you have a patent, you will find you probably can't afford to defend it in court if the company stealing your design can afford more lawyers than you can. Carl and I hold the basic patent on computerized timekeeping. We applied for it long before IBM had a PC on the market. Today there are millions of dollars spent on products that should fall under the control of our patent. We spent several thousand dollars and a tremendous amount of effort to get that patent, and, in a sense, that effort was wasted. Patent attorneys don't inform you how hard it is to protect a patent, because they make their living getting the patent for you. The standard defense against your patent is to try and prove that your idea was common knowledge. Most people don't realize that a patent on a new process or product can be impossible to enforce if it has been suggested in print anywhere in the world. You could end up wasting a lot of time and money to have a patent certificate to decorate your wall. On the other hand, it is wise to have a thorough patent search done to keep from producing a product that already has an enforceable patent on it. Of course, I'm not an attorney and I'm talking in generalities to make you aware of the problems with patents, but I do have a couple of patents that never made any money for anyone except the patent attorney. Again, remember that the patent attorney makes money by getting you a patent and may be the last one to inform you that your patent may be worthless and impossible to enforce.

Necessity is the mother of production

I started buying old machine tools that I believed I needed for production. I became an expert at taking a worn out machine, fixing it, and putting it back to work. I have a natural love for machinery similar to that of a farmer who loves his land. It is hard to describe, but it is very rewarding to set up a machine to make parts automatically. I'm sure a farmer gets the same feeling when watching his crop being harvested. I remember an injection molder running at Kraft Systems that had a 45-second cycle time to make a plastic part. The worst profit we could make was five dollars per shot, and the machine would run all day unattended. It was like having an oil well in your back yard. I have never been nearly as successful as that machine, but I keep on trying.

Today we have to put our efforts in new and modern

equipment. Old CNC machines can be like a fleet of old trucks. They can become more of a problem than an asset. Machine tools are the great equalizer in a world economy. Machine tools cost the same to operate worldwide, and when the cost of the machine becomes greater than the cost of labor, low-cost labor doesn't have such an effect and gives me an opportunity to compete.

For me, it's a sporting event

Don't get me wrong. I don't invest in my new ideas just to make money. I've always found that the people who work only for money don't seem to have much. To me, it is more like a sporting event where my machines are my players and I'm the coach. Of course, I have employees and they are very important to the company, but in today's market there are few products that could be manufactured with manual machines. Computer controlled machines have allowed a low volume producer like me to exist because they allow one machine to do many tasks. In a sense, you are teaching the machine how to make the parts and teaching the employees how to set up and program the machine. A good employee today is no longer a tireless worker with quick hands, but rather a very intelligent person who knows how to make a CNC machine work harder. CNC machines are marvelous machines that never complain, and every day they are doing jobs once considered impossible. I love them.

The score of this game is tallied in the sales figures, and I'm gratified when someone buys our product. The difference between a salesperson and me is that I'm happy because someone thought my idea and product was good enough to spend their money on, while a salesperson is happy because they closed a deal. The skill of "closing a deal" was one I never excelled at, so my satisfaction comes from the acceptance of our products.

What's the worst that could happen?

Before starting on a new venture, I arrive at an estimate of the percentage I have for success. This number is really just an educated guess, but it does give me some insight into the odds. I always know I may fail before I start a new project, and if I do fail I can put it behind me. Not knowing what is going to happen tomorrow makes life exciting, and I'm very happy I have a choice.

When I first started marketing Sherline tools I was held back because of the customers' reluctance to buy a product that was relatively new on the market. I would get questions that would express a potential customer's distrust of my company's success. At that time, the machines cost less than three hundred dollars, and yet the same customers who were reluctant to buy a Sherline tool were buying imported cars for thousands of dollars, which didn't have a track record and had fewer guarantees than my machine. The money spent on hobby tools has to be justified to the customer, and even after manufacturing this product line for more than thirty years we still encounter customers who are reluctant. On the other hand we have the nicest customers anyone could ever ask for, because hobbyists are a great group of honest, hard working, intelligent people. When I was first starting out I had to attended trade shows by myself, and when nature called I would walk away from my booth and leave it unattended. I can't ever remember something being stolen. I don't think I would try that with any other group.

Working with skilled employees

Machining is a slow process because parts are made one at a time. The interesting thing is, a skilled machinist may take almost as long to make the same part as a novice. Shortcuts usually end in failure. Unlike some other trades, mistakes cannot be covered up. There are no erasers, whiteout or "putting-on tools" for machinists.

I've never met a good craftsman who wants to do a job over, even when they get paid for it. It's against their nature. I also never met a good craftsman who didn't have to do a job over because of his own mistakes. This is a good time to stay away from them because they are mad at themselves. The fact is you can't work with this many types of tools, dimensions, and materials without making an occasional error. The trick is not to make errors when it counts. Good toolmakers will work with an entirely different attitude when they are making an inexpensive fixture than they will when they work on a part that has thousands of dollars worth of material and labor in it. I can compare it to a driving a race car at over 100 mph to cruising down the highway at 65 mph.

Another thing I enjoy is determining how a particular part will be run through the shop. Designing new products has become easier for me now because of wide assortment of tools we own—about a million dollars worth. Ten years ago, I could set up and operate every machine I owned, but that

time has passed. I don't operate my own machines now because they are too complex to casually start pushing buttons. I have to rely on my employees, and I get a lot of enjoyment out of watching them progress to become accomplished craftsmen in their chosen trade. However, I still don't believe anyone in the shop knows more about making good parts than I do. I may not know what button to push any more, but I'm still the best at solving problems in the shop.

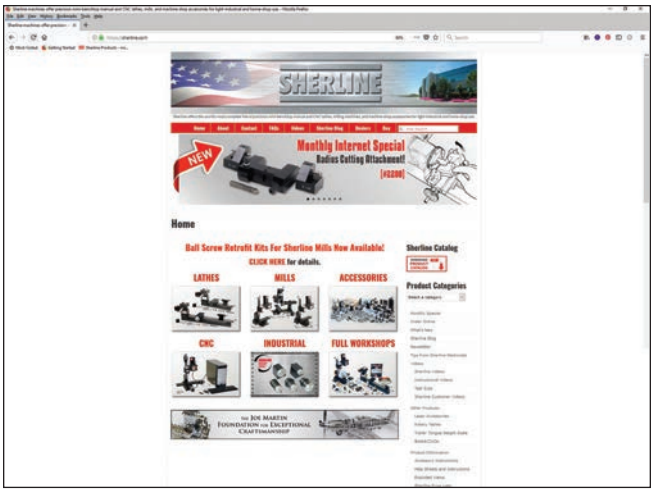
Most of this knowledge I've gathered has been learned the hard way because money was too tight to hire experts. At Sherline we make all of are own parts and only "contract out" the plating, heat-treating, and powder coating. In the past, we have also done a lot of contract machining and I've learned the problems one can get into by finding errors in "inspection". It's just too late. Parts must be inspected as they are built, not after the entire batch has been run. Errors that are found after the parts are made mean you start over. Design errors found after the parts are made will always result in scrap. The only difference is who pays for the scrap.

The credit for a good part goes to the craftsman

Good craftsmen know when they have made an exceptional part and get much satisfaction from it. They also have the ability to produce good work on machines that should be in a junkyard; it just takes them longer. I have a great respect for good craftsmen because they have to work without excuses or erasers. I try to keep reminding you of this fact in this book because it's the craftsman, not the machine, who builds the beautiful things we see daily in this world. Modern machines have given this talented group of people a way to produce more and better work, but it will always be their "touch" that makes those parts beautiful. In my eyes, they just don't seem to get enough respect.

Taking advantage of the Internet

Our website has been a very good investment for both the customers and Sherline dealers. What inspired me to put the effort into having Craig make a very complete site was I believe it is the way of the future, and I didn't want to be left behind. What I really like about it is you don't have to live with mistakes because you just had 25,000 copies of something printed. Information is easily corrected or updated—instantly. I felt that if we did a really good job we wouldn't have to change it, and it could be useful for years, just like the good tooling I keep



An Internet site is an inexpensive way to reach a lot of people who might not be able to find you in other ways.

referring to. I believe we have created a useful site by including plenty of good information such as instructions for our machines and accessories for our customers and potential customers to examine. We also reach a readership that is worldwide. This can be impossible with standard advertising methods. We have picked up a number of new distributors in other countries because of our web page. Our dealers and we have also made an increased number of direct sales overseas because fax and email communications make it easy for anyone looking at a web page to order. Time of day, long distance phone calls and the language barrier are much less of a problem. The bulk of the website was put together over a period of about four months, and has been constantly expanded and improved over the years. The most interesting thing is how inexpensive it is. It costs only $500 to $700 a year for a very large site. Compare that with a two by three inch ad that costs $1,000 and is history once the next issue comes out. I believe only the surface of the Internet has been scratched and it will keep growing for many years. It represents the leading edge of the "information revolution" that is to our era what the industrial revolution was to our grandparents and great grand parents.

Steps in the design of a new product

I enjoy having customers call and tell me about a business they started by being able to build prototypes with Sherline machines. You should never commit yourself to a design until you have at least built a crude mock-up that you could hold in your hand. Looking at it from every possible

angle will be very helpful to you. Usually you will start making changes in your design before your prototype is even completed. This is how my partner, Carl, and I designed new products. I usually would make a rough sketch of an attachment that will help solve a customer's problem. We then make a simple drawing that contains all the fixed dimensions that must be adhered to. A ball bearing would be an example of this. Then Carl would make a quick set of drawings. From this we build a mock-up to get an idea how it will look. The next step is to consider manufacturing methods while trying to work with the equipment you have. This is where you can go astray. A product has to have a certain look, and that look shouldn't be sacrificed to make it easy to manufacture. Don't make it look like the design was picked because it was easy to manufacture.

There are now 3-D computer programs that can do this on the screen amazingly well. We have one, but we still build a prototype as well, the old fashioned way...one part at a time. For $300,000 you can even buy a machine that will make a plastic part directly from your CAD designs. When large companies spend this much money for a machine that is only good to develop a shape you can look at, it should give you some idea of the value of what can be gained from seeing an actual prototype. Again, don't design a product that is just easy to build. It has to look good enough for a potential customer to buy it. Some products need a compact, modern look and others require a massive look, but these designs should always be pleasing to the eye. Don't use the first idea that pops into your head. I very seldom (if ever) come up with an original idea after nine AM because I am a "morning person." I don't have any problems running the business in the afternoon, but new ideas come to me long before I get to work. It is wise to analyze yourself so you know when is the best time for you to plan for the future.

After we have decided on a suitable design, detailed drawings are prepared in a computer aided drafting program called AutoCad®. We may have to change the design again as we make the first production run of parts, and we run these parts in a sequence that allows for change whenever possible.

Towing a race car leads to another product line

I was towing my race car home after a race and something just didn't seem right. The tow vehicle was a 29-foot motor home and the race car was in a 26-foot enclosed trailer. It was dark when I stopped

PRODUCT EXAMPLE—A race car alignment system. The race car alignment is typical of many of the products I've produced because I've gotten involved in what they are used for. This system had many advantages for a system that sold for less than $2000. It never returned a profit because I misread the market. I should have made a $3000 unit with digital readouts. It took me longer to write the instructions than to design the product.

and looked inside the trailer, checked the tires and hitch and couldn't find anything wrong. I went on my way, but it still felt like the car was loose in the trailer. I made it home, but the next morning I found that I was towing the trailer with all the hitch welds broken except one. When I looked into it, I found I had the hitch overloaded by a factor of 2.5. The hitch shouldn't have had over 350 pounds loaded on to it. Why the motor home manufacturer put a

The hydraulic trailer tongue weight scale was easy to make and addressed a portion of a market that was without competition.

The suspended version of the Sherline hydraulic scale was conceived of as a companion unit to the trailer scale to aid truckers loading heavy items for shipping. It started out as a slow seller but has now found entirely new markets among farmers, elevator companies, utility companies and many other applications we had not considered when designing it. Like the trailer scale it is also easy to make and has been a profitable sideline.

light-duty hitch on a big motor home is beyond me, but I was the one at fault for not checking its rating. Of course I immediately had a better hitch put on my motor home, but I felt I needed a simple way to check the hitch weight. I made a simple hydraulic scale by making the piston and cylinder equal to one square inch of surface area and using an inexpensive pressure gauge that reads in pounds per square inch (PSI). One pound of weight creates one pound of pressure on the one square inch cylinder, so the PSI gauge reads in pounds. It worked well, and I decided to produce one that looked more professional than my prototype. This was something I could easily manufacture, and I considered this a good gamble. Along with the scale we included a useful booklet that Craig and I put together on towing trailers. We were lucky to find a nationwide distributor to market it for us. They have sold several thousand units now, and I believe we made the roadways a little safer for all of us. It all came about because of my error, yet it made a few bucks for the company at the same time.

I then thought that the world needed a low cost 2.5-ton hanging scale using the same simple hydraulic method. These are usually called crane scales and are quite expensive. I felt that a scale would be still useful even if it weren't accurate to .5%. It could be used for loading. People don't get into trouble making 50-pound errors when it comes to loading trucks. Trouble comes when they make big errors, and this scale would help prevent that. I was right, and we found a good mail order company to market it.

While I wouldn't want to own a company that only offered these two scales as a product line, these two products are easy to manufacture in my facility and add to our overall profit.

Battling poorly written manuals to learn AutoCad® myself

My dear friend and partner Carl passed away in September, 1997. This was a great loss for me as we had been through a lot together. I also realized that I now had no option but to learn a computer-drafting program. Up until then, Carl had done all my detailed drawings and there wasn't anyone else in the organization who had the time to take on this task. I couldn't go to school because we needed our drawings done now, not several months from now when a class would graduate. I was reluctant to hire someone because it wasn't a full time position. I decided it would be easier for me to learn computer drafting than to teach a new employee our product line. Carl and I worked together for so long I knew I couldn't replace him, and it helped me to ease the pain of his death by diving into this new endeavor. I started working at home to eliminate the constant interruptions at work. The difference between a word processing program and a drafting program is that a letter can be written with a word processing program without knowing the slightest bit about the program. This isn't the case with drafting programs. At first I had trouble just putting a line on the screen. I went out and bought a couple of the popular books on the subject. When I finally drew a box and wanted to dimension it, I looked up that subject in the index and found the first information about dimensions was on page 700. I knew then that I was in trouble, but I had an "ace in the hole"—Friends.

Studying at the "University of Friends"

My friend Jerry Nelson had started teaching himself computer drafting several months before and was "over the hump" on learning this program. I called him and he taught me enough over the phone in 15 minutes to do my first drawing. I couldn't get this much usable information from the books after studying them for the previous week. The books I read were typical of the technical manuals I've had to deal with for the better part of my life. It isn't that the subject is so difficult, it is the method that the information is fed to you. You never know whether you are getting the main course or a snack. The main purpose of an engineered drawing is to convey dimensions to the person who is going to build or use the part. To give you 700 pages of BS before getting into the meat of the matter is another

example of a failed attempt to teach a subject. As the instructions I write keep getting longer and more complex I use these as examples to remind myself how not to do it.

Learning AutoCad®

The first task I took on to learn the program was to lay out and design a set of bevel gears that could be cut on a Sherline mill using a rotary table mounted on an angle plate. By drawing the cross sectional view accurately, the angles needed to cut this gear could be taken directly off the drawing without using a trig table or a calculator. I was beginning to see the light.

I'm getting pretty good at using the program now, and it has put a lot of the fun back in designing for me. Looking over Carl's shoulder at an assembly designed by computer was of no help for me. I would need a standard, full-size or larger layout to design with. I've since found that doing the design totally myself has become the perfect way for me to work. I love the program. It has made me more productive than ever.

I'm fascinated with the program because it does a drawing without errors when used properly. The program eliminates much of the boredom of adding and subtracting numbers as you go. Accuracy isn't attained by the precision of your lines but rather by the accuracy of the information the program is given. Angles are not derived from a protractor and using divider points but from calculations by a computer to as many decimal places as needed. I learned drafting in high school back in the fifty's. My problem was I was a slob when it came to drafting a pretty drawing. My numbers and views would be correct, but my lettering and lines weren't neat enough. Things have changed now with the aid of this program, and my lettering is just as good as the best. I can no longer spill gobs of ink on an almost completed drawing and have to start over. I can change my mind as much as I want without irritating anyone. I'm a happy man.

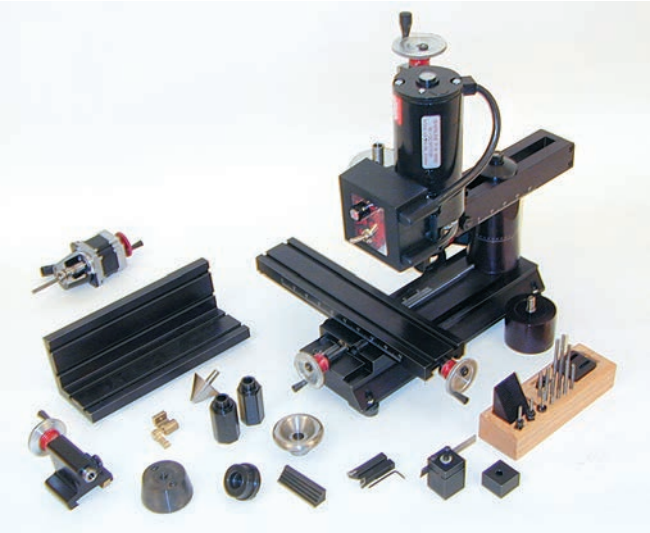
Opening the floodgates of design

Since learning the program, I have added many accessories and put many new products into production. As I became better at using the program I found that I now could easily design a new product. I had many ideas in the back corners of my mind. I would take a break from the boredom of reviewing and redoing the hundreds of existing drawings and design something new. It was a piece of cake. In a couple of days I could produce what used to take several months. You should also note that when I design a new part the design includes how the part will be made in our machine shop. As an example, I designed the quick-change tool post along with the tool holders in over a weekend. I'd be working on several new projects at the same time. If I ran into a problem with the design, I'd switch to another project until I'd come up with an answer to the problem. If I weren't inspired with a good idea I'd work on the existing drawings. I don't think any of my employees believed I would ever finish the drawings; however, they weren't around when I started and would work an unbelievable amount of hours to finish a project on time. They didn't realize how persistent I could be. I'm happy to state that all our drawings (around 900 now) are up to date and in the same format today.

Getting the shop to develop flow charts

For years I had been trying to get the machine shop to document the procedures to manufacture each part. I had talked for hours on the subject to Carl, my partner, and Karl, my shop foreman, to no avail. I even hired someone to help them. You just can't threaten the most important people in your business to get something done. The loss of Carl drove home the need to get this done. I was burying Karl with new parts to make, and he finally realized there wasn't a chance in hell of remembering all the procedures needed to produce all the different complex parts we now manufacture. Finally we have job folders on each part that have the machining sequence, machining times, programs, tooling, setup instructions and exactly where the tooling and programs are stored. This was also no small undertaking and the job folders took many thousands of dollars to document.

I then entered the machine time and labor cost and material cost obtained into a marvelous Microsoft spreadsheet program called Excel that allowed me to get our true manufacturing costs of each product. Until then I was relying on an old job-costing sheet for these numbers. It turned out that it wasn't being updated properly and we were losing money on some sales. When you're selling something for less than it cost to manufacture it you can't make up for it with increased sales. I raised prices and restructured the discount schedule. These are the "dammed if do and dammed if you don't" type of decisions you get stuck with as you get bigger.



Once I learned AutoCad®, designs that had been bottled up inside me poured out in a hurry. Between 1997 and 1999 all the new products in the above photo were added to the line. Also introduced, were the industrial line on page 287 and a new quick-change tool post system.

A little advise on purchasing full size machines

I would like to give you some views I have come up with after spending well over a million dollars on machinery. I'm addressing this mainly to the portion of our customers who will end up moving up in size to standard machine tools. The first machine I would buy would be a Bridgeport® vertical mill. These machines haven't changed for years because they are just right the way they are. More successful businesses have been started with this marvelous machine than any other. You can build prototypes, tooling and production parts with this machine. There are imported copies of the Bridgeport, but they don't seem to have the quality of the original. Although this book is written about home shop machining, I'm also trying to give you some insight into producing metal products. If you happen to come up with a great idea, you may want to build these parts yourself and start a business.

A mill is usually more important than a lathe; therefore, it has to be in better condition. You can still make good parts on a lathe that may have made parts for the First World War. A little filing and polishing and you have a good part. On the other hand, trying to work with a mill that has worn out slides creates a different problem. The forces that are generated as end mills cut can come from any direction. A lathe generates most cutting forces straight down toward the bed. You can always bring a diameter to size with a file on a lathe with worn out ways, but to file a bored hole to its correct position is next to impossible. The things you do on a mill have to be done right the first time. If you plan on stepping up from miniature tools to full-size machinery, the cost, particularly the cost of accessories, will rise dramatically. Another thing you will find is that these machines aren't as much fun to operate.

Before buying any full-size machinery, I would give it a lot of thought, because the cost and space this type of equipment take is substantial. Even if you can afford the extra money and have the space, they will not bring you happiness unless you have a definite need for them.

Buying used machines at an auction

I have purchased machinery from every source available, but I like auctions the best. It is a game that is played for high stakes, and high-dollar machines are often sold in less time than a fifty-dollar vise. It takes two people who really want a particular machine to get the price it is actually worth. If you have many bidders, the price may go way beyond what would be considered a good buy. At that time the auction may turn into a bidding contest that leaves common sense behind. Know your limit before you start bidding and know what the machine is really worth. Of course, I didn't always follow this rule and ended up buying a few "turkeys", but that was part of the fun. Buying used machines from a dealer has some advantages, and many times it can be more economical than an auction. In addition, you can usually get a money-back guarantee. You can't even get that on a new machine. Putting large machines in place is costly for both parties, so you have to be sure of your decisions.

Choosing between mechanical and CNC machines

If you are trying to build a product and you need to produce a particular part, you may have a choice between a computer control and a mechanical machine. CNC machines have been more reliable than mechanical machines for me. There are more employees available today who are trained to operate these machines. If you bought an old CNC machine without documentation you may have bought a piece of junk unless there is someone in your area who can fix it. You must know if you can get it fixed before you buy it. A technician a thousand miles away will not be of much help if it is going to cost you $2000 in travel expenses to fix a $100 problem.

I look at CNC machines differently than mechanical machines. They are more like automobiles and have a limited life. If you can afford it, buy a new CNC machine. Often they will be able to make a better part in half the time it takes a machine that is seven years old, and time is money.

A new home for Sherline

The last few years had become the most productive years of my life and I'm still amazed by the amount of work I produced. My partner, Carl died when I was just starting to write this book. You can't help but take a close at your own life after your best friend passes on. I did and realized I had only scratched the surface of what I wanted to accomplish, but where to start? What I wanted more than anything was a modern manufacturing facility that I could truly be proud of. The building I had built almost twenty years earlier now was turning into a junkyard because of the limited floor space. I had more equipment than room, but I had to deal with my more immediate problems first.

Back to seventy hours a week

I was at a point with this book that I was committed to finishing it. I got Craig started on creating the format I wanted him to follow throughout the book. This allowed me to take a break from writing while Craig caught up with me with the graphics and switched my attention to my most immediate problem: the product drawings. I never realized what a mess I had on my hands until I had to find a drawing myself. I'd find several drawings of the same part with several variations. There were also several variations of the AutoCad drawings stored on disk. Carl had the ability to keep these sorted in his head and could pick out the proper drawing from a pile stacked on his desk in moments. We couldn't.

The facility at 2350 Oak Ridge Way was a nice building, but even before we moved in I realized it was not going to be big enough for our future needs. It became our temporary home for two years.

The closer I looked, the worse it got. Now that I knew more about AutoCad, I realized the drawings didn't have any standard. Carl must have stopped working on the drawing the moment the printed version was suitable to send to the shop. We had around 450 different drawings at that time drawn in many formats. You have to realize just how serious a problem this was. If we manufactured a part to the wrong version of his drawings it could result in thousand of dollars worth of scrap. This was a problem that I had to sort out because I was the only one in the company who truly understood how the parts had to fit together and the allowable tolerances.

Since right after Carl died I had started waking very early and it became a blessing. All the drawings were brought up to date between 4 AM and 10 AM. This is the time my mind is at its best. I hired a professional to help me decide on a drawing format. I still didn't know enough about the program to get me started on this gigantic task. I then started to replace any drawing in doubt before putting it on the production floor. The first drawings were very time consuming for me to produce, and having ten hours in a drawing wasn't unusual. If I found something I didn't like about the format we were using, I would go back and change all the drawings I had done up to that point to the same format. I wasn't going to fall into that trap again. It took about eighteen months of hard work to get the production drawings to the point I began to have confidence in them again.

I still had to be very involved in the day-to-day operations; however, I could solve problems such as these on the spot at any time of day. I finished the missing chapters in this book and again started thinking about a new home for Sherline. An advertisement came in from an industrial Realtor that had pictures of a building that looked just right. I looked around but this still seemed to be the best deal in town. The building was around 30,000 square feet and was to be built in a brand new industrial area. I didn't want a building that was surrounded by old buildings. Modern industrial parks and buildings in California have changed dramatically in the last few years. The buildings are designed to look good, withstand earthquakes and have sprinkler systems. I wanted one. The selling price was around $2.2 million including improvements, and I eagerly put my name on the contract. It would take about six months to complete the new building.

The new accessories bring home the need for more manufacturing floor space

The new building turned out great and I moved Sherline into it and left Martin Enterprises in the old building. Remember that Martin makes the parts and Sherline assembles, sells and ships the product. Sherline hadn't even moved completely when I realized I had screwed up. I not only didn't allow enough room for Sherline there wasn't any way I could fit the machine shop in there without crowding the machines. Can you imagine the thoughts going through my mind when I had just purchased a $2.2 million building and it was too small? I never moved the machines into that building and started putting money aside for my next move. Putting money aside was difficult because I was also buying Carl's share of the Martin Enterprise partnership from his wife at the same time.

There was an empty lot across the street that would be perfect to put up a building for the machine shop on. The people that I bought the new building from owned it. I talked to them about it and couldn't get a direct answer and was getting upset when calls were not getting returned. I needed to make plans now because sales were up another 30% and the employees at Martin were packed in like sardines. When I found out that they sold all their remaining lots to another developer I was pissed and on the move again.

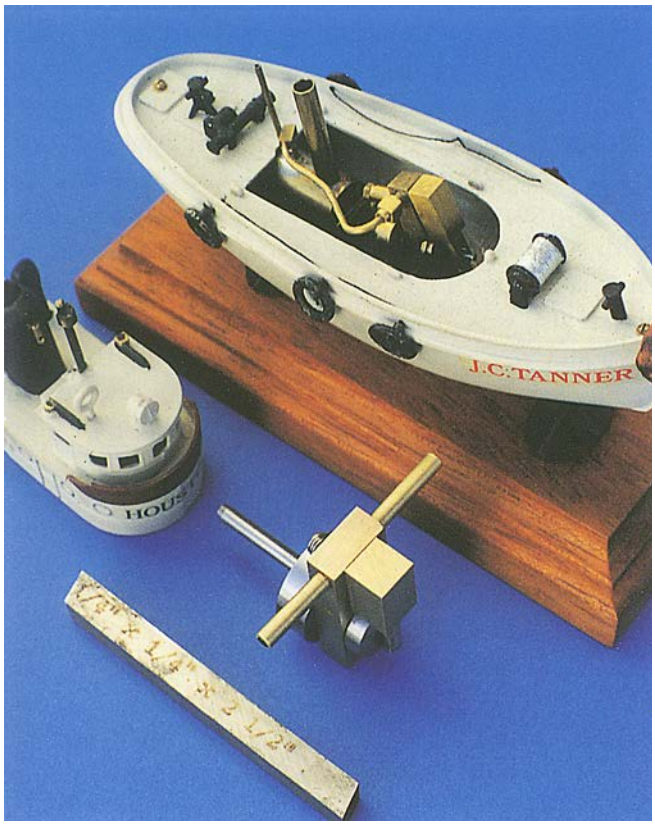
Home at last

I thought about it for about an hour and remembered some nice lots I had been driving by on the road between the two shops. There were some nice looking buildings in that area and a "Build to Suit" sign on the remaining lots. There was one lot on top of the hill on the end of a cul-de-sac that I had to have. A beautiful ocean breeze would come through every afternoon, and it overlooked a small valley with a residential area with expensive homes on the opposite side. It had a better view than the homes did. It also was located next to a 16-acre green space area and would have an ocean view from the west facing second floor. This is where I was going to build my monument (building) "come hell or high water."

When I finally got to talk to the developers I found out that the builders were a family operation. After having the last building built by a large corporation, I liked the thought of being able to talk directly to the people that could make it happen, and we struck a deal for a building with a 55,000 sq ft (5120 sq meters) pad on 3.5 acres (12,263 sq meters). The building would be of tilt-up concrete construction 25 feet high. The architect came up with a basic design. He also worked in AutoCad and said he would email me the design to work with. I changed the basic layout so the building faced the valley rather than the street and made a change to the shape so the building looked and fit the lot better. The office would have a glass front overlooking the valley. My office would have an additional view of the ocean. Now all I had to do was come up with more money than I had to pull this deal off.

Think about this. When this building was completed

We got it right with the building at 3235 Executive Ridge. My office window looks out on the Pacific Ocean to the left and the windows facing the camera look out over a valley with the mountains in the distance to the South. This is a fitting monument to the company's success and offers room for future growth.



Enjoying what you are doing is what it should be all about. Scotty Hewitt's little 5" tugboat is shown with another version of a single cylinder oscillating steam engine that could be considered large only in comparison to Scotty's. Plans for the larger engine are included in Section 5 so you can begin having fun with your tabletop machine tools.

but not ready to move into the payments for all three buildings came up to $85 an hour, 24 hours a day and 7 days a week. I didn't want to turn the old buildings over to a Realtor because I believed I could sell them myself quicker and save the commission that would amount to many thousands of dollars. I was turning down at least two Realtors a week who all told me they had a potential buyer if I would sign up with them. If you didn't think it took a lot of balls to stand firm you must have a hell of a lot more money than I did. Fortunately I was right and leased both buildings with an option to buy in four months. I was also spending thousands of dollars to move into the new building at the same time. I'm somewhat broke now but the main thing for me is I did it on my own again.

As I look back on my life now I realize that I was the happiest when I got into deals like this when I wasn't sure whether I could stretch out and grab that elusive "brass ring" again.

Don't forget to have fun

The information I have provided in this book comes from all sorts of places. Sometimes you learn something when everything goes right. Most of the really valuable things I have learned, however, came along with a certain amount of either physical or financial pain. If I have saved you some of that pain and provided some entertainment in the process, this chapter has been a success. The main point I want to leave you with is too not to put so much importance on the destination that you forget to enjoy the journey. I have always found that I am happier and more enthusiastic when starting a new project than I am right after I have finished one. Before I am done with anything, I find I am usually thinking about what I want to do next. Strive to take your work beyond the level of a laborer or even a craftsman. Work not only with your hands and your brain but also with your heart. When you are done, your project will be more than just a bunch of nicely machined parts. It will be a work of art.

The end of a journey

At 66, for the first time in my life I feel like I have finished what I started. I'm a self-taught man who started with nothing and now owns a beautiful manufacturing facility that is worth several million dollars. If I died tomorrow the company will be left in good shape and will have the organization to continue to give our customers good service. The equipment and inventory is completely paid for and I have passed on the skills to keep the business running smoothly. I never screwed anyone to get to this point and always paid my bills on time. The only money that I really risked was my own and only invested it in my own ideas. I still enjoy working with new ideas but I know that I know longer plan to get myself into a position where there is a great deal of risk. There is just too much to lose now. Employees, customers, dealers and suppliers all have to enter into the equation. It's no longer a one-man show, and it's time for me to kick back and just enjoy what I've created.

"Art is not a thing, it is a way."
—Elbert Hubbard

The media seems to enjoy portraying modelers as meek little people sitting at home and never venturing far from their desk or workbench. Joe Martin belies this image. In business or pleasure, Joe has always found a challenge in putting his skills to the test, whether it is building a business, flying R/C models or racing fast machines.

Top left: Joe windsurfing at Lake Lopez. Joe is an experienced windsurfer, having speed-sailed at "The Ponds", a high wind spot in the California desert (which has since been fenced off), and surf-sailed in Southern California and Maui, Hawaii. Above: Joe's former Erickson 32 ocean racer in the Newport-to-Ensenada race. Top right: Joe is shown at the helm of the Erickson. Above right: All you can see is Joe's head sticking out of this mini version of a 12-meter yacht here being raced in light air in Oceanside harbor.

It doesn't matter if the top speed is 15 knots or 185 MPH, if it goes fast and you can get in it, Joe will put numbers on it and go racing. Top: Joe's first venture into auto racing was a Triumph Spitfire raced in the production classes of vintage sports car racing. Above: Joe at speed at Willow Springs Raceway in a Swift DB-1 Formula Ford. He was San Diego Sports Car Club of America (SCCA) Regional Champion in that class in 1994.

Sometimes you're just in the wrong place at the wrong time. At an SCCA race in Holtville, CA, Joe (#80) is caught by surprise by a spinning car that entered the turn too fast behind him. Fortunately, his car didn't flip, but ended up back on its wheels with only a badly damaged suspension.