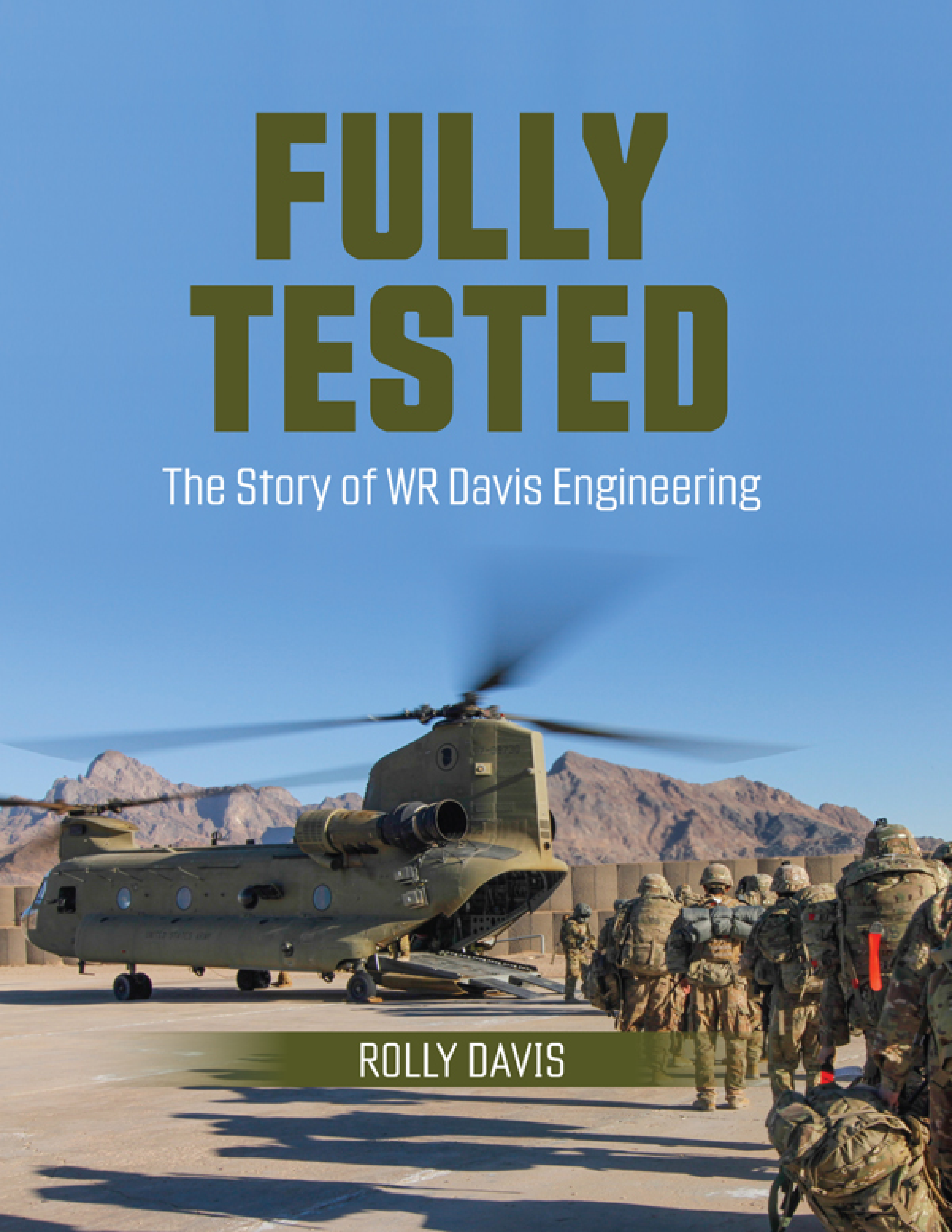
FULLY TESTED

The Story of WR Davis Engineering



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PROLOGUE

From Vague Idea to World-Beating Business

In 1975 I could not have imagined that the one-man engineering consultancy I was setting up in Ottawa would one day become a global leader in defence technology, doing its bit to protect navies and air forces around the world.

I had just returned to Canada with my young family after 3 years in Syracuse, New York, and it was becoming clear to me that there was a demand for engineering expertise in non-traditional fields—a view reinforced by Dennis Eryou, my graduate school office mate and good friend. And so, the two of us decided to offer our recently acquired expertise in heat transfer and aerodynamics to a network of local contacts that dated back to my time as a research engineer and lecturer at Carleton University.

Those early years had also opened my eyes to a growing international interest in computer tools that could help in the design of turbomachinery, such as turbines and compressors, which transfer energy between a rotor and a fluid. I had been increasingly exposed to this work during my first job in Boston, my work in Syracuse, but especially thanks to the contacts I made while developing software for the analysis of gas turbines and other machinery at Carleton.

Whatever the attractions of such work, however, Dennis and I initially had little choice but to search for and take on almost anything in order to survive without outside equity financing. So we tackled projects as varied as vehicle fuel-economy testing, hydraulic wave generators, solar heating, hail guns, and more.

Though our business may have seemed a little unfocused in those days, the early contacts we made, especially at Canada's National Research Council and the Department of National Defence (DND), were to prove invaluable. Not only did they keep us afloat, but they also laid the groundwork for Davis to become what it is today: a world leader in the stealth technology that shields military aircraft and naval ships from heat-seeking missiles and mines.

Infrared suppressors designed and built by Davis are now fitted to hundreds of aircraft, including the CH-47 Chinook helicopter, the C-130 Hercules transport aircraft, as well as a variety of ships, most recently the new British/Canadian/Australian Type 26 frigate. Navies in more than a dozen countries have equipped their frigates, destroyers, and other vessels with our active shaft grounding system, making them less vulnerable to "influence" mines detonated by low-frequency signals emitted by a ship. They have been equally impressed by Davis's proprietary software, known as the Naval Threat Countermeasure Simulator, which models the interaction between naval vessels and antiship missiles.

Thanks to these innovations, Davis has steadily expanded over the years. We now employ about 170 people at manufacturing facilities in Ontario and Florida, supplying customers as far afield as Australia, Europe, South Korea, Turkey, and the United Kingdom. Our expertise is internationally recognized, and our team members are regularly invited to address at high-level conferences on defence technology.

The journey that started with a vague idea of building on expertise in a niche field of engineering and led to a specialty of which I wasn't even aware has been a classic story of entrepreneurial risk-taking. Although the concept of developing stealth defence technology came to me early on, the path to where Davis is now has been marked by ups and downs, stops and starts. As with so many entrepreneurial ventures, there have been times when I wondered if we would be able to make payroll at the end of the month. But thankfully and luckily, we always did.

I have been fortunate to be able to draw on the support of a group of immensely talented, loyal, and hard-working colleagues, many of whom have worked for Davis for over 20 years. My family has also been a source of strength. Davis Engineering remains a family-controlled business, with three of my four children holding senior positions. I remain chairman of the board, though I retired some years ago from active involvement in operations. Tom, our second son, is currently president and chief executive; daughter Courtney is director of business development; youngest son Andrew is senior liaison engineer; and son-in-law Patrick is senior structural engineer.

Beyond entrepreneurial risk-taking and supportive employees and family, Davis could not have succeeded without a host of valued partners around the world. All of our key technologies have had their origins in a branch of the Canadian government, notably the National Research Council and Department of National Defence. In the United States, the Naval Research Laboratory has also supported us with business opportunities and valuable expertise. These relationships have been based on contracts to supply equipment and software for these organizations' operations. These contracts have typically funded our development work, and we have then gone on to supply the required hardware. This is not the currently popular model, which tends to measure success by the amount of research dollars spent.

In addition, for over three decades Davis has enjoyed a close and mutually beneficial relationship with the mechanical engineering department at Queen’s University in Kingston, Ontario, where one of our former employees, Mike Birk, was on faculty until 2021. This arrangement has given us access to a pipeline of engineering talent that continues to this day. Given the immense effort undertaken by so many over the years, I felt it would be interesting and worthwhile—for our employees, our family, and our many friends—to recall the way it all came together. Hence, this book.

CHAPTER 1

Early Days

In 1962 I was in the first year of engineering studies at Carleton University when the school's dean, John Ruptash, noticed that both my attention and my marks were slipping. The professor called me to his office one day and politely but firmly asked, "Why aren't you doing so well? Is there something else you'd rather be doing?" He had hit the nail on the head. I was far more interested in football and basketball . . . in fact, just about anything other than engineering. I told him, quite truthfully, that I would far rather be a gym teacher. Most of the faculty at that time had backgrounds in either industry or research so, after a brief chuckle, Dean Ruptash was well-equipped to offer a wise bit of career advice, indeed some of the wisest I would ever receive: "Well, Rolly, if you become a gym teacher, you'll never be an engineer. But if you take engineering, you can still become a gym teacher."

Thanks to that bit of common sense, I did become an engineer, and the seeds were sown for the formation of Davis Engineering, a world leader in the highly specialized but critical field of infrared suppressors, the technology that helps repel heat-seeking missiles. Davis is now a smoothly running organization with all the processes and controls that fighting forces around the world expect from their key suppliers. As I write this in early 2022, our order book is full and our finances are on solid ground. We have not only survived the COVID-19 pandemic but have won valuable new business and set up a manufacturing operation in Florida to augment our 50,000-square-foot plant on Old Innes Road in Ottawa, Ontario.

Yet the road from the dean's office to a thriving and internationally respected defence contractor has been winding and not always smooth.

I wish I could say that Davis Engineering owes its success to a burst of inspiration or a carefully conceived plan. In fact, the story is one of hits and misses, of ups and downs, of gradual evolution, and of perseverance and teamwork—not to mention some impatience and tough decisions. Bruce Hiscoke, currently Davis's manager of structures and design, and one of our longest-serving employees, tells me that he and his colleagues used to half-joke about the "laser beams" coming from my eyes. "Rolly is a teddy bear now compared to what he used to be," Bruce says, though he adds—and I would not disagree—that "anyone in that kind of entrepreneurial situation, when the fat is in the fire, is going to have a harder edge."

There was a time when we would put our minds and hands to almost anything just to make sure we had money in the bank to meet the payroll at the end of each month. Our team tackled any job we took on and, with just a few exceptions, made it work. These days, Davis is known around the world for infrared suppressors and active shaft grounding systems, but over the years we also did well in some totally unrelated niche markets, such as wave generators, water tanks for regional jets, and hail and bird guns. We also tried our hand—less successfully—at dehumidifiers, solar panels, and a water curtain to help icebreakers plow through the Arctic. We did consultancy work for Canada Post, studied how to measure the coverage of car and truck headlights . . . and much more.

My entrepreneurial—some might say restless—spirit is no doubt a function of my upbringing. Born in 1944, I was third of five children. We lived in Smiths Falls, south of Ottawa. My father started his career as a public school teacher and later became a principal, but with such a large family he felt the need to find a better-paying job. So he started selling life insurance, and soon did very well at it. Each promotion brought another move, first to Kingston, later to Fort William (now Thunder Bay) and several other cities around Ontario in between. After I turned seven, we spent no longer than 2 years in any one place. Those were challenging years for me, moving from one school to another, being thrown in among a group of often-hostile strangers and seldom staying long enough to make real friends. But in the end our nomadic lives worked out just fine and, with hindsight, probably did me quite a lot of good. I developed the thickish skin that every entrepreneur needs, taking mistakes and failure in stride as I moved on—sometimes impatiently—to life's next adventure.

The family returned to Ottawa for my final two years of high school, and I then enrolled in an engineering degree at Carleton University. To this day, I can't explain what attracted me to engineering, but one influence was certainly the uncle after whom I was named. Uncle Rolly was an electrical engineer who at one time was head of Ottawa Hydro, and then ran the public utilities in Kingston. He and his family had a cottage next to ours, and he always seemed to be busy with some or other home improvement project. I had great respect for Uncle Rolly, and he often encouraged—though by no means pressured—me to follow in his footsteps.

As Dean Ruptash at Carleton quickly discovered, my engineering studies did not get off to a strong start. But I took his gym-teacher advice to heart, and my marks steadily improved to the point where I emerged near the top of the class in my final year of mechanical engineering. My professors even recommended that I stay on for a master's degree, which turned out to be another smart suggestion.

My thesis supervisor, Doug Millar, was a remarkable man whom I greatly admired and who became a mentor and valuable sounding board as my career progressed. Doug had been a pilot during the Second World War, flying transport aircraft over what was known as The Hump, a treacherous route between India and China that the Allies used to fly supplies to the Chinese leader Chiang Kai-shek and American forces based in China. After the war, Doug enrolled as a mature student at the Massachusetts Institute of Technology (MIT), returning to Canada with a PhD. He worked first at the National Research Council and later at Pratt & Whitney Canada, helping to design the PT6 turboprop aircraft engine, which became one of Pratt & Whitney's great success stories. The first PT6 rolled off the production line in 1960, and it remains in service to this day, with the 50,000th engine produced in 2020.

In 1967, thanks to an introduction from Doug, I landed my first job with Northern Research and Engineering Corp, known as NREC, a small company located on the MIT campus in Boston that was using an early generation of computers (what we now call design software) to design gas-turbine engines. Our association didn't last long. NREC was in many ways a fine company, but I arrived as it was going through a management shake-up, and I soon became impatient with not being given enough work. So I quit and joined NASA's Electronics Research Centre, also in Boston, where I spent a fruitful year working on the concept for what is now the global positioning system (GPS), the engine behind car navigation systems and Google Maps.

I might have stayed much longer at NASA had Doug Millar not contacted me again in the spring of 1968 and asked whether I would like to return to Carleton as a sessional lecturer and research engineer, and work with him to develop a computer program for designing and analyzing gas-turbine engines. By then I was married with two young children, and a move back to Ottawa made sense.

The 5 years I spent at Carleton turned out to be an invaluable stepping-stone. We developed software now known as computerized fluid dynamics, or CFD, which studies the flow of air through gas-turbine engines as a way of predicting and then enhancing their performance. Little did I realize that a few years later this knowledge would form the foundation for a thriving global business.

Those were heady days for a young engineer still in his early twenties. There was plenty of interest in our work, and I helped Doug write five refereed papers for the American Society of Mechanical Engineers, which we presented at conferences around the world, from London, U.K., to Houston, Texas. Another benefit was that I had time to take on outside consulting jobs with various government agencies and companies. We were even able to sell our CFD software to NREC, my first employer in Boston. There were clearly no hard feelings about my abrupt departure just a few years earlier. Pratt & Whitney was another customer. Our clients seemed pleased to have a young, energetic—and cheap—outside contractor to whom they could assign work that they could easily integrate into their existing operations. The arrangement worked well for me, too. I was able to augment my income and, perhaps most importantly, make some valuable contacts that would later put Davis Engineering in good stead.

Then, in 1972, I was approached by Carrier Corporation Research Centre, a unit of the big air-conditioning company based in Syracuse, New York, just a couple hours' drive from Ottawa. Would I be interested in helping Carrier develop computer programs for designing steam turbines? The work would be similar to what I had done in Boston and at Carleton, and it seemed a great opportunity to broaden my horizons, both personally and professionally. So we decided to make the move to Syracuse. I enjoyed the work, made many new friends, and Syracuse was a wonderful town to raise a young family. Even so, I was always on the lookout for greener pastures and, sure enough, after 2 years at Carrier, one emerged. Or so it seemed.

During my master's studies at Carleton, I shared an office and became good friends with Dennis Eryou, a brilliant fellow engineering graduate. Dennis went on to earn a PhD from MIT and lived in Boston at the same time as me. We remained in touch, and shortly after he moved back to Ottawa, around 1974, he called me in Syracuse with what sounded like a great idea for a new business. I would return to Ottawa, set up an engineering consultancy, and Dennis would channel work to me from his employer, Hovey & Associates, run by Gord Hovey, an ex-military man with good contacts at the Department of National Defence. If things worked out, Dennis would join me and we would become partners in a growing enterprise.

And that's exactly what happened.

By then, my first wife and I had divorced, and I had married Wendy Walstrom, a nurse from Vancouver. With a young family in tow, we moved back to Ottawa in the summer of 1975 and rented a house in Blackburn Hamlet, in the east end of the city. I set up a home office and started rekindling my old contacts at the National Research Council, Computing Devices, and other government agencies and companies. Working from home was definitely not my cup of tea, so within 6 months I rented office space on Woodward Avenue in the west end of the city. My landlord, Hari Anand, ran a company that provided mainframe computer services for businesses that couldn't afford their own machines. Hari could not have been more accommodating. He had extra space and told me I could use as much or as little of it as I needed. I spent about a year there, managing to land enough work that I was able to hire a couple of employees and occupy a few more of Hari's offices.

Dennis soon joined me, much to the annoyance of his boss Gord Hovey, and we went about setting up Davis Eryou & Associates. We billed ourselves as engineering consultants, though "engineering mercenaries" might have been a more apt description, given our willingness to take on just about any paying job that presented itself. Eric Poirier, who joined in 1977 as our third employee, puts it well: "We'd chase any work we could. We took risks that other companies weren't willing to take."

Thanks to our network of contacts, Davis Eryou was kept busy with a variety of jobs from the Department of National Defence, the National Research Council, the Department of Transport, and others. The global economy had yet to recover from the Arab oil embargo against Western countries that supported Israel in the 1973 Yom Kippur War, so much of our work was for Transport Canada, researching ways to improve fuel economy, especially for trucks.

Here's how Eric Poirier remembers those early days:

> My first decade at Davis involved a lot of vehicle testing. Whether it was fuel economy, brake testing, or compliance tests, we were kept busy. Some of this testing needed to be done in an isolated area, so we would travel to a remote site near La Macaza in the Laurentians each Monday morning and return to Ottawa on Friday night. Later, testing was done at the Transport Canada test facility in Blainville, Quebec. We were doing so much testing there that we ultimately rented an apartment for our staff to live in.

One contract that seemed to run on for many years centred on rolling resistance. Our equipment consisted of a 45-foot flatbed trailer equipped with instruments mounted over the axle that measured the amount of resistance the tires encountered on the road surface. Measurements were recorded using different tire pressures as well as a variety of wind-blocking devices. I clocked a lot of mileage driving that rig up and down Highway 417.

Davis Eryou grew and prospered. We soon outgrew our Woodward Avenue offices, and in 1978 moved again to the east end, this time to a 5,000-square-foot building on Sheffield Road (just half a kilometre from our present location) that offered not only offices but also space to install some manufacturing equipment. From testing for compliance with safety standards, we quickly progressed to building various bits of equipment for Transport Canada. One big contract was for a crash barrier, used to simulate the impact on a vehicle involved in a real-life accident. That was Dennis's brainchild, a great example of his ability to design and build just about anything he set his mind to. We also built equipment to help the two South Korean carmakers, Hyundai and Kia, meet North American safety standards as they entered the United States and Canada for the first time. We eventually taught the Korean engineers how to operate it themselves, working ourselves out of a job but gaining knowledge of South Korean business culture that would later prove invaluable as we moved into the suppressor business. By 1979, our payroll had grown to about 40, and we had set up a joint venture with Wajax, a well-known maker of industrial equipment, also based in Ottawa.

The contacts I had made during my time at Carleton were to prove extremely useful—even indispensable—to our success. One was Sandy Patry, who was in charge of Carleton's engineering shop, which designed and built experimental apparatus for faculty members. Sandy later joined Davis Eryou and helped with many of our early designs. Another supporter was Bernie McIsaac, a brilliant PhD student who came from a modest background in Atlantic Canada. Bernie soon left us to start his own company, Gastops, which grew into a global business making sensors and other systems that improve the productivity and safety of equipment used in the aviation, energy, shipping, rail, and mining industries. Bill Rainbird, another fellow faculty member at Carleton, introduced us to Dilworth, Secord, Meagher & Associates, an engineering group that designed wind tunnels around the world and helped pave the way for Davis Engineering's breakthrough into South Korea in the 1990s.

Transport Canada crash barrier facility. An instrumented school bus is towed at high speed into a steel-and-concrete barrier.

Those were exhilarating days, seeing ourselves as "the little engine that could" and often flying by the seat of our pants. There was virtually nothing we weren't willing to tackle, if only because we needed to meet the weekly payroll. Eric Poirier isn't far off when he recalls that "Rolly made some ballsy moves, in some cases, promising stuff that we hadn't even developed yet." We bought an IBM 1620 computer from the federal government's surplus stock, partly to convert data on fuel-economy measurements, but also because we figured it might impress visitors and prospective customers.

Mike Birk, who joined us in 1983, remembers:

> Rolly and I complemented each other very well. He's about 10 years older than me, so he's a bit more experienced, and a little bit more of a risk taker. I felt like I was very technically competent. So Rolly would promise something to a customer and my response would be: "Well, I think we can do that." And then Rolly would say: "Yeah, you can do that Mike." The first couple of times we did that I was scared to death. But then after a while, it just became the way we worked. We would always accept unreasonable schedules and unreasonable budgets, but we pulled them off.

For a while, the buzz of activity was all we needed to convince ourselves that the business was thriving. At this point we had hired more staff and moved to a larger building on Cyrville Road. But even as it seemed that Davis Eryou and DEW (Davis Eryou Wajax), our joint venture with Wajax, were firing on all cylinders, we were in fact dangerously over-extending ourselves.

Queen's University professor and former Davis employee Mike Birk, speaking while I survey the audience.

Our third home on Cyrville Road, which we enjoyed from 1978 to 1985. A big step to 30,000 sq. ft. (from the previous 5,000 sq. ft) on Sheffield Road.

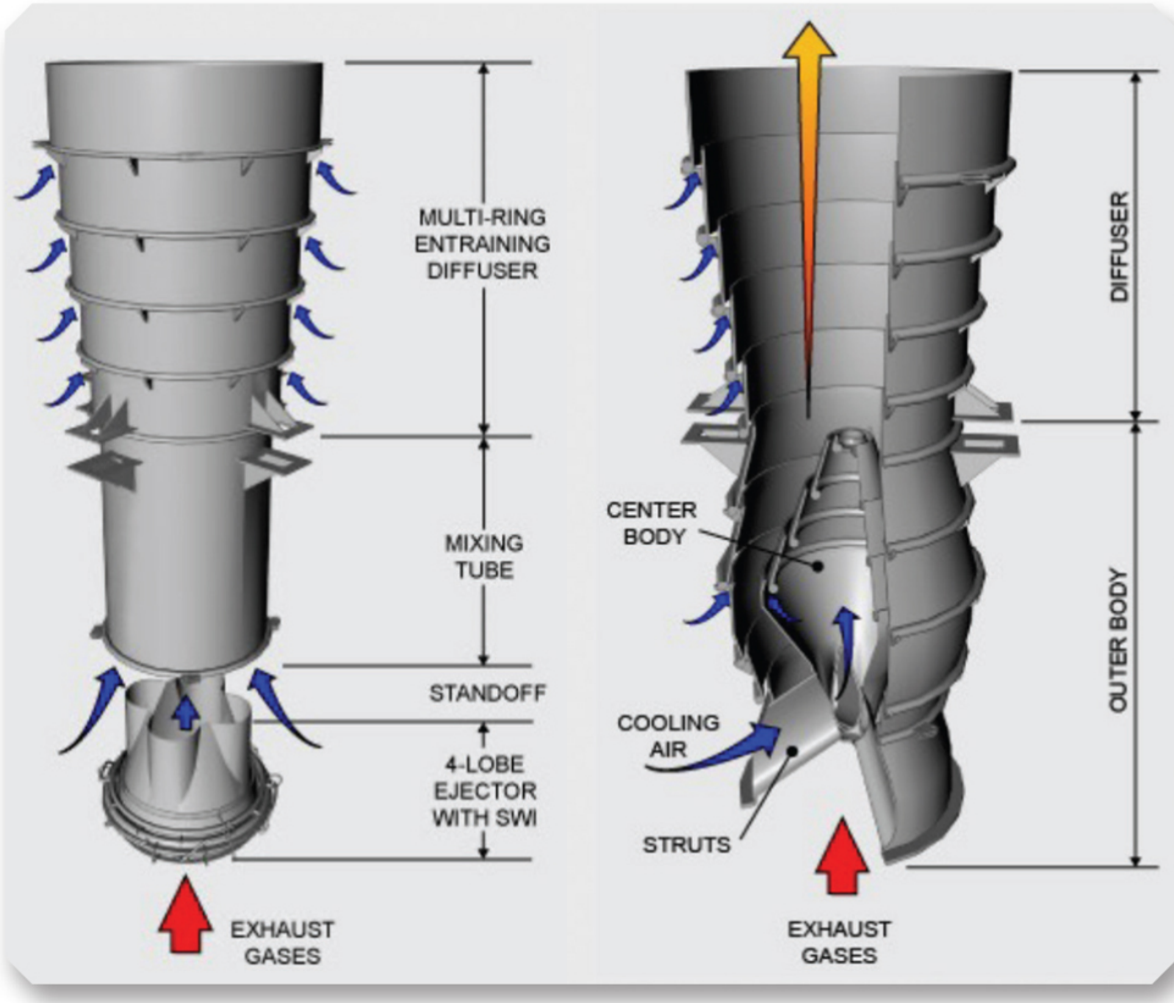
Dennis and I were engineers not accountants, and we were both rather naïve about financial management. In fact, the company was seriously under-capitalized, and we had very little money in the bank. That didn't bother us so long as business kept flowing in and our customers paid on time, but the party came to an abrupt halt shortly after Joe Clark's Conservatives came to office in the May 1979 general election. Within weeks of being sworn in, the new government imposed a spending freeze. Given that almost all our business was coming from the government, this was a potentially lethal blow. At the same time, we lost more than $100,000 on the big crash-barrier job with a Transport Canada contractor.

We reckoned that we would need about $100,000 in fresh equity to weather the storm, but we were unable to raise even that relatively modest amount. More drastic measures were called for. First, we hived off DEW, and Dennis went with it. Due in part no doubt to the stress we were all under, it was not an amicable parting, and regrettably marked the end of what had been a long, close, and rewarding friendship. The silver lining was that both of us went on to bigger and better things. Dennis made a great success of DEW. Now called DEW Engineering, the company remains in business to this day as a sizable and successful defence contractor. I was left as the sole shareholder of the rest of the business and decided to rename it WR Davis Engineering. In order to put the business on a firmer financial footing and spread the risk, I invited five senior colleagues to join me as shareholders and junior partners. Each of them owned 15 percent of the equity, while I held the remaining 25 percent.

A big breakthrough came in 1980 when we decided to bid on a contract to design the first infrared suppressor for the Defence Research Establishment (now Defence Research and Development Canada), an agency of the Department of National Defence (DND) with a laboratory near Suffield, Alberta. The purpose of the suppressor was to disperse heat emitted by aircraft engine exhausts, thereby making planes less vulnerable to attack from heat-seeking missiles. These weapons came to prominence during the Vietnam War. They were very effective and man-portable. Early countermeasures were adapted on the fly and were quite crude but helpful.

I knew as soon as I heard about the tender that this project would be right up our alley because it dovetailed neatly with our expertise in gas-turbine engines and my earlier work in computerized fluid dynamics with Doug Millar at Carleton. The United Kingdom and United States already had designs for ships, but Canada felt we could develop a superior device. DND had a design on paper and a patent, and our expertise in the software design tools made us a very good fit.

The military laboratory had patented a device called a DRES Ball (named after Defence Research Establishment Suffield), which was essentially the predecessor of our signature suppressor, and they were looking for someone to design and build it. Davis submitted a proposal, based mainly on the argument that we had a ready-made tool to design a concept DRES Ball based on the Carleton software. The shape of the DRES Ball device and the fluid flow field are similar to a gas turbine. Sure enough, we won the contract, and the design that we came up with still forms the basis of the suppressors that Davis builds today.



Diagrams of Eductor/Diffuser (left) and DRES Ball (right)
Eductor/Diffuser: The nozzle creates a high-speed jet to pull in cool air and mix it with hot exhaust gas before entering the diffuser, where cool air is drawn in through multiple slots, cooling the metal.
DRES Ball: Similar principle but with a cooled centre body.
All infrared signature suppression devices operate similarly but come in various shapes with different optical blockages (the pieces of metal in the centre that prevent a missile from detecting the hot end of the duct).

The DRES Ball contract was followed by a licence from DND to design and build the suppressors, for which we paid a royalty. This arrangement was subsequently repeated for other contracts with the military. Our first ship suppressor was designed for a new fleet of 12 patrol frigates for the Royal Canadian Navy. That paved the way for an upgraded version for the Tribal class destroyers, known as TRUMP. Despite some bumps along the way, the frigate licence turned out to be the foundation for a close and fruitful association with DND. It ran for almost 20 years, expiring only in 1999 and cementing our reputation as a reliable and top-quality supplier.

The first suppressor, for the patrol frigates, was a good case study of Davis's perseverance and our willingness to take risks that our larger competitors tended to shy away from. Initially, results fell short of our expectations. Our device operates by drawing in ambient air to cool the metal and gas, and it wasn't sucking hard enough. But Mike Birk and others persuaded me that we should give it another try. As Mike recalls:

> I started doing some analysis and some computer modelling. My wife was living in Kingston, and I was renting an apartment in Ottawa 4 days a week. So I had nothing better to do than to work 15- to 16-hour days. I figured out what was wrong with the suppressor device and went back to Rolly and said, "I think we can make it work." It literally meant taking a saw to it, cutting bigger holes, and prying it open. We got it working.

The frigate saga taught me the value of perseverance. Our early suppressors weren't everything we had hoped for, but we were determined to work on improving the design and were sure that we would eventually succeed. So whenever the defence department or any of our other early clients raised a concern, we would take note of the problem and then get to work on an improved version.

Meanwhile, other business was also flowing in. DND awarded us a five-year contract to build shelters fitted on the back of military trucks. This was not exactly high-tech rocket science, but it provided valuable cash flow. In addition, we were now working on wave generators, used to test models of offshore oil platforms and naval vessels, and gather data on erosion and breakwaters along shorelines.

Slowly but surely, Davis was gaining a reputation as the little Ottawa company willing and able to rise to whatever challenge was thrown in its path. In those early days, we seldom had the time or the resources to cross all the *T*s and dot all the *I*s. Doug VanDam, who joined us in 1986 and is now director of mechanical engineering, remembers being surprised "at how little checking and supervision of my work was done for a major project like the calorimeter (a device that measures the amount of heat in a chemical reaction)." That wasn't because we were willing to turn out slipshod work. Rather, it reflected my confidence in talented colleagues like Doug, and the fact that we were willing to accept unreasonable schedules and unreasonable budgets just to get our foot in a customer's door. Thankfully, we pulled it off.

For a time, these successes masked rising tensions among Davis Engineering's six shareholders. For all their technical expertise, my five co-owners were cautious engineers who had little appreciation of what makes a successful business tick. While I felt we needed to take risks if we were to continue growing, their top priority was to preserve the substantial gains they were seeing in the value of their equity in the company. They became increasingly eager to reap the rewards that would come from selling the business to a deep-pocketed outside investor, and spent a good deal of time and effort trying to find one, in some cases without my knowledge. Among those they approached were the Montreal-based engineering group SNC Lavalin and Indal.

Our home since 1985 at 1260 Old Innes Road. It provides almost unlimited space, which means we have been able to keep adding as required.

Our old drafting office with big drawing tables. Now all the work is done on computers.

Trouble was, these efforts were having a corrosive effect on our business. Whenever I was travelling, word reached me that the daggers were out. I couldn't ignore the office politics, and our disagreements reached the point where I saw little alternative to buying out my five partners. Three of them left on amicable terms in the mid-1980s, but the two remaining shareholders, Tony Bosik, who was in charge of mechanical engineering design, and Laurie Corish, head of the drafting department, were a constant source of friction and, as I saw it, a heavy drag on Davis Engineering's future prospects. The tensions took a heavy toll, most notably the departure of Carol Anderson, my loyal and efficient executive assistant, who could no longer abide the constant sniping taking place around her. Tony and Laurie demanded a price for their shares that I considered excessive and that, in any case, I could not afford.

Eventually, in 1988, we came up with a deal that seemed to offer the only realistic solution. A private-equity firm, Kettlewell Kettlewell and Craig (KKC), controlled by two brothers from Toronto, bought 51 percent of the business, while I kept 49 percent. I basically received nothing for the shares I sold beyond a promise by the new owners to buy out Tony and Laurie. Their departure certainly solved one big problem but, unfortunately, KKC's arrival brought fresh headaches.

Our association with the Kettlewells lasted less than a year, but it was a traumatic period for the company, for our hard-working and loyal employees, and for me personally. Like many other private-equity investors, KKC was determined to wring the greatest possible return from its investment in the shortest possible time, no matter what the long-term damage. As Eric Poirier recalls: "The whole atmosphere sort of changed, and you became more of a number. Nobody really liked them, and nobody liked the way they worked." Few parts of the business were spared. Among other upheavals, the managers parachuted in by KKC were eager to remove a wind tunnel that, as far as we were concerned, was one of Davis's most useful pieces of equipment.

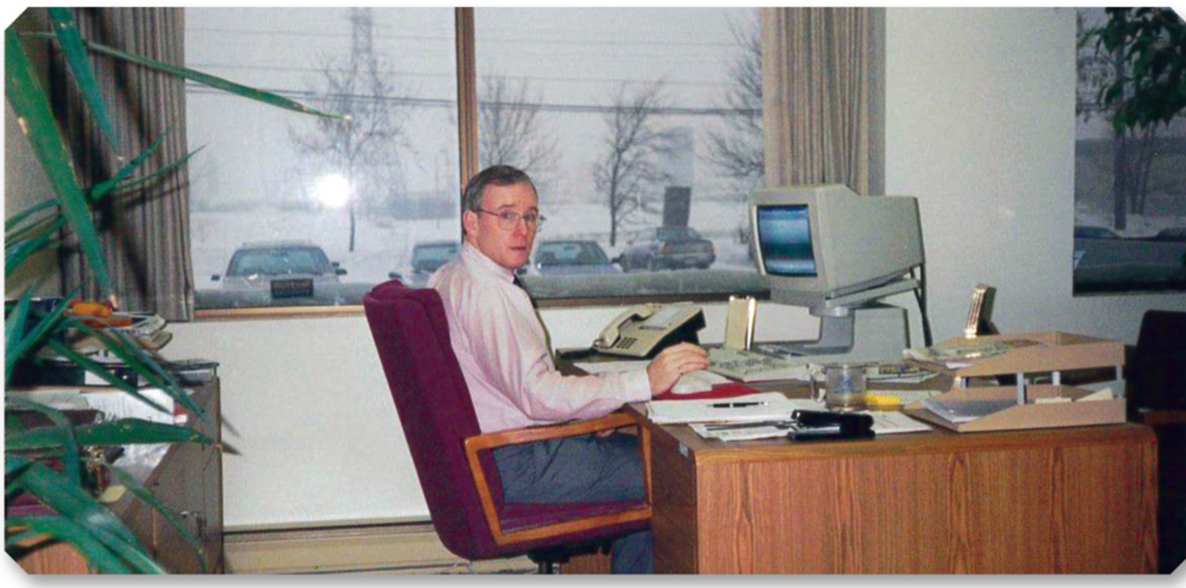
It didn't take long for the KKC people to grow disillusioned, and I started hearing rumours that even my own days might be numbered at the company I had founded and that bore my name. As Mike Birk recalls: "I was not part of all the politics when the new guys came in and bought a stake in the business. I did not know what was going on behind the scenes, but I remember thinking 'Rolly is going to find a way to get rid of these guys.'"

The story of how we got rid of KKC began in the early 80s when I met Bill MacSween during my regular lunch-hour squash game at the Ottawa Athletic Club. Bill was a computer consultant, and as we became friends, we began discussing Davis's software capabilities. By 1984, I had suggested that Bill join us to handle the software side of our products, but he was more interested in developing software for the VAX minicomputer.

After some discussion we decided to set up a separate company, jointly owned by Bill and Davis. The new company, Demac Software, would be the subcontractor for the software portion of Davis contracts, pursue independent software contracts, and use the profits from those activities to fund R&D for software products.

Demac's first employees comprised some Davis staff who were already doing software work as well as a few new staff members to focus on product development. Mike Gow and Gary Llewellyn were two Davis employees who joined Demac at the beginning. Since Demac and Davis would be working closely together, it was decided to house Demac in Davis Engineering's offices. Bill oversaw Demac's day-today operations, and I helped with business and personnel management. All major decisions were made jointly by Bill and me, and I'm pleased to say we had no significant disagreements.

The first product that Demac developed was called SqueezPak, which was the industry's first disk defragmenter, a program that organizes files on disks to improve a computer's performance. Defrag programs are now installed on almost every personal computer, but they were unknown in the 1980s. SqueezPak was specifically written for the VAX minicomputer, which was a popular computer platform for small and mid-size businesses in the 80s and early 90s.



Bill MacSween, our partner in Demac Software, in his office at 1260 Old Innes Road.

Left to right: Laurie Corish and Tony Bosik.

Selling a relatively inexpensive software product to a mass market required new skills for an engineering company like Davis, so we hired several marketing, sales, and customer support specialists. The expertise of Rick Church, Geoff Cooke, and Derek Street was especially valuable. Government grants helped fund some of the R&D work, and government export finance facilities enabled us to attend international trade shows so that we could introduce SqueezePak to the world.

Since the purpose of the software was not widely understood at the time, Demac designed and Davis built a display box with moving parts and lights. This eye-catching piece of equipment had the dual purpose of illustrating what it did and drawing attention at busy trade shows. We cobbled the box together with the moving parts coming from the guts of a washing machine. It turned out to be quite a hit at trade shows and was definitely a big factor in the product's initial success.

After a rocky start, SqueezePak sold well, generating enough revenue to fund R&D on two companion products, DiskManager and SecurePak. Minicomputers tended to have lots of users connected to them and each user consumed disk space, which always seemed to be in short supply in those days. DiskManager helped system managers find where the space on their disks was being used, enabling them to de-clutter and free up space by removing unnecessary files. The second product, SecurePak, was designed to detect security flaws like weak passwords and poor file protection. SecurePak was released just as the first computer viruses and computer break-ins were making headlines, so it was well positioned to meet an emerging need among system managers.

Demac became well known over time in the VAX marketplace. In 1989, a Silicon Valley venture capital company was looking to consolidate a number of VAX system products so that it could offer a "one-stop" solution to larger clients. The venture capitalists liked Demac's product line and made an attractive offer to buy the company.

The prospect of a sale was especially welcome because it ended up playing a significant role in extricating Davis from the grip of Kettlewell Kettlewell and Craig. No sooner had KKC learned of the deal than they sensed a way to get out of Davis profitably and quickly. Of course KKC was motivated by the cash they would receive from their 51 percent stake in Davis, or 25.5 percent of Demac. Through their contacts, they determined that the valuations that Bill and I had used substantially undervalued Demac, so with their help we negotiated a much higher price.

Once the sale proceeds were sitting in Davis, KKC accepted an offer from me to buy back the company. This left me as the sole shareholder for the first time in 10 years, with no further worries about interference from my former partners or anyone else.

The buyers of Demac chose to set up a new company, which they called Demax, with the idea of retaining some association with the former name. They hired all Demac's staff, who continued to work out of Ottawa, even though the head office was now in California. Bill stayed on for about a year to help with the transition, but even after that we remained close. He bought a cottage close to ours from Australian friends who had decided to return Down Under.

We emerged from the KKC saga bloodied but unbowed, and in some ways even strengthened.

For all the upheavals, KKC did make some valuable contributions to Davis. We had previously sub-contracted much of our manufacturing to a company in Toronto. The fellow whom KKC installed as our plant manager suggested to me one day, "Why don't you do that yourself? You'll make the investment back pretty quickly." We took his advice and bought various metal-forming, rolling, and shaping machines that we would probably not have spent our own money on for fear of taking on too much debt at a time when business was in the doldrums. That equipment, some of it second-hand, put us in good stead for the future, enabling us to make more parts in-house, which in turn gave us more control over quality and scheduling. The cherry on top was that Carol Anderson returned as office manager, this time staying with us until she retired in 2015.

That was the good news. But the distraction, infighting, and office politics had come at a bad time or, more to the point, had made a bad time worse. The early 1990s were a tough period for the economy in general, and our order backlog shrivelled. Some potentially lucrative orders were pending at the time the new owners took over, including suppressors for the Greek navy and a number of wave generators. We also had a US$3 million contract to install suppressors on an Israeli corvette being built at a shipyard in the States, and a US$2 million order for a wave generator in Texas. The U.S. Navy was installing active ground shafting systems on its ships and submarines, giving us an order backlog of US$12 million. But as so often happens in the defence business, the work took longer than expected to materialize.

Our revenues plunged from almost $10 million a year in the late 1980s and 1990, to about $5 million in 1993 and 1994, reaching a low point of less than $3 million in 1995. Within the space of a year or so, we had little choice but to let go more than three-quarters of the workforce, bringing our numbers down from 100 to fewer than 20.

The handful of employees who remained were a pillar of strength, willing to take on extra jobs and encouraging me to keep going. Multitasking became the order of the day. Eric Poirier found himself in charge not only of manufacturing but also shipping, receiving, and purchasing. Doug VanDam took on responsibility for engineering, design, and quality control. "I guess my versatility, work ethic and luck contributed to me being the last 'working level' engineer in the company in the early 90s," Doug recalls. "I found that I had little difficulty in making decisions and multitasking, which turned out to be good qualities later on." We all yearned for a return to the more relaxed times of earlier years when we would play poker and share a pizza at the office each Friday evening.

The silver lining was that, with both KKC and my two disaffected partners out of the way, I was liberated from the stresses and strains of office politics, giving me more time to look for new business not only in Canada but in the United States and further afield. We knew that numerous contracts were in the pipeline, and that it would just be a matter of time before they materialized. Sure enough, it didn't take long, and we soon found ourselves in the heady excitement and growth of what one former employee described as "the roaring 90s" at Davis Engineering.

CHAPTER 2

Stealth Technology

Were it not for the Vietnam War, Davis Engineering might not be in business today—and almost certainly not in its present form. Among the most potent weapons used by the North Vietnamese guerillas were Russian shoulder-launched missiles that downed hundreds of American aircraft and helicopters during the course of that long conflict. What made these missiles especially dangerous was that the North Vietnamese soldiers did not have to aim directly at their target but only in the general direction of an aircraft as soon as a distinctive beep on their headset told them it was within range. That's because the missile's guidance system was attracted to heat—in this case, the red-hot metal of the aircraft's engine exhaust and exhaust ducts. The U.S.'s helicopters and propeller-driven planes were especially vulnerable because they flew more slowly than jets, making it easier for the missiles to lock on to them.

More than 90 percent of U.S. aircraft shot down during the Vietnam War were casualties of heat-seeking missiles, and these weapons have become even more sophisticated in the half-century since then. They are now effective at distances of up to 8 kilometres, compared to just 1 or 2 kilometres when they were first used. Ironically, the Americans turned the tables in the 1980s by supplying their own Stinger heat-seeking missiles to rebels in Afghanistan during the Russian occupation of that country. The shoulder-launched Stinger uses a sensor to lock on to infrared rays produced by heat from the aircraft engine's exhaust. It also identifies a target's ultra-violet "shadow" to distinguish it from other heat-producing objects in the vicinity. The Russians never lost a pitched battle on the ground in Afghanistan, but they did lose plenty of aircraft, and many experts believe that Stinger missiles were the key to their eventual retreat.

More than 90 percent of all U.S. air combat losses since 1985 can be attributed to infrared (IR) missiles, which use heat signatures to seek their targets. About 8 of every 10 U.S. fixed wing aircraft lost in Operation Desert Storm in Iraq were casualties of IR surface-to-air missiles, known as SAMs.

Naval vessels face much the same threat. The typical frigate or destroyer is powered by one to four 30,000-horsepower gas-turbine engines, which produce a huge amount of very hot exhaust fumes and thus a large heat signature around the ship, making it vulnerable to a missile attack. Anti-ship missiles can be fired from as far away as 80 kilometres, so they are initially guided by GPS. But since modern warships can detect radar signals, the missile operator turns off the radar as the projectile approaches the ship. The missile then switches to a passive heat-seeking sensor that, unlike radar, does not emit a signal.

It is hardly surprising that a great deal of time, money, and energy has been spent—especially by the U.S. military—on finding ways to defend against heat-seeking missiles. The best way of doing that is to "suppress," or reduce, the target ship or aircraft's infrared signature by cooling its exhaust and the metal surrounding it. The first countermeasures applied in Vietnam were quite crude. One of the first helicopter suppression techniques was to attach cooling fins to the tailpipe so that air flowing around it would help cool the hot metal. But like the missiles themselves, the technology to counter them has become far more sophisticated over the past 50 years. A missile can lock on to a helicopter not equipped with a suppressor from a distance of 5 or 6 kilometres, but it must come much closer if the helicopter is protected in this way.

In terms of appearance, a heat suppressor can easily be mistaken for an avant-garde sculpture, and a collection of them would not look out of place in an art gallery (though they may not be to every art lover's taste!). A ship suppressor can be as long as 10 metres and up to 3 metres in diameter. The aircraft and helicopter versions are, of course, much smaller and lighter. They are fashioned from sheets of stainless steel, titanium, and, increasingly, Inconel, a nickel alloy that retains its strength at much higher temperatures than the other metals.

As mentioned previously, Davis Engineering's interest in suppressors has its origins in work by the Defence Research Establishment in Suffield, Alberta, known as DRES. Engineers there worked on infrared suppressor designs in the 1970s and early 80s, and managed to register a patent on their work, even though questions have been raised whether the design was as original as the military claimed it was.

The suppressor patented by the DRES researchers has two main components: a film-cooled tailpipe and a centre-body, also known as a DRES Ball, named after the Suffield research group. The film-cooled tailpipe (FCT), which replaces the normal exhaust, consists of a series of concentric metal rings with open slots of varying shapes and sizes from front to back. The device decelerates the exhaust gases to reduce the pressure inside, thus drawing cool outside air into the tailpipe, and reducing the temperature of the exhaust gases. It also adds a film of cool air to the surrounding metal, bringing down the temperature of the metal, typically from about 500°C to 50°C. Meanwhile, the film-cooled DRES Ball acts as an optical block between the hot engine and the tailpipe, making it harder for an incoming missile to detect the hot engine at the other end.

Designing a suppressor takes more than just finding a way to cool the exhaust and surrounding metal components. Ideally, every navy and air force would like a suppressor that adds nothing to the weight of an aircraft or ship, produces no back-pressure—in other words, no loss of performance—and costs as little as possible. But we do not live in an ideal world. The typical aircraft suppressor weighs from 30 to 100 kilograms. It also puts back-pressure on the engine, inevitably causing some loss of power. As Jim Thompson, head of Davis's aero/thermal and performance group, puts it: "We would love to have suppressors that give a fabulous 98 percent reduction in signature and zero power loss. But they would be just too large for the aircraft." Weight is less of an issue for marine suppressors, though they can also entail a loss of power or higher fuel burn.

These constraints inevitably require some trade-offs, especially in performance, which can lead to months, if not years, of back-and-forth with the customer. One of our first questions to prospective customers is "What can you live with in terms of weight and power loss?" No matter what their constraints, we have been able to assure them time and again that no other supplier can come up with a more efficient design than Davis.

Each aircraft and ship type has different limits in terms of weight, size, and back-pressure on the engine, and each thus requires a different suppressor design. We have made many refinements over the years to accommodate these differences and minimize the constraints. Thus, the suppressor we designed for the C-130 Hercules transport aircraft has an S-shaped duct instead of a DRES Ball at the end of the tailpipe. Some naval customers consider a DRES Ball to be superfluous, given that a ship's exhaust leaves the vessel from a vertical funnel well above the superstructure, while missiles typically fly in from the side of the vessel. In other words, they see no need to block the “down the funnel” view.

As we got to know our customers and the technology, we began a never-ending process of product improvement. Another Davis innovation on marine suppressors was the Eductor/Diffuser (E/D) as a replacement for the DRES Ball. Originally fitted to Canada’s Tribal class destroyers, the E/D is much lighter than a DRES Ball, and cools the uptake metal to within 25°C of the prevailing temperature, and the plume temperature to less than 250°C. The E/D consists of three main components: an ejector nozzle, a mixing tube, and a multi-ring diffuser. The nozzle pumps in cool air, which combines with hot exhaust gas in the mixing tube, sharply lowering its temperature as the gas enters the diffuser. Outside air is also drawn in through gaps in the diffuser, cooling the diffuser rings and further lowering the gas temperature.

We have also devised a sea-water injection system for marine suppressors that uses atomizing nozzles to spray a fine mist into the exhaust stream. As the water evaporates, heat is transferred from the hot exhaust gas into the water vapour, dramatically lowering the temperature of the gas. The nozzles are custom designed according to the size of the funnel so that the system uses water as efficiently as possible, and the exhaust plume is uniformly cooled.

The Canadian military began taking an interest in infrared suppression as part of the Canadian Patrol Frigate Project in the 1980s because its leaders believed that the future threat would come from infrared seekers. As design work started, the navy began looking for an outside contractor able to turn the Suffield DRES Ball patent into a piece of equipment that could be fitted to the new vessels. We submitted a bid and won the contract. As mentioned previously, we did all the engineering work, while DRES continued to hold the patent.

Davis was one of the first companies in the world to build a ship-based suppressor. Even now, the number of suppliers is quite small. Most big defence contractors have shown little interest in this work. A shipset — in other words, the suppressor for one vessel — typically costs between US$300,000 and US$1 million, depending on the size of the ship, which is small change for most large contractors, and requires maintaining a very specialized capability. One British company, Darchem Engineering, used to build a rudimentary device for the Royal Navy, nicknamed "the cheese grater," but we usually had little difficulty outbidding them.

Our next big breakthrough came in the early 1990s when we designed our first helicopter suppressor for the Bell 212 and 412 models operated by the Canadian Armed Forces. The rotor on the 212 has two blades, and the 412 has four, but the two models have basically the same engine. Our work began in a small way, searching the literature for ways to adapt existing technologies. We followed many of the same principles as for the marine suppressors, except that we used much lighter materials. Our mandate was to minimize modifications to the aircraft, and we were able to come up with a suppressor that fitted in exactly the same space as the existing tailpipe, with just millimetres to spare.

Canadian patrol frigate fitted with DRES Ball, 1986. The infrared signature was six to seven times better than the best available at that time.

Davis manufacturing team with one of our first Halifax class DRES Balls ready to ship, 1990. At right: Doug VanDam shortly after he started at Davis.

Getting there turned out to be quite a saga. The film-cooled tailpipe, or FCT, for the Bell 212/412 was largely designed by Doug VanDam, using Davis's hot gas wind tunnel. It was a tricky process, as the air management system for the aircraft had a rather sensitive inertial particle separator that had to maintain a certain airflow. Without that airflow, the FCT would shut down, exposing the aircraft to damage from dirt and ice. When it became obvious that a higher pumping rate would be needed to maintain the flow, we took a leaf from our marine suppressor and added a lobed nozzle. Mike Birk created a 3D model of the nozzle out of modelling clay during one of his weekly visits to the office. Doug then used the model to draw some sketches from which the shop created a metal prototype. Sure enough, it worked.

The next step was to test the FCT on a real engine. The Department of National Defence had donated an engine to the National Research Council's gas-turbine laboratory located on the Montreal Road campus in Ottawa. The military was also willing to supply the gas and pay for the lab's time for the necessary bench runs to test the device. We sent Bruce Hiscoke, our structures and design manager, over to the lab with the prototype and accompanying components, and everything was then set up and ready to go. But it soon became obvious that the swirl from the exhaust was far more complicated than the wind tunnel tests had led us to believe. Nothing worked.

Nevertheless, we persevered. For several weeks, we stuck to a daily routine as we worked to produce a more effective design. Testing took place at the NRC labs first thing in the morning. The results were analyzed right away, so that Bruce could take them back to Innes Road before lunch. Doug would then sketch the next concept on a piece of paper, and the shop would modify the prototype during the course of the afternoon, well in time for Bruce to deliver it to the lab the next morning.

One day, while Bruce was taking the rig apart, he noticed that the vanes that were supposed to be tack welded into the nozzle had gone missing. He searched high and low, but could find no sign of them. The NRC test engineer who was with him had the bright idea of climbing up a ladder to see if they were on the roof. He headed out the door and, sure enough, soon returned with a chunk of twisted metal in his hands and a grim expression on his face.

"Find them on the roof?" asked Bruce.

"Didn't make it that far," replied the NRC engineer, "I saw them sitting on the picnic table before I went up the ladder."

"Picnic table?" asked Bruce weakly.

Indeed, the vanes had been blown up the stack, then flew over the roof, and came straight down on the picnic table in the employee break area, leaving a burn mark on the wood. Luckily, no one was sitting there at the time.

Needless to say, the pace slowed a bit as we had to check the robustness of each modification before it could be tested on the engine. Eventually, on the 51st try, we had a fully functioning device and air management system that met all requirements. The final product was a variation of the ship design and was, to be honest, not a terribly sophisticated piece of equipment. But it worked.

Bruce tells an equally entertaining story of another such initiative a few years later where speed was of the essence:

> In 1996, Jim Thompson came on board and started looking at programs like the C-130 Hercules and the ships. Later on, Brett Brooking, another engineer, joined us, and then in 1998, when we were still doing the film-cooled tailpipe, we hired Mike Campbell as a mechanical designer. Mike's first job was to redesign the FCT to be more suited to aircraft. In his interview, Doug VanDam asked him, "So, how long will it take you to model that?" Mike replied, "I don't know, probably about a week."

We hired him, and he first sat in Ian Jeffrey's office while Ian was away in Korea doing a wave-generator installation. Doug dropped some drawings of the FCT on the desk beside the computer. "ANSYS is installed on that machine," he said. "You said you needed a week to model that. See you in a week." With that he left.

While Mike had used ANSYS before, he hadn't used it for this type of work. I remember him sitting there with his tie on going "Oh!" (We all still wore ties back then.) Nothing like on-the-job learning! When the week was up, Mike had produced a workable model of the FCT. Doug looked at it and judged it acceptable.

"Hmm," he said. "Guess we'd better get you an office then." That's when Mike knew he was staying.

Armed forces around the world have come to recognize the value of infrared suppressors for aircraft as well as ships. As of early 2022, we had fitted more than 800 suppressors to 14 different types of aircraft and helicopters, each model custom designed. Davis had also become by far the world's dominant supplier of marine suppressors. Besides the U.S. and Canada, we have equipped navies in more than a dozen countries, including, Australia, Denmark, Finland, France, Greece, India, Italy, Japan, Norway, Oman, Poland, Singapore, Saudi Arabia, South Korea, Spain, the United Arab Emirates, and the United Kingdom.

Educating military chiefs on the need for active shaft grounding, commonly known as ASG, has been more of a struggle, but one that has gradually borne fruit.

In a nutshell, ASG protects ships from sophisticated mines triggered by the electric currents emitted from every vessel's shaft and propellers. The earliest and most rudimentary mines—whether on land or sea—were set off by contact with an object (a soldier, a tank, or a ship). They were followed by magnetic mines, which blow up on contact with the metal side of a vehicle or ship. But the latest naval "lie-and-wait" mines are far more sophisticated, triggered by what's known as the ship's cathodic protection system, or the electric current that passes through the propeller shaft and bearings to keep the hull from corroding. The current produces a low-frequency signal, akin to an electronic wave, that can be picked up by a mine placed in the water along the vessel's path. The mine then attaches itself to the bottom of the ship and explodes, though some types are designed merely to collect data on vessels passing close by.

The active shaft grounding box, attached between the propeller shaft and the hull, is a type of suppressor, in the sense that it greatly reduces the ship's underwater electromagnetic signal, thereby neutralizing any nearby mines. A side-benefit is that ASG lessens corrosion on the ship's shaft bearings because the current no longer passes through them.

The United States, the United Kingdom, and Canada began taking an interest in active shaft grounding in the 1970s as part of their intelligence-sharing agreement that also includes Australia and New Zealand (a group known as the Five Eyes). Canada was assigned the task of developing an ASG box, and it fell to the navy's Defence Research Establishment Pacific (DREP), based in Esquimalt, B.C., to take the lead in the project. In much the same way as we secured the initial contract for the infrared suppressor, the navy contacted us around 1985, asking if Davis could build a prototype based on the DREP design. We did that and, after some adjustments, secured an order in 1986 for five shaft grounding units. Some were sent to the States for trials, which resulted in the U.S. Navy placing another order in 1992 for an updated version. Much of the ASG development work was done by a small team of just two or three engineers originally led by Jim Lougheed, followed by Doug Ballantyne, Wayne Giddings, and finally Ian Jeffrey, who joined Davis in 1990 as manager of electrical engineering from the National Research Council.

Canadian Tribal class destroyer fitted with the Eductor/Diffuser, 1986.

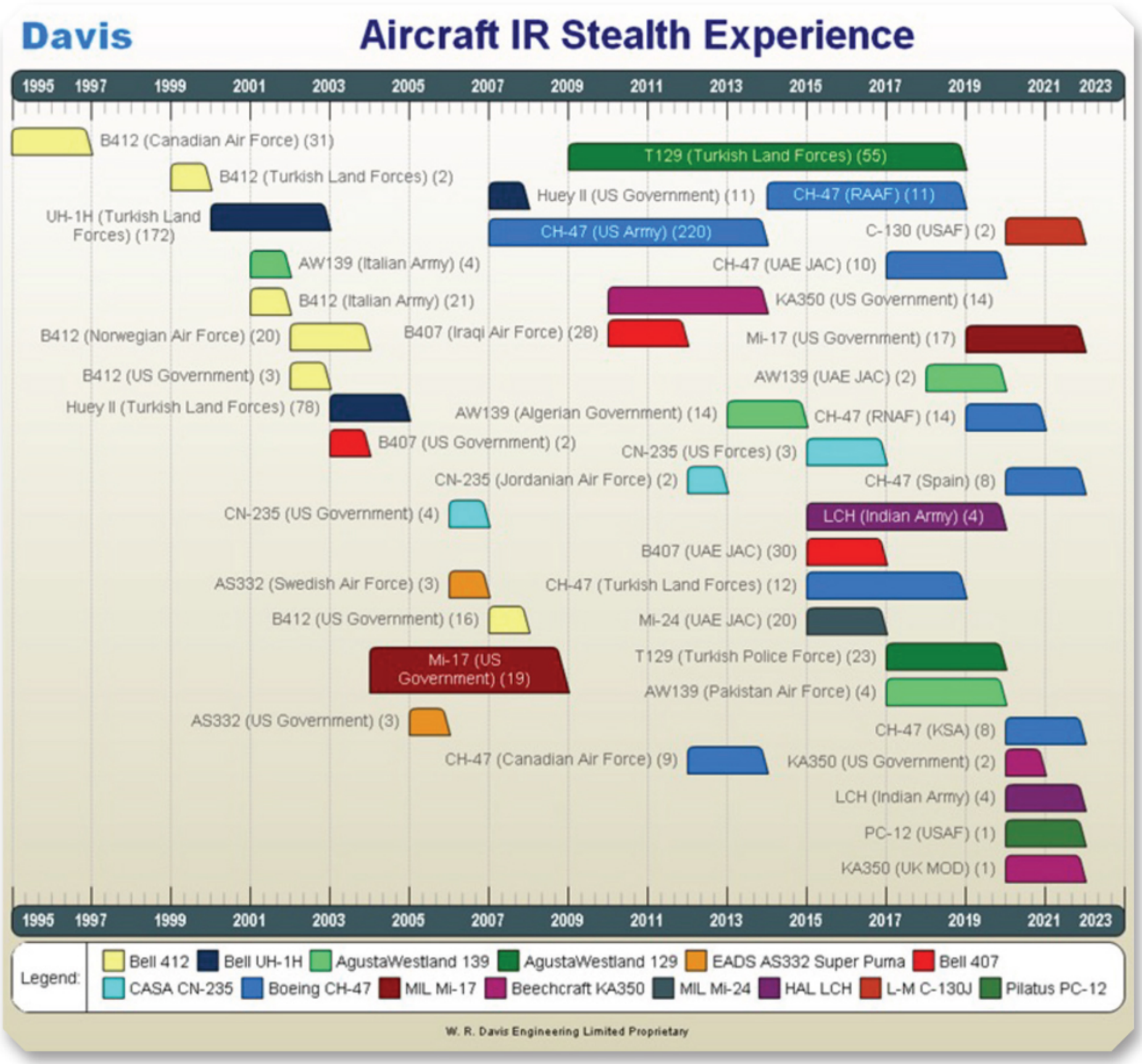
Spanish F-100 Álvaro de Bazán class frigate fitted with the Eductor/Diffuser, 1998.

Greek MEKO-200 class frigate fitted with the Eductor/Diffuser, 1990.

Israeli SA’AR 5 corvette fitted with DRES Ball. The SA’AR 5 was built by Ingalls Shipbuilding in Mississippi and gave us an entry into the U.S. Navy.

Davis Christmas party, early 1990s. Clockwise from top left: Max Miner, Bev MacSween, Bill MacSween, Brook Jeffrey, Wendy Davis.

As of early 2022, Davis had sold over 200 ASG units in Canada, the United States, South Korea, France, Germany, Britain, Norway, and Australia, priced at about US$200,000 apiece. The U.S. Navy now installs active shaft grounding boxes on all its combat vessels. Some other countries, however, use ASG only on submarines but not surface ships; others only on surface vessels, depending on their assessment of the threat, balanced against the price.

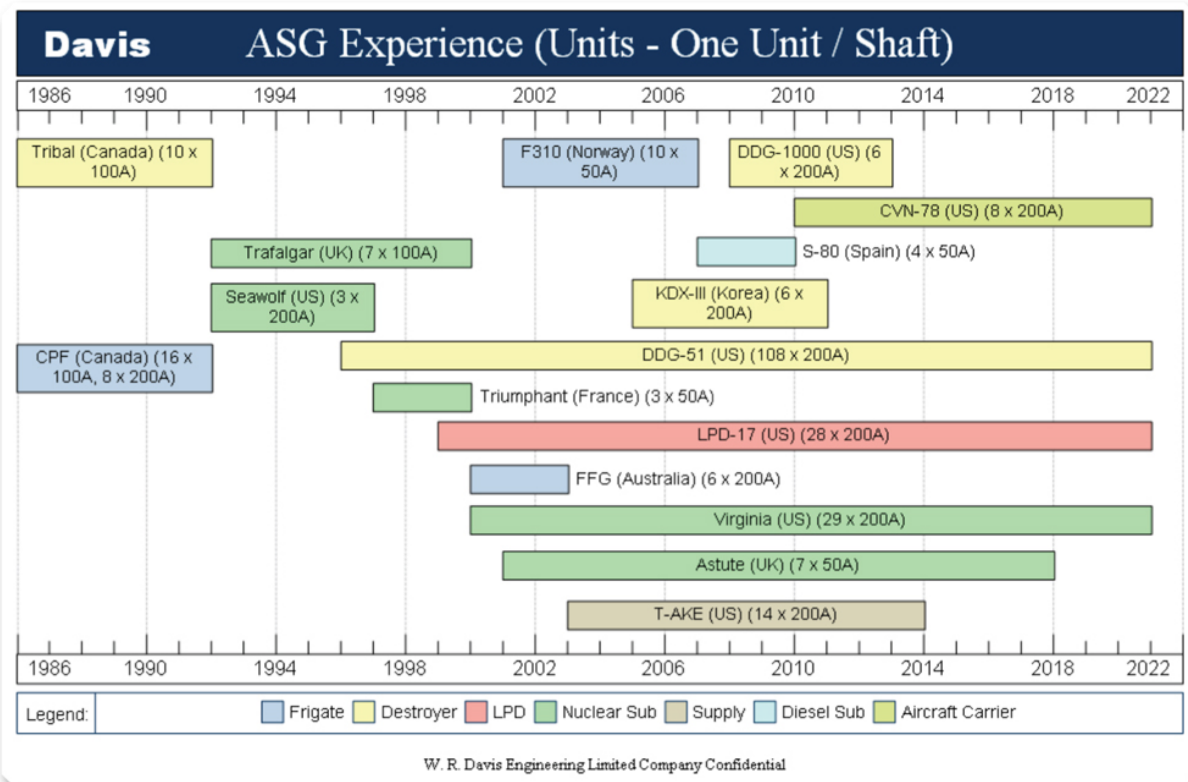


Summary timeline of aircraft suppressor orders.

Besides infrared suppressors and active shaft grounding boxes, which are pieces of hardware, Davis has also pioneered a valuable software package known as a Naval Threat Countermeasure Simulator, or simply ShipIR.

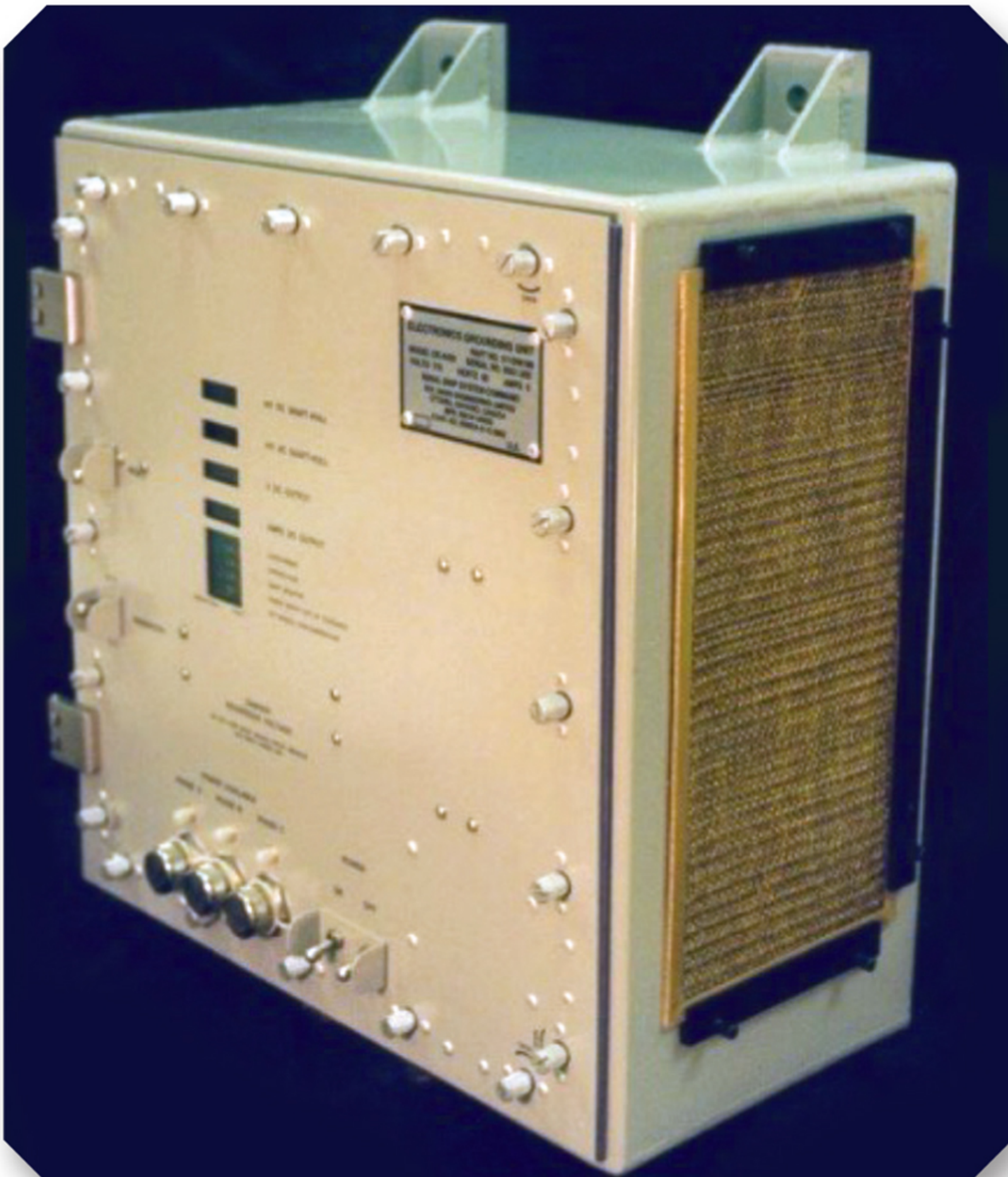
While most armed forces have long been aware of the danger that shoulder-fired missiles pose to aircraft, some have been slow to appreciate that ships are also vulnerable to heat-seeking missiles. In particular, we encountered a good deal of skepticism in countries like Japan and South

Korea, which have never lost a ship to a heat-seeking missile. I often compare our marketing efforts in these countries to the work of a missionary.



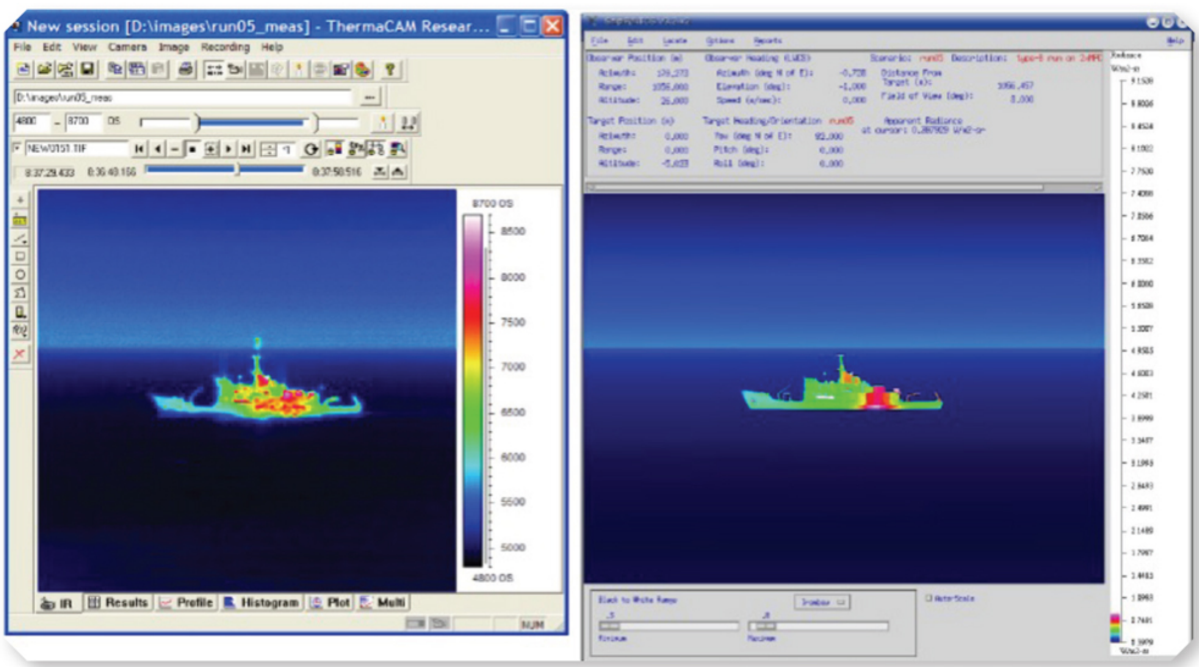
Summary of active shaft grounding (ASG) orders.

I would try to explain why their navies needed IR suppressors but often went away with the impression that they thought our pitch was motivated by Davis's own self-interest and that we were trying to sell them something they didn't really need. To help get the message across, David Vaitekunas, a world expert in the field who joined Davis in the early 1990s, developed software that shows a model of a ship on a computer screen. The user specifies the characteristics of the ship and the environment, and the software calculates temperatures and the ship's infrared signature. David's software then calculates the IR signature with and without suppression, and displays the difference. This software is now widely recognized as the best of its kind in the world, with users in over 30 organizations.



Active shaft grounding (ASG) system (200 amp). It actively eliminates the low-frequency electromagnetic signal that detonates influence mines.

Our work on ShipIR began in 1989 when we submitted an unsolicited proposal to the Defence Research Establishment Valcartier (DREV) to build the first version. The project consisted of three phases: 1) procuring a workstation and any existing relevant software; 2) designing and integrating new software components; and 3) implementing and testing the finished product. The design phase was especially challenging because we needed to come up with a coherent plan to incorporate existing software components that were deemed usable. Interestingly, part of the software came from William Lytle Grosshandler of the U.S. National Institute of Standards and Technology, who was one of the authors of the report on the collapse of the World Trade Centre. One of his star students, Walter Romaniuk, worked for Davis at the time.



CFAV (Canadian Forces Auxiliary Vessel) Quest. IR measurement and ShipIR prediction.

The first ShipIR model for Canada's Tribal class destroyer had to be put together manually using a text editor, since we did not have enough time to develop a computer-assisted design tool.

What's more, the budget allocated to the project turned out to be insufficient, so we were able only to partially complete the plume model component of the software. We let DREV know, and after a visit by two of their officials, Denis Faubert and Paul Chevrette, to assess progress, we agreed to amend the original contract to provide for a full plume model algorithm.

Even during the development of ShipIR, Davis was already performing basic infrared susceptibility analysis using a simplified threat model, known as Baby ShipIR. In partnership with SPAR Aerospace, we submitted a proposal to the Canadian Navy in 1992 to develop a Naval Threat Countermeasure Simulator (NTCS). However, excessive costs forced us to terminate the partnership with SPAR, and we ended up being awarded a sole contract in 1994 to develop the NTCS system.

NTCS has been through numerous permutations, both as an analysis tool and a product that can be installed on a ship. It has been a huge success, and seldom fails to make a big impression on an audience. David Vaitekunas is recognized as one of the world's foremost experts—if not the leading expert—in this field, and the U.S. Naval Research Laboratory has provided funding for his work. The Davis Engineering ShipIR package has become a NATO standard, and almost all NATO navies have bought it. The market has also broadened beyond NATO members, with countries like India, the United Arab Emirates, and Saudi Arabia also showing an interest. Customers also pay Davis an annual fee to receive upgrades. Meanwhile, David still travels the world training users on both the basic package and the upgrades. We are also often invited to make presentations at naval engineering conferences.

David has adapted the ShipIR model to helicopters and transport aircraft, and made numerous other improvements over the years. Among the innovations he has developed are a plume water injection system, and a hull cooling system. The hull cooling system consists of nozzles that spray water onto the surface of the ship, cooling it and thus shrinking the infrared signature and making the vessel less detectable to a heat-seeking missile. The nozzles are installed on various parts of the hull, each of which can be controlled separately to achieve the optimum temperature.

I summarized our achievement in the 2000 edition of the Davis Engineering newsletter:

> The IR Signature Management of both today's modern and future warships has dramatically increased in scope and complexity. Davis continues to remain the world leader in this field by making technological advancements which equal or exceed that of the threat. The engine exhaust continues to be the largest "hot spot" on a ship and therefore this area has received the most attention.

As our suppressor business grew in the 1980s and 90s, it was only natural to look at other equipment that capitalized on our expertise in this area. One obvious candidate was the intakes and uptakes that are part of a ship's exhaust system. The performance of gas-turbine and diesel engines can be significantly diminished by loss of pressure in the ductwork that channels air into the engines at the bottom of the vessel (intakes), and then takes it out again (uptakes). The uptakes can be as long as 30 to 40 metres in a large ship.

We explained to our suppressor customers that it made sense for a single supplier to take responsibility for the entire intake and exhaust system to guarantee engine performance. Many of them agreed, with the result that we ended up designing and supplying complete systems for the Indian Navy's P-17 frigate, Polish corvettes, the South Korean PKG-class patrol vessel, and the Royal Navy's Type-26 frigate.

Most recently, our intake and uptake work has led us in an entirely new direction: the offshore oil and gas industry. A typical oil rig has one or more large gas-turbine engines at its centre that spew large volumes of very hot plumes into the air. Depending on which way the wind is blowing, these plumes can disrupt operations on the rig, including cranes, helicopter flights, and even drilling. We have been able to adapt our aircraft and marine suppressor technology to cool exhaust gases from the engines, allowing the rig to operate in a wider range of conditions. As of early 2022, we had built plume coolers for six oil rigs.

We signed our first rig contract, with Chevron's North American exploration and production arm, in August 2011. Our job was to perform a plume trajectory analysis to assess whether gas-turbine exhaust stacks on Chevron offshore rigs would impinge on drilling operations or cause safety problems around the helicopter landing pad. The project was called Bigfoot and was planned for a field in the Gulf of Mexico.

Chevron had already done computational fluid dynamics work on some prevailing wind cases and knew it had a problem. The most obvious solution was to raise the top of the stacks to such a height that the exhaust plumes cleared the derrick and were high enough not to interfere with the helicopter landing deck. But raising the stack is an expensive process, not just in terms of design but also because of the extra weight that the rig structure must support.

Chevron was looking for alternative ideas and decided to ask General Electric for advice, given that a GE engine exhaust was causing the problem. The relevant expert at GE dug up an old paper he had from previous work with us. This paper dated back to when Davis did a plume trajectory study in 2001 for Ingalls and the U.S. Navy as part of a planned conversion of the main propulsion engines on the LHD-8 amphibious assault ship to gas turbines. Our study examined the effects of adding a plume cooler to the exhaust system, and the benefits we identified were great enough that we were commissioned to design and supply the plume coolers for the ship.

As part of this work, we developed a model of plume trajectories based on actual engine exhaust plumes in various wind conditions. The model produced results for a wide range of exhaust permutations and weather conditions, and required very little computation time. As a result, predictions could be quickly calculated under a wide range of conditions. We were confident that the same model could be used for offshore oil rigs.

Even more important to Chevron was that Davis could assess—and guarantee—the benefit of adding various plume cooler configurations to the exhaust system. None of their suppliers of computational fluid dynamics studies could do this work, and a year of the Bigfoot program had already elapsed with endless iterations of possible exhaust stack configurations. It took us just 6 weeks to produce a prediction of the current stack performance and the impact of various plume cooler configurations. We followed up with some predictions for specific conditions of concern.

The "dual-split" plume cooler was deemed to produce the best results, and after some preliminary hardware sizing, we signed a contract in March 2012 to design and supply plume cooling systems for three GE LM2500 engines on a Chevron rig.

The offshore oil and gas industry is fairly open in the sense that it is common for multiple contractors to take an ownership stake in a single project and for numerous engineering companies to compete for each rig design. A lot of information and know-how is shared among energy companies and their prime contractors. This meant that knowledge of our capabilities and our success on the Bigfoot program began to spread across the industry, resulting in a spate of follow-up orders. Among them:

- June 2013: Hebron, Atlantic Ocean, Newfoundland, Canada, 3 x GE LM2500, ExxonMobil, plume coolers;
- January 2015: Gina Krog, North Sea, Norway, 1 x GE LM2500, Statoil (now Equinor), plume cooler;
- December 2016: Peregrino II, Atlantic Ocean, Brazil, 2 x GE LM2500, Statoil (now Equinor), plume coolers, silencers, and cold-case uptakes;
- June 2017: Leviathan, Mediterranean Sea, Israel, 3 x Solar Taurus 70, Noble Energy, plume coolers and uptakes; and
- September 2021: Sanha, Atlantic Ocean, Angola, 3 x Mars 100, Chevron, plume coolers and cold-case uptakes.

These are all highly specialized businesses where we owed our success to the "can-do" attitude of our team and our willingness to make whatever investments were needed to stay abreast of our chosen areas of expertise. Chapter Seven describes some of the talented people who did this work, building Davis into the respected global business that it is today.

As far as equipment goes, our pioneering work would not have been possible without the wind tunnel that we installed at Cyrville Road in the early 1980s, and then brought to Old Innes Road when we moved there in 1985. The core of the tunnel belongs to the Department of National Defence, but Davis has made a substantial investment in replacement fans, motors, and other modifications. The tunnel has a 100 horsepower fan and a 10 million BTU natural-gas burner that can simulate the exhaust of a 2,000 to 3,000 horsepower engine. It also has swirl generators that produce the right amount of turbulence for any engine. The tunnel's 120-decibel roar is deafening, so anyone working near it needs to wear double ear protection. At one time, the wind tunnel was running almost constantly, but we rarely need it these days for marine suppressors. Computational fluid dynamics have replaced the wind tunnel in many cases. However, ground and flight tests remain essential.

Much else has changed as our business has grown and diversified. Bruce Hiscoke recalls the transformation of design and manufacturing tools:

> When I started at Davis, there were still drafting tables, and we were just converting to two-dimensional computer-assisted design from pen and pencil drawings. We had a blueprint machine that stank of ammonia every time it was used. The telex wasn't used, but it was still sitting in the corner, and everything else was done by phone or fax, along with overhead projectors. Desktop PCs were rare, and all data was plotted by hand. Drawings were two-dimensional representations of the finished product. We would lay out some chalk developments on the shop floor, and the shop then made something that conformed.

Thankfully, times have changed. As Bruce notes:

Now we model everything and get in tens of thousands of flat patterns that can be formed up to make the final parts. Another big change is from building mock-ups of everything for the wind tunnel to doing most of it by computational fluid dynamics. We have white-light scanners that can capture 3D shapes, and sophisticated simulation technologies. We have 3D printers that can print the tools we use for making metal parts on our rubber pad-forming machine. Heck, we even have 3D-printed Inconel parts, and have gone flying with them!

CHAPTER 3

Wave Generators, Hail Guns … and More

Looking back, I'm often amazed at the winding path that has led Davis Engineering to its position as a global leader in infrared suppression, software simulation, and active shaft grounding.

As we learned from the start, the world of defence contracts tends to move very slowly, often painfully so. A project can take more than 10 years from conception to completion, and in some cases—such as our work on the C-130 Hercules aircraft—we have worked on a project for as long as 15 to 20 years before starting production. What this means for a supplier is that, unless you have deep financial backing, there is little choice but to look for other business that can keep talented and experienced staff busy, and retain the "institutional memory" vital for work such as ours.

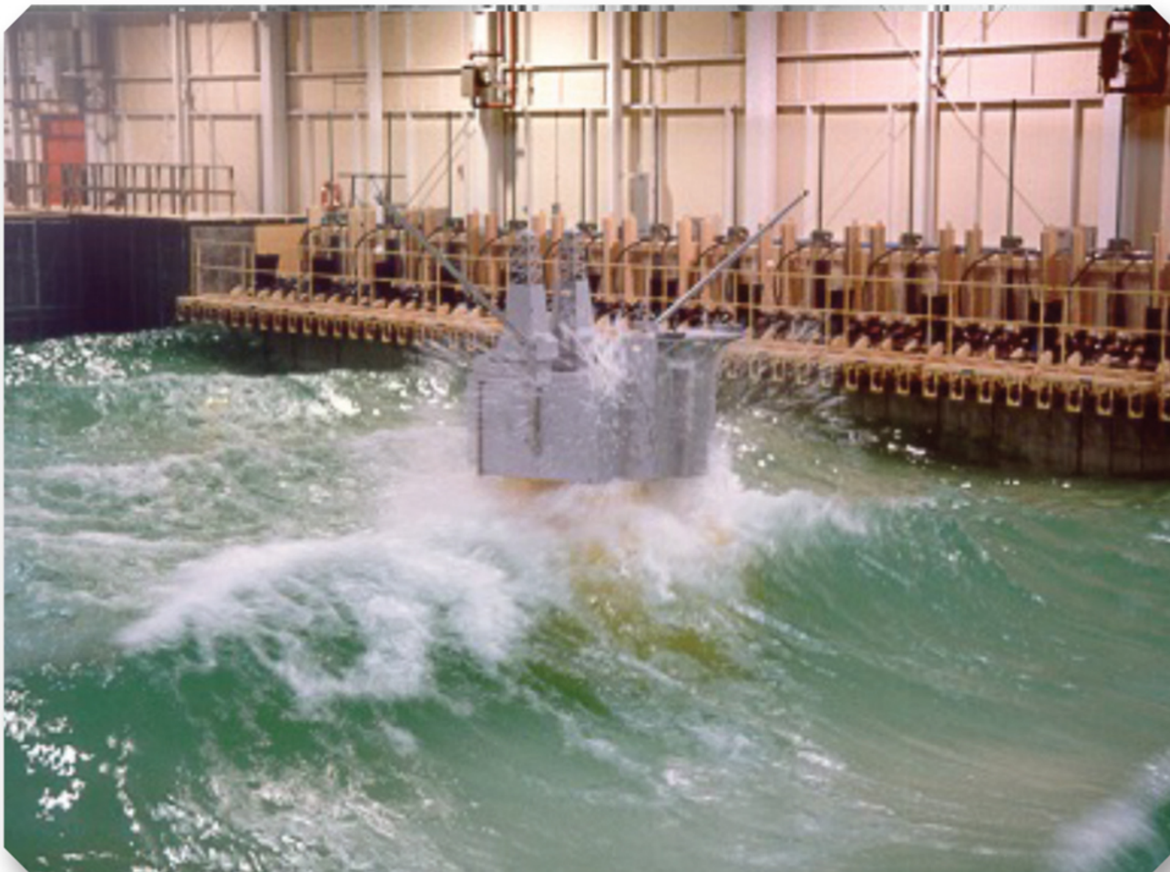
Davis has taken the route of innovative diversification, with the result that we have at times embraced a variety of unusual endeavours bearing little resemblance to our core specialties. What they had in common, as the following pages show, was an entrepreneurial spirit—in other words, a willingness to take some risks and even have some fun. Nonetheless, all these projects were serious and important ventures for us and our clients, though some, for one reason or another, had more staying power than others.

The impetus for our move into wave generators came from our work with the National Research Council's hydraulics laboratory in the early 1980s. In essence, these machines are a sophisticated version of the wave-makers used by theme parks for their artificial beaches. They are a useful tool to test models of ships and offshore oil platforms, and to gather data on erosion and breakwaters along shorelines. The waves are generated by a varying number of separate segments, not unlike paddles, directed by a software program to create waves of various heights, strengths, and shapes.

Although the market for wave generators was—and still is—limited mostly to a few government and university laboratories, they provided a valuable opportunity for us to broaden our connections with naval authorities and respected research groups around the world. The wave-generator community is small, so much of the business comes through word-of-mouth recommendations. What's more, wave-generator orders helped us keep our head above water in the early 1990s when revenues from other sources dropped off sharply.

Our first foray into this field was a contract to build a dual-mode segmented machine for the NRC's hydraulics laboratory on Montreal Road in Ottawa. The testing and delivery deadlines were extremely tight because the machine was urgently needed to aid investigations into the collapse of the Ocean Ranger offshore drilling platform 250 kilometres east of St. John's, Newfoundland, in February 1982, a disaster that killed all 84 crew members aboard. The first model, about the size of an upright piano, was followed in 1985 by another order from the NRC for a much bigger machine, with a 30 metre-long wave tank and 64 stainless steel wave boards, each fitted with its own computer controls. The boards could be hinged for flapper, piston, or combined motion, and the entire wave-generating structure could be raised or lowered in the tank, as could the water level. The machine could churn up waves of almost any height, angle, or intensity to match the conditions one might encounter in the middle of the ocean.

Signing ceremony for a wave generator contract, 1984. Left to right: Harvie Andre, Minister of Supply and Services; Rolly Davis; Ross Pottie, NRC President.



Segmented wave generator at NRC testing a model of the Ocean Ranger oil rig, which sank off Newfoundland in 1982 with the loss of 84 crew members.

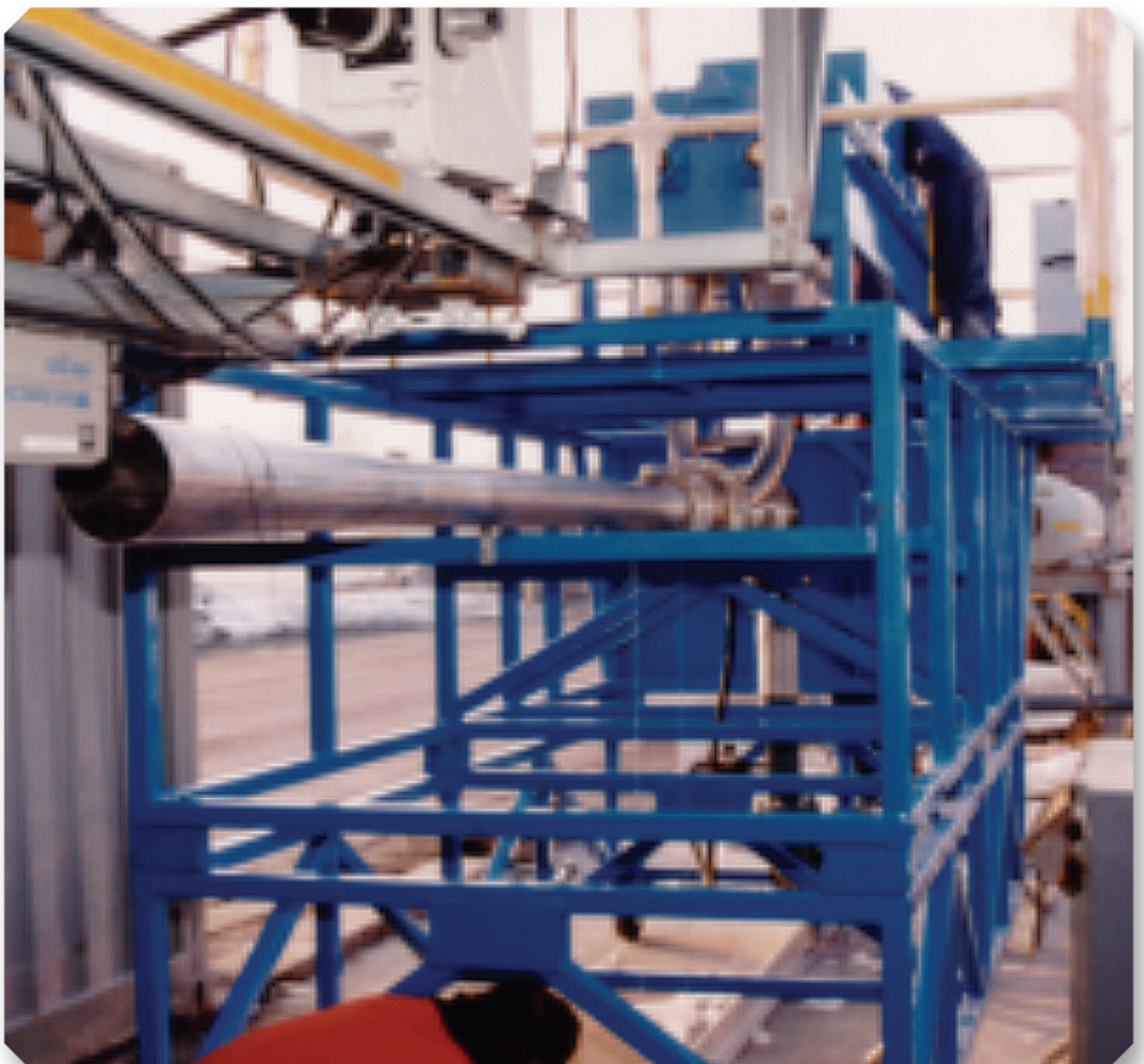
Another big break-through came in 1989 in the form of an $11 million contract for a large, 192-segment model for the Institute for Marine Dynamics in St. John's. The NRC supplied the digital control system, while Davis provided the generator components. We jointly installed and tested the machines. Tom, our second son who is now Davis's president, supervised the installation in the time between his bachelor's and master's degrees at Queen's University. One important benefit of these early installations was that they were a showcase for Davis and the NRC as we started marketing similar products outside Canada.

Before long, Davis had become the global leader in segmented wave generators, and Ian Jeffrey, our head of electrical engineering, was kept busy supervising the installation of machines around the world. "Our part of it wasn't all that difficult, it was just kind of mechanical automation," Ian recalls. Revenues from this business topped $20 million in the first 10 years, and by 1998, we had shipped more than 500 segments. Our customers included the Offshore Technology Research Centre at Texas A&M University; the national hydraulics laboratory at Électricité de France; the Centro de Estudios de Puertos y Costas (CEPYC) laboratory of Spain's Public Works Department; South Korea's Research Institute of Ships and Ocean Engineering (KRISO); and the Institute of Harbour and Marine Technology in Taiwan. The Korean contract turned out to be especially valuable because it helped pave the way for our subsequent success in infrared suppressors there.

We were able to make significant improvements to the technology in collaboration with the NRC. The original hydraulic actuators used to control the motion of each segment were replaced by electric controls that were easier to use, more reliable, more energy efficient, and required less maintenance. One project we were especially proud of was a large follow-up order from the Spaniards with a flume, or water channel, 90 metres long and as much as 4.4 metres deep. The 6-metre-high wave board weighed 6 tons and could produce waves as high as 1.5 metres.

Our wave-generator business has tailed off in recent years, as we have focused increasingly on suppressors and active shaft grounding. In any case, the market for generators has almost dried up now that most of the laboratories in this field have working machines, and new business consists mainly of contracts to upgrade them.

The **hail guns** and **bird guns** that we devised in the mid-1990s may not have been runaway commercial successes, but they were great examples of Davis Engineering's ingenuity and can-do approach to even the toughest challenges. They helped cement our reputation with some important customers and produced more than a few moments—amusing, embarrassing, and lots in between—that none of those involved in the project will easily forget.



Hail gun, capable of firing 1,200 balls per second. We made less on the guns than on millions and millions of ice balls.

Aircraft often fly through storms, and jet engines must be able to ingest a certain amount of hail without seriously damaging the combustion chamber inside the engine. Hail turns into water vapour the instant it enters the chamber at high speed, raising the danger that it can cause an explosion and snuff out the flame. Similarly, birds can pose a serious threat when they fly into engines or cockpit windows. Cannons that simulate hailstorms and bird strikes are thus a critical part of the engine-testing process.

The genesis for our hail gun business came from a collaborative research project between Mike Birk, who was by then at Queen's University, and Walter Di Bartolomeo, a young engineer at Pratt & Whitney in Montreal who went on to become a vice-president there until he retired in 2021. Mike suggested Davis as a partner to build the guns. We signed a fixed-price contract with P&W for a gun with the capacity to spit out 1,500 balls of ice at 400 knots every second for 90 seconds—no easy feat.

Doug VanDam takes up the story of our first demonstration:

> We set this thing up in our shop, and finally got it working. We had these plastic balls, with a diameter of 5/8ths of an inch and the same weight as ice. Pratt & Whitney came, and they brought along some people from Transport Canada because they had to certify it. About 15 people altogether. We had built plexiglass barricades for them to stand behind. This thing was loud. It was a supersonic gun and sounded like a rocket engine. We ran it, but the plastic balls ricocheted all over the place, and took out every light in the shop. Glass and plastic balls were raining down on the Pratt and Transport Canada guys, and they were diving for cover. They were huddling on the floor by the time we were finished.

Not long afterwards, we conducted a second test using a real engine at the Pratt & Whitney plant in Saint-Hubert, Quebec. Bruce Hiscoke describes what happened:

> After 2 weeks of getting it all set up and certified, they wanted me to stay for the engine test. A Transport Canada guy was there. The gun goes off, everything is working perfectly on my side, as far as I can tell from the panel and the video. And I'm like, "Okay, good. Everything is working, everything is going perfectly. Wonderful."
>
> But right beside me is the engine operator, and I suddenly see in front of him red light, red light, red light . . . warning, warning, warning. He eventually shuts it off, and I remember feeling relieved, and I just started laughing. Of course, everyone else is looking at me, except for the Transport Canada guy, who was like, "Yeah, what's so funny here?" Turns out the gun had destroyed the engine. It failed utterly. We were 6 months away from their deadline at that point in time, and Pratt had to rebuild the engine and change the design."

We finally delivered the first production-model hail gun to Pratt & Whitney in April 1995. Subsequent customers included the National Research Council, and France's Snecma (now Safran Aircraft Engines). But pleased as we were with our work, we ended up making less money on the guns than on the millions and millions of ice balls that we sold.

The bird guns were a separate project, also with Pratt & Whitney as the lead customer. Pratt already had a bird gun but turned to Davis to design an improved version. We obviously didn't want to test the gun by firing live birds at it, so we initially used dummies instead. But then, as Bruce Hiscoke recalls, things got a bit more complicated:

> When the time came for final certification testing, the people from Pratt brought in some dead seagulls. They had to be raised in a controlled environment so they didn't eat rocks and all the other junk that seagulls typically ingest. Once they had been euthanized, they were X-rayed to make sure they didn't have junk in them. It was about passing a test requirement, not creating a worst-case scenario. These birds were very expensive, about 600 dollars each, back in the late 90s, so the people from Pratt didn't want to use too many of them. They literally had a veterinarian on site to euthanize a bird and then, bang, they'd shoot it from the gun.
>
> They wanted to try out their high-speed video and make sure we passed all the various points. But back then, high-speed video needed a lot of lights. Not LED like they are now, but incandescent lights that generated a ton of heat. We had a target with a circle that we fired the dead bird into, and there wasn't much room for error. You had to aim carefully. Another problem was that birds don't fly straight when they're shot out of a gun at 400 knots, so we had to do a couple of test shots to get that right. The very first shot we did, the bird missed and splattered in the heat of the lights. Brett Brooking, one of our engineers, just said: "I smell fried chicken." And sitting on top of the target looking back at us was the head of the seagull. The head had flown off, done a loop-de-loop, and come back to sit on top of the target. You could never repeat that shot in a million years.

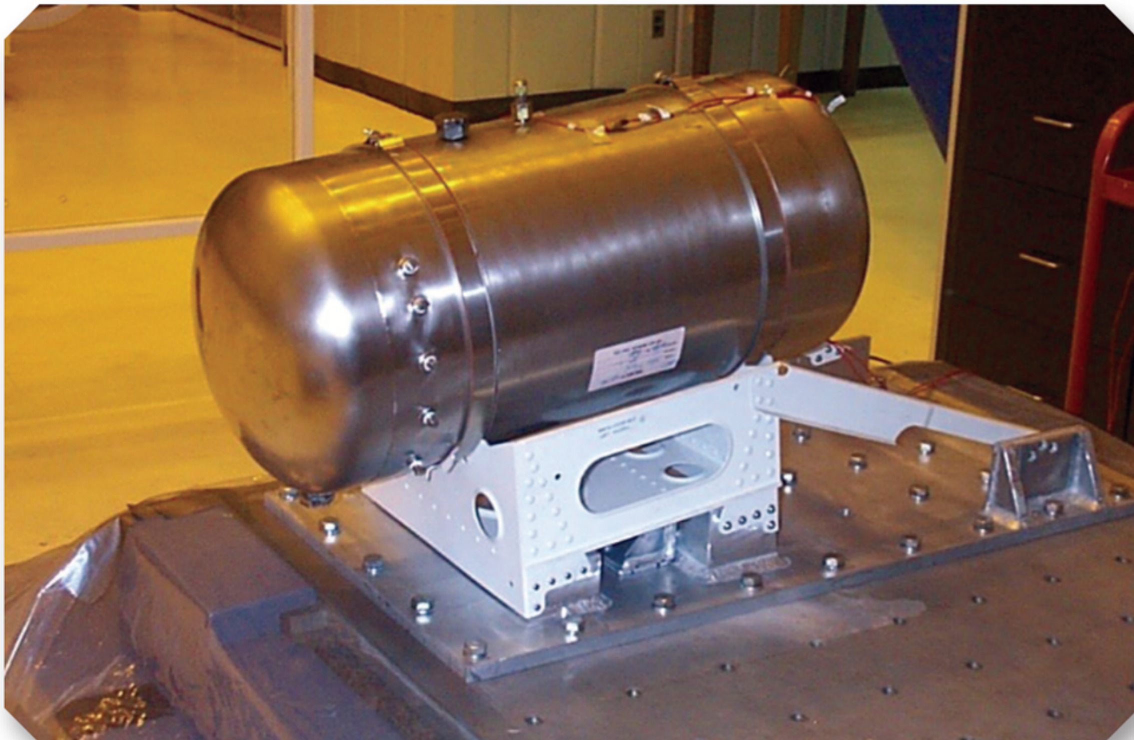
As is our usual practice, we sent several Davis employees to oversee the hail gun installation at the Pratt & Whitney plant in Montreal. Paul Sutton, Andy Langham, and Gilles Champagne decided to share a hotel room so that they could pool their travel-allowance savings and spend the money on beer. They also rented a cargo van with only two seats, and Paul remembers lashing an office chair down between them for the third person: "When the van went back to the rental company, there may have been a few beer bottles shoved down the interior spaces as well." Bruce remembers showing up at the test site about 5 minutes before the Pratt & Whitney brass arrived, and finding beer bottles strewn around from the previous night's installation. He had the presence of mind to quickly gather them up and toss them in the shipping boxes, just as the customers walked in the door.

There was an amusing postscript to the hail gun project, as Bruce relates:

> We had situations over the years where we would just take on another bay at the plant, or give up a bay, depending on business conditions and what we were producing. At some point we stopped using the two bays where the hail gun had been tested, and then years later when we got busy again, we took them back. We broke through the wall and I remember the guys coming to me and saying when they were cleaning up: "What the hell were we doing with these little round plastic balls?" Of course, those were the balls we had fired from the hail guns.

We entered the **aircraft water tank business** in 1997 when we won a contract from BF Goodrich in Ohio, now part of United Technologies, to make stainless steel tanks for Bombardier's RJ-700 regional jets, among the world's best-selling planes at the time. Goodrich had a much bigger contract with Bombardier that included galley equipment, pumps, and valves, but decided to hand over the tanks to a sub-contractor. The initiative for the contract came largely from Don Lovegrove, who joined

Davis after leaving the company that originally designed the tanks for the RJ-100, Bombardier's first regional jet model.



Aircraft potable water tank, a stable and valuable line of business for Davis.

The water in these tanks was used only for drinking and handwashing, not to flush toilets. The manufacturing process comprised mainly metal-forming and welding, which was right up our alley. The tanks were initially made of stainless steel, but we later used titanium, which is both lighter and stronger. We put Eric Poirier in charge of the project, and Don Lovegrove also played an important part, given his prior experience with this type of product. They then set up a team and took over a section of the plant floor for the job. Eric recalls:

That project was quite a coup for me because I had never been a project manager before. The heads of the tanks were round, so we would buy those from a subsidiary, and they would come in as a finished part. The metal would come in as flat sheets. We would cut it and roll it, and then weld it. Very thin. Everything about aircraft is about saving weight. We would get the fittings from a local machine shop, and then it was just a case of putting all those parts together. Engineering spent hours on the phone with Transport Canada and Air Canada about the certification process.

We built our own testing apparatus so that we could show that the water in the tanks would neither freeze nor become too hot. We also had to demonstrate that the pumps would stop and start as they should, a process known as pressure cycling.

Paul Sutton, one of our master welders and a jack-of-all-trades, remembers being involved in one rather ill-considered pressure test. The tank was filled with water and attached to a nitrogen cylinder with a regulator to keep the pressure at 3,000 pounds per square inch. A young test engineer suggested that "maybe we should go to failure," in other words, keep raising the pressure to the tank's breaking point. Paul wasn't so sure, but the response that he received was "Why not?" So he cranked up the valve on the nitrogen cylinder. Unfortunately, as the tank distorted, additional nitrogen flowed in, causing the tank to take off like a rocket. It flew up into the air, careened off the side of the building, and came back to earth only just in time to avoid ripping the regulator off the nitrogen bottle, which would have sent it blasting backward through the shop. This little adventure lives on in the form of the scars on the brickwork and siding of our building that remain to this day.

Davis has built over a hundred potable water tanks a year, which means we've made several thousand over the past two decades. In fact, as of early 2022 we were still making them. They've turned out to be a solid business with a good profit margin. Every Bombardier regional jet in the sky today is fitted with a Davis water tank.

Much of our early business was a product of the OPEC oil crisis. I have mentioned elsewhere the testing work we did for Transport Canada on **fuel-economy standards for cars and trucks.** We helped the National Research Council build **windmills,** and even a prototype of today's hybrid **gasoline-hydraulic cars.** The search for power sources other than fossil fuels also led us to try our hand at **solar heating systems.**

We began our foray into solar heating by designing and building a solar-assisted heat pump system for a townhouse complex in Ottawa owned by Minto Construction and funded by the National Research Council. At that time, it was the largest system in Canada, and it worked well. The problem with solar systems then, as now, was that they were expensive, and no one wanted to install them without a government subsidy.

Solar heating system at the Ottawa Athletic Club installed by Davis Engineering.

We installed another large system at the Ottawa Athletic Club to heat the water used for its kitchen and showers. I was a member of the club, and decided to ask Sol Shabinsky, the club's founder, to allow us to use the club building as a guinea pig for the heaters that we had designed in collaboration with the NRC and hoped to sell in large numbers. Sol quickly agreed, and we installed 150 panels on the club's sloping aluminum roof. The project, paid for by the NRC, initially seemed a great success. After a few rainstorms, however, Sol noticed signs of corrosion on the roof and blamed the panels. I took the view that the panels could not possibly be responsible, but he was equally adamant that they were and insisted on removing them. As it turned out, we were both right—the rain was interacting with residues on the glass panels, raising its acidity. So when the water dropped off the end of the panels, it corroded the roof. (Talk about acid rain!) Sol gave me the cold shoulder for many years afterwards, but I'm pleased to say that we later repaired the relationship.

One serious project that was a lot of fun (but also somewhat frustrating) was the contract that we won in 1985 to design and build **exhibits for the Canadian National Railway pavilion** at Expo '86 in Vancouver. Our mandate was to produce a variety of large, crowd-pleasing, and interactive toys representing the four different types of motion: uniform, accelerating, circular, and oscillatory. We came up with some imaginative ideas, the most unusual being a hula-hoop 3 metres in diameter that would climb a pole whenever a visitor pedalled a nearby bicycle. It was a big contract, but the job involved far more work than we had expected, and making sure the exhibits functioned properly for 12 hours and more a day turned out to be a real headache.

Even so, the contract also brought a number of benefits to Davis, some of which live on to this day. I was aware at the time that Doug Millar, my former mentor at Carleton, had moved to Chilliwack, outside Vancouver. He was still consulting for Davis, and we approached him to be our representative on the West Coast for the Expo project. He took on that job and then continued to consult for us long after the interactive toys were taken down.

Expo '86, Vancouver. One of the interactive exhibits we built for Canadian National Railway to illustrate four fundamental motions: uniform, (parachute), acceleration (block and ramp), circular (hula hoop), and ocscillation (bouncing balls).

One person who especially enjoyed the experience was our eldest son Steve. We asked him to go out to Vancouver to be Davis's man on the ground and keep the project moving. He spent close to 6 months there, and ended up having such a good time that he came home to Ottawa telling us that he wanted to move to the West Coast. Another family member whose services turned out to be invaluable at Expo '86 was my wife Wendy's cousin Doug Wick, who made his living, and still does, by maintaining and repairing boats. Doug seemed a natural choice to look after the Expo '86 toys once we had installed them.

Expo 86 had another lasting legacy for Davis Engineering: We designed a new corporate logo when we bid for the contract as a way of making an impression on CN, and we are still using the same logo today.

The never-ending versatility of the Davis team was again on display in the **police firearms training system** that we developed as part of our efforts to counter the downturn in our other businesses during the late 80s and early 90s. The initiative sprang from the pressure on firearms instructors that comes from tight budgets, growing classes, and a broadening range of students' physical abilities. The RCMP had begun to realize that its instructors were hard pressed to maintain, yet alone improve, officers' firearms proficiency. Also, law enforcement agencies were recognizing that inadequate training can result not only in lost lives but expensive legal liability costs.

Expo ’86 circular motion exhibit. By rotating the black pole, the red hula hoop would climb to the top. Visitors could operate the exhibits by pedalling bicycles.

Stephen Davis (son) was head of maintenance and support for 6 months at Expo '86.

We began work in 1988 on a system that would provide immediate visual feedback to both shooter and instructor for two key functions: grip and trigger control. Our son Steve managed the project as one of several ventures he and his partner John Martinho were involved in through their software company Metaware. In conjunction with the RCMP and the Canadian Police Research Centre in Ottawa, we built two prototypes that yielded good results but also had a number of limitations. We then redesigned the system to achieve a more reliable and functional tool for trainers at lower cost. The new design, known as Range-Tutor, was compatible with RCMP revolvers as well as the automatic pistols used by many U.S. police departments.

We unveiled Range-Tutor at an international police chiefs conference in Detroit and followed up with a mailing to over 2,000 instructors around the world. In the end, however, we were unable to get the product off the ground. Steve recalls that although the Range-Tutor system won much respect from shooting instructors, they were not able to justify the expense to their chiefs.

Another prong of our diversification drive in the early 90s was our involvement with United Marine, a company with three main product lines: security systems for military bases; public address, intercom, and other communication systems for ships; and a hospital nurse-call system.

These products were peripheral to Davis's main business, but they represented what seemed at the time to be an attractive opportunity. Bill MacSween had joined Davis as vice-president for business development after shepherding the sale of Demac to the California venture capitalists, and part of his mandate was to broaden Davis's horizons. We heard about United Marine from Harry Keays, an outside accountant who worked part-time as Davis's chief financial officer. Harry was also a part-owner of United Marine, and he told Bill and me that the company had landed in serious financial difficulty after taking on a large contract with the RCMP that involved building a security system to monitor foreign embassies in Ottawa. The project was way behind schedule and way over budget, and United Marine urgently needed an infusion of funds if it were to survive.

Bill and I decided to buy a 50 percent stake in the company in 1993, with our investment being used to stabilize its finances. Bill took over as president in charge of daily operations, and United Marine's staff and manufacturing equipment moved to 1260 Old Innes Road, where we had a good deal of spare space. The staff who came included Lynton Cooke, vice-president of engineering; Bob Gauthier, head of the marine division;

and Joe Woloszyn, chief engineer (Joe was still with Davis in early 2022). Rick Church, who had been on Demac's payroll, was in charge of sales.

We wasted no time making some changes. The nurse-call system was operating in a very competitive, low-margin market so it was discontinued. The security system for the armed forces bases was a very specific product that targeted a small market. United Marine continued to bid on contracts as each base was upgraded. The security work petered out after a while, but we were still able to generate some maintenance revenue. The ship-based communication products were mainly sold to the Canadian Coast Guard and to ferry operators on the East and West coasts. We decided to make a push into the U.S. market, and secured numerous orders from the U.S. military, the Coast Guard, ferry operators, and supply vessels for offshore oil rigs.

The uptick in sales from the U.S. meant that United Marine needed more space than we could provide at Old Innes Road, given that Davis's own business had begun picking up. The solution came in the form of a partnership with a U.S. company, Hose-McCann, whose products complemented but did not compete with United Marine. Hose-McCann's long-established presence in the States helped open doors and land many new contracts. After a year of collaboration, Hose-McCann made an offer to buy United Marine on the grounds that its own products were aging while United Marine's were in strong demand.

We accepted the offer, and the sale closed in 1999. All of United Marine's manufacturing operations moved to a Hose-McCann facility in Florida, and several of the engineering staff moved, too.

Like every business owner and manager, I have made my fair share of mistakes over the years. One of the most memorable was our foray into **dehumidifiers** in the mid-1990s.

The initiative had its origins in my and Bill MacSween's investment in United Marine. The company had some experience in building energy management equipment, and introduced us to Chinook Phi-Beta, based in Hull, Quebec, which was owned by a University of Ottawa professor who convinced us that he had a "better mousetrap" to manufacture and market energy-efficient and potentially lucrative heating, cooling, and dehumidification products.

Under an agreement that we signed in 1995, Chinook would provide the design or, as Doug VanDam puts it, the "magic beans" that promised to turn dehumidifiers into gold—or so we thought. We also had a lot of input from Jim Bowen, our salesman at the time. Bruce Hiscoke relates the early part of the saga quite colourfully and succinctly:

> Rolly brought in this genius guy who had a design for a dehumidifier, and all we were going to do was build it. He did all the drawings, but the problem was that he was a tinkerer—he was just never quite done. So he was tinkering with them, and tinkering with them, and we had to deliver. And he was still tinkering with them. And eventually Rolly just got annoyed with him and said "Go away."
>
> So then Doug (VanDam) comes into my office, it was a Monday or a Tuesday, and says, "Come with me." We go out and the thing is sitting on the shipping and receiving dock, and it's still not quite done yet. And he says, "So, this thing ships on Friday, and we gotta figure out how to make it work." And that's how we got into dehumidifiers.

The aim was to build both commercial and residential models, and by May 1996 we had shipped 16 units, and were on the verge of an ambitious marketing thrust into the United States.

But we failed to appreciate just how robust these machines have to be, and the design we had licensed turned out to be far too complicated. The few models we produced were too sensitive and couldn't handle the change in seasons. Plus, the market was more competitive than we anticipated, and we found ourselves up against such mass-market giants as Black & Decker.

Our foray into dehumidifiers ended with Davis embroiled in lawsuits, not only with prospective customers but also with Chinook Phi-Beta's owner, who claimed the rights to the original design. Rather than fighting a protracted and costly court battle, we settled and moved on. As Eric Poirier puts it: "We ended up losing a fair bit of money, and we no longer talk about dehumidifiers very often. But it was a lesson learned."

With hindsight, it's easy to see that we could have avoided some of the stumbles that marked our diversification efforts during the first 25 years of Davis's existence. A little more upfront analysis would probably have persuaded us that ventures such as dehumidifiers and firearms training were not the best fit for Davis Engineering.

On the other hand, several of the ventures turned out to be well worthwhile, and for very different reasons. The segmented wave-generator business produced significant revenues and profits, and—equally important—international recognition that helped us cement our position as a leader in missile-repelling technology. Likewise, the exhibits we designed for Expo '86 challenged the innovation skills of our engineering team, helping Davis to retain talented employees as we developed our mainstream products.

All in all, we've had many more winners than losers, and even the losers have taught us—me as well as many others at 1260 Old Innes Road—some valuable lessons.

CHAPTER 4

Ready for Prime Time

The 1990s and early 2000s were an exciting time for Davis Engineering. Our ship suppressor business was growing steadily, almost entirely outside Canada. But the biggest breakthrough came in aircraft suppressors, thanks mainly to two contracts that transformed Davis into the respected and successful company it is today.

As mentioned in Chapter Two, we entered the aircraft business for the first time in the early 1990s in the form of a film-cooled tailpipe (FCT) that we supplied to Canada's Department of National Defence for the Bell 212 helicopter. The FCT, which was based on the design for our ship suppressors, uses two nozzles (one for each engine) and two entraining diffusers to cool the tailpipes. The device replaces the normal exhaust pipe at the top of the engine cowling. The Canadian Bell 212 order was not a large one, certainly not large enough for Davis to brand itself as an aerospace company. But it gave us the confidence to submit a bid to the Turkish military in 1997 to supply suppressors for four Bell helicopters of the same type as the Canadian ones, as well as 170 others based on the Bell single-engined UH-1 Iroquois, known as the Huey, which was a mainstay of U.S. forces in Vietnam in the 1960s and 70s.

The request for proposals came from Turkish Aerospace Industries (TAI), which had been contracted to build the helicopters for the Turkish Land Forces. Doing business in Turkey was unlike anything we had encountered before, and the negotiations with TAI were far from easy. We had a skilled agent, Ramazan Kara, who worked for DORMAK, a trading group that specialized in military work. But even Ramazan's contacts, wise advice, and sense of humour were not enough to bridge the gap between North American and Turkish business cultures.

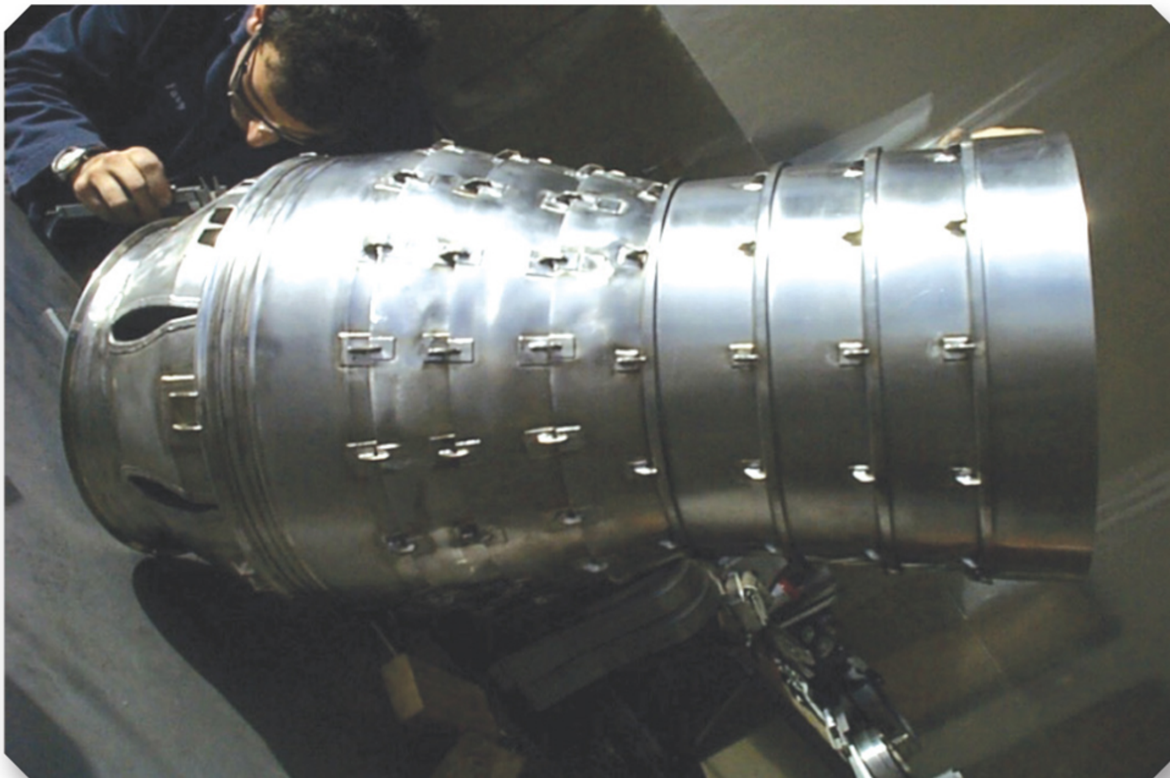
Mike Campbell, one of our engineers, encountered this culture gap first-hand during a visit to the TAI plant near Ankara, where the suppressors were being built. Mike was visiting the plant with Ramazan and needed to give the Turks the bad news that some parts would have to be reworked. There had already been some problems, and the relationship had become a bit tense, so Mike was not looking forward to the conversation.

Since most of the TAI engineers didn't speak much English, Ramazan acted as interpreter. He turned to the TAI technical lead and rapidly fired off some words in Turkish. The man looked angry and leaned in to Ramazan, shouting in Turkish and waving his hands. Ramazan shook his head, banged the table, and yelled back. This went on for a few rounds, with some of the other people around the table also shouting and waving their hands. Most of the shouts, fist-waving, and emphatic head shakes were directed at Ramazan, but some of the TAI people broke off to argue among themselves as well. Finally, there came a lull in the yelling. Ramazan paused, turned to Mike, and said calmly, "He says 'No problem.'"

Thanks to the Turks' negotiating style, I came to know Ankara quite well. They would invite me for supposedly conclusive discussions, only to keep delaying the meetings, leaving me to cool my heels in the hotel for days on end. Another complicating factor was that the military and TAI were close to one another, and obviously planned their strategy together. Both knew our negotiating position, but we would often talk to one with no idea what the other was thinking. That gave them an enormous advantage, especially since they insisted on negotiating a fixed-price contract.

On the very day when we thought we had finalized the contract and were driving back to the hotel, Ramazan received a call from the customer saying that, in fact, one final obstacle remained: the small matter of price. Having learned a little about the Turkish way of doing things, I asked how much more they were asking for. “Just 100K will do it,” Ramazan replied. I agreed, and we signed a contract a few months later for US$8 million.

As things have turned out, Turkey has been a great market for Davis. We redesigned the original suppressors when TAI upgraded the helicopter engines in 2002, and the Turkish army has been a key customer for the T129 ATAK helicopter, developed by AgustaWestland and marketed by TAI, which is also equipped with Davis suppressors. Once the early frustrations dissipated, our relationship with the Turks turned out to be an excellent one. I have made almost a dozen trips to Turkey, and my wife, Wendy, came along on two of them. The second time we spent a memorable few days in the historical region of Cappadocia with Ramazan and his wife.



Centre-body cooled tailpipe (CBT) for Turkey's UH-1 helicopter.

The Turkish contract will forever be remembered at 1260 Old Innes Road not only as a key business breakthrough but also because it was the genesis of a memorable phrase that has become part of Davis folklore and that I have adapted for the title of this book.

Doug VanDam was in charge of designing the equipment for the Turks. While we were confident that we could meet their specifications, the suppressor had not been fully designed, much less manufactured, at the time we signed the contract. I assured the Turkish officials that the work was well advanced, but that, to use Doug's expression, it was "not fully tested." That was a bit of an understatement, but I was quite confident that Doug and his team would produce the goods, as they always had. Once again, they did not disappoint.

A Turkish Huey UH-1H with centre-body cooled tailpipe. This was our first big international contract.

A Turkish TAI/AgustaWestland T129 attack helicopter with an infrared signature suppressor.

Davis was expanding its horizons in numerous directions during this time. As Doug recalls:

We made good progress on the FCT and also got some very high-profile contracts from SPAR Aerospace for two Canadian satellite programs, the RADARSAT and MSAT container modifications and redesigns. It seemed to me by around 1993 that things were finally on track and the future was looking good. I hired Bruce Hiscoke in 1994. I was the acting quality manager, and Bruce was my inspector. By 1996, when I hired Jim Thompson, we were well on our way to success in aerospace. We had a solid core group of people in engineering and manufacturing who would do whatever it took to get the job done.

By this time, almost all our ship suppressor work was outside Canada, though we did have an interesting encounter with the Canadian Department of National Defence in 1996. Bruce Hiscoke tells the story well:

The uptakes on the patrol frigates were cracking at about the time they were due to come in for their mid-life refit. We did a whole bunch of work to fix the problem, in an engineering sense, because we had analyzed the uptake along with the suppressor at the start and had told them they were going to have this cracking problem. Their response was: "Oh, you predicted it so you can fix it."

Although the uptake wasn't our design, we kept on coming up with analyses and solutions, and they kept saying "That's too expensive. Try this, try that." We eventually came up with something, and they said "Okay, we think we can make that work." We gave them some drawings of what they had to do, and they went off with them.

I had a feeling they were never going to do anything, and the mid-life refit was delayed for years because they never had any money. They got round to it not too long ago, and I saw online that a guy at the Royal Military College got his master's degree on the basis of a lining redesign very much along the lines of the one we did for the patrol frigates, funded by DND. He had obviously redone the analysis without any idea that we had already done it.

In a communication that seems almost quaint a quarter-century later, we proudly told our customers and suppliers at the end of 1995 that "Davis has now joined the internet. In the very near future we will be opening a home page on the World Wide Web (http://www.davis-eng.on.ca) where anyone can visit to retrieve information on Davis and its products . . . There will also be an E-mail form for requesting further information."

By the end of the 1990s interest in suppressor technology was growing by leaps and bounds. The need to prevent missile attacks on aircraft had become a high priority—indeed, the very top priority, according to the U.S. Army's chief of staff. It was widely recognized that signature suppression was the most effective first step toward achieving that goal, combined with other countermeasures, such as flares and jammers. Davis was in a strong position to capitalize on this trend, and we were determined not to miss any opportunity to win new customers.

Our marketing efforts took us around the world, and we often had no idea until the very last minute whether they would pay off. Bruce Hiscoke remembers sitting in a small conference room at the Palmachin air base in central Israel where he was hoping to convince the Israeli Air Force to sign an order for suppressors. The Israelis had heard about the suppressor from the Turkish air force, which had recently purchased two flightworthy production versions. But the meeting was not going well. Bruce was surrounded by glum-looking air force engineers, and right across from him at the table sat a colonel, the most senior officer in the room.

"We have discussed this matter, and we feel that the prototype you have brought us is not safe for flight," the colonel said. "We will not be flying it."

This was a big blow. Bruce had been there for a week, embroiled daily in talks with maintenance and engineering officers, explaining every feature of the suppressor that was supposed to be flight tested.

The prototype itself was not a pretty sight. It had been built for use in the Davis wind tunnel in Ottawa, and few refinements had been added. But the Israelis were in a hurry and insisted on having something to test. However, when the flight safety engineers saw it, they were dubious about attaching it to a helicopter. It did not help that the suppressor nozzle somewhat resembled a human backside and had been dubbed "the Turkish ass" by the Israeli technicians.

As the Palmachin meeting dragged on, Bruce was getting a sinking feeling, increasingly convinced that his efforts over the previous week had come to naught. But as everyone stood up to leave, the door opened. A soldier walked in; the little crossed sword and olive branch insignia on his epaulettes signalled that he held the rank of brigadier general. Everyone snapped to attention. The general said something in Hebrew to the colonel, who shook his head as if to say "no," and gestured toward Bruce, whose heart sank further. Then, without switching his gaze at all, the general barked some rapid-fire instructions in Hebrew, to which the colonel nodded, clearly understanding the order he had been given. Without another word, the general left, closing the door behind him. Everyone relaxed back into their seats.

"Good news for you," said the colonel with a thin smile. "Tomorrow we fly the suppressor."

A landmark opportunity to transform Davis—even more so than the Turkish contract—came in 2004. I received a tip from one of our representatives in Washington that the U.S. Army was interested in a suppressor for its heavy-lift Boeing CH-47 helicopter, commonly known as the Chinook, a workhorse that has transported troops and supplies to trouble-spots around the world since the early 1960s. The Chinook was first used in combat in Vietnam in 1965, and over 700 were in service by the time we started to take an interest in the program.

Two developments gave us reason to hope that we stood a good chance of winning an order for Chinook suppressors. First, the helicopter's two gas-turbine engines gave it an unusually large infrared signature, and the proliferation of heat-seeking missiles in combat zones, notably Iraq and Afghanistan, had convinced the U.S. military of the value of signature suppressors. Second, we heard on the grapevine that the army might be looking for an alternative supplier to U.K.-based Rolls-Royce, which had already built and tested a suppressor for the Chinook as a natural extension of its aircraft engine business.

It was clear from the start that we would need to find one or more reputable U.S. partners if our bid was to succeed. Since the infrared suppressor works in conjunction with both the engine and the airframe, we decided to approach the two companies that supplied those two components—Honeywell and Boeing, respectively.

My first port of call in January 2004 was the Honeywell plant in Phoenix, Arizona, which assembled the Chinook's gas-turbine engines. The trip did not get off to an auspicious start. I was with Wendy, and Phoenix was the first stop in a planned round-the-world trip that would also take us to Australia, India, and Europe. We had barely landed in Phoenix when I received a phone call to say that my mother had died that morning in a retirement home in Ottawa. After consulting my siblings, Wendy and I decided that it didn't make much sense for us to return home, mainly because my father had already passed away several years earlier. Instead, we would arrange a memorial service once we were back in Canada a few weeks later. Having taken that decision, I was able to go ahead with the presentation in Phoenix, and the rest of the trip.

Honeywell responded enthusiastically to our approach, and the next step was to persuade Boeing to join us. We quickly agreed that, if our bid was successful, Honeywell would conduct the suppressor-engine testing, while Boeing would coordinate the integration of the suppressor with the airframe, as well as the flight tests. Honeywell's original plan was that Boeing would take the lead and Honeywell would simply collect a royalty from Davis. However, our first task was to persuade the Pentagon that we could do a better job than Rolls-Royce. The challenge was compounded by the fact that two sections of the U.S. Army shared responsibility for this type of procurement contract. One was Project Management Cargo, also known as Big Army, headquartered in Huntsville, Alabama; the other was Army Special Operations, based in Newport News, Virginia. The advantage of dealing with Special Ops was that it was able to move far more quickly than Big Army due to the high priority of its missions; in fact, the army often ends up using the equipment that Special Ops develops.

The negotiations for the Chinook contract reminded me of the "invisible hand" of Adam Smith, the 18th-century economist who studied the forces that drive the free market. We were dealing with about a dozen people from Special Ops, Big Army, Boeing, and Honeywell, each of them looking to advance a particular agenda but with no obvious coordination or planning.

The amazing thing was that we all ended up working together toward a common purpose: supplying the best possible suppressor for one of the U.S. military's key aircraft.

Within a few days of cementing the partnership with Boeing and Honeywell, our son Tom, who by then had returned to Davis as vice-president, flew to Newport News to meet the Special Ops procurement team. It didn't take long for him to discover that Special Ops favoured renewing the contract with Rolls-Royce, which had been working on the project for the previous 6 years. For a moment it seemed that we would not win the Chinook business after all. We realized that the only path forward was to direct our marketing efforts toward the Project Management Cargo team in Alabama.

We launched the sales pitch in July 2004, 5 months after Tom's visit to Newport News. Honeywell and Boeing suggested that we accompany them to the army's annual review of the Chinook program at a Boeing plant in Philadelphia. Both Tom and I went along, and our first task was to make a presentation to Boeing. One of Boeing's negotiators was Carl Trincia, an experienced and skilled government liaison executive, who took us under his wing and provided valuable advice on how best to tailor our marketing strategy to the army's needs. Carl suggested that the next step should be a presentation to both Project Management Cargo and Special Ops. Because Special Ops favoured Rolls-Royce, we were basically competing against two entities. Fortunately, however, we soon discovered that the most influential voices in awarding the contract were likely to be the head of PM Cargo, Col. Tim Crosby, and his executive assistant, Ray Sellers. Neither of them appeared keen to go with Rolls-Royce and actually wanted to make the decision themselves.

CH-47 Chinook fitted with an infrared signature suppressor. This hugely successful project brought together several companies, each pursuing its own interest for a common goal.

We made our first presentation to PM Cargo in Huntsville in August 2004. It went off well, if only because it was an opportunity for them to get to know us a bit better. The next meeting took place a month later at the Fort Rucker army base in Alabama, where we met two more key Big Army players, Dick O'Connell and Paul Grossmyer. Paul had a reassuring word of encouragement: "One month ago I could not discuss the IR requirement of the F Model of the CH-47 fleet," he told us. "Today I've been sent by management to discuss the requirement and how to move forward." Tim Crosby had clearly gone to bat for us.

CH-47 fitted with infrared signature suppressor.

The next presentation, on November 4 in Huntsville, was a classified one, which we were barred from attending because, as foreign nationals, we did not have the necessary security clearance. Even though the meeting was about Davis's technology and we were obviously best equipped to discuss its performance, we had to turn the presentation over to a Boeing infrared specialist by the name of Denny Cho. Regardless, the meeting went as well as it could for us. Boeing's enthusiasm certainly helped, and it was agreed that Project Management Cargo would fund a test flight by a Chinook using a Davis suppressor.

The process was moving along less smoothly at Special Ops. We also needed to make a classified presentation to them, and Col. Crosby suggested that I come along. But the moment the meeting started, John Shipley, head of the Aviation and Missile Command's aviation integration directorate, said sharply, "Get that Canadian out of here." Besides such security concerns, I heard later that Special Ops was convinced that the little company from Ottawa, Canada, was not yet ready for prime time.

US Army CH-47 helicopter fitted with infrared signature suppressors, in Afghanistan.

We continued to work with Boeing over the next few months, and I felt that we were making solid progress, despite some bumps along the way. By June 2005, we were ready for our first engine test, which took place at the Honeywell plant in Arizona. Unfortunately, the 3 percent loss of power from the Chinook engines was too high, which meant we had to modify the design of the suppressor. Another problem was that Boeing had decided to do the mock-up on a full-scale helicopter. We did a second engine test at Honeywell 2 months later when we managed to reduce the power loss to a more acceptable 2 percent. Another encouraging development was the news that the army was looking for funding for more flight tests and was planning to order a total of 60 suppressor sets.

We had a critical meeting in Arizona in September 2005 that included Ray Sellers for Col. Crosby from Big Army as well as Gary Smith, another senior army procurement official. We all got on well together and managed to fit in a round of golf, despite the 100-degree heat. Best of all, at the end of the meeting, Ray told me that Big Army would go ahead with the order for the flight test, a real turning point. By then, we had been working on the project for almost 2 years. The next step was for Denny Cho, Boeing's infrared suppression expert, to move ahead with tests to measure the Chinook's signature. He drew up an aggressive testing schedule, starting in October 2005. But just as we were preparing to pop the champagne corks, we encountered a potentially serious setback.

Boeing officials visiting Davis to inspect the CH-47 suppressor mounted on a fuselage. Left to right: Tom Davis, Eric Poirier, Rolly Davis, Bruce Hiscoke, Denny Cho (Boeing), Kent Smith (Boeing).

The army's lawyers raised a red flag questioning the appropriateness of the close cooperation with the customer—in other words, Big Army and the Boeing-Honeywell-Davis consortium. In their opinion, the support we were getting from PM Cargo might give us an unfair advantage over Rolls-Royce, which was still working with Special Operations. The folks at Big Army were advised to take a more hands-off approach toward our bid in the interests of a fair competition between the Boeing-Honeywell-Davis team and Rolls-Royce. As a result, the army asked Boeing to set up a special evaluation team as a firewall between itself and the bidders to ensure an unbiased determination. A separate group at Boeing would evaluate the submissions.

Boeing installation team with our mounted infrared suppressor.

As everyone now knows, the evaluation team concluded that the Boeing-Honeywell-Davis bid was the superior one. The mood of elation in our offices when we heard the news is hard to describe. Suffice to say that we all knew this was a huge victory and the result of incredibly hard work. It turned out to be an even bigger achievement than we initially thought because Boeing ended up incorporating structural design improvements that had been needed for some time into the Chinook platform. Honeywell was really out of the picture by this stage because no further engine testing was required, but it would still be entitled to royalties, which have continued to this day. As for

Boeing, the Chinook contract marked the start of a fruitful and still-intact collaboration with Davis.

As of early 2022, we had fitted suppressors to hundreds of U.S. Army Chinooks, as well as others in service in Australia, Canada, Italy, Saudi Arabia, Spain, Turkey, United Arab Emirates, and the Netherlands. We are confident that every army and air force around the world that flies the Chinook will eventually equip at least some of their helicopters with a Davis IR suppressor.

The Chinook project catapulted Davis into the big leagues in more ways than one. By winning a prestigious contract from the U.S. Army, we showed that we could meet the most exacting standards for military suppliers. And by beating out Rolls-Royce, we proved that we could compete successfully against companies many times our size, even those with a seemingly entrenched market position.

On the other hand, the Chinook contract put us on a steep learning curve, and we realized that we needed to make some big changes in our internal processes. As Bruce Hiscoke puts it: “We went from doing what we had to do to survive, taking any job at a fixed price and getting it done, to being a real aerospace company, with procedures, processes, and, unfortunately, the overhead that goes with that.” For example, the Chinook suppressors contained more hydro-formed parts than our previous products, which forced us to start using some unfamiliar materials, notably titanium. (Previously, all our suppressors were made from stainless steel.) But the really big change was the need to design with an eye on the manufacturing process. On the Chinook contract, we had more drawings of machine tools than of suppressor parts, which was a first for us.

CN-235 transport aircraft fitted with infrared signature suppressor.

The Chinook's design and weight restrictions also created new challenges for our engineering department, while the manufacturing team had to figure out how to process and assemble larger volumes with more precise specifications than they were accustomed to. That entailed installing a lot of new equipment, including more precise machine tools and an X-ray quality welding shop. Eric Poirier, Davis's now-retired manufacturing manager, sums up the Chinook saga well: "It may well have been our toughest job to date, but the outcome was great and all the lessons learned were transferable to other projects."

A Swedish Super Puma helicopter with infrared signature suppressor.

An Mi-24 helicopter with infrared signature suppressor.

CHAPTER 5

Valued Partners

As we all know, two heads—or even three—are invariably better than one. That truism helps explain many of the ground-breaking technologies developed by Davis Engineering over the years. We have benefited enormously by working with some of the smartest heads in research agencies and military organizations around the world, especially in Canada and the United States. It is no exaggeration to say that they have been instrumental in Davis's success, and we owe them a huge debt of gratitude.

Sharing their ideas and, in some cases, their laboratories and equipment, these partners have worked closely with us to design and build innovative products. They have been eager to see us succeed for the sake of the greater good, without necessarily wanting to make a lot of money out of us. In particular, Canada's Department of National Defence and National Research Council have been smart enough to see the benefits of turning a small Canadian company into a national—and even international—champion, and have enthusiastically supported us along the way. Even so, these relationships have by no means been a oneway street. I believe that Davis has more than pulled its weight in our collaborative ventures, achieving results that have gone far beyond anyone's expectations.

Our partnerships have taken many different forms. At one end of the spectrum has been the long and close association with the National Research Council, specifically its hydraulics laboratory, that stretches back to Davis Engineering's earliest days in the 1970s. At the other are the one-off licences that we have negotiated with navies, air forces, and government agencies around the world.

Some of our most important projects have sprung from collaboration with the Defence Research Establishment laboratories in Suffield, Alberta; Esquimalt, British Columbia; and Valcartier, Quebec—all part of Canada's Department of National Defence. South of the border, the U.S. Naval Research Laboratory in Washington, D.C., has been a valued partner. As mentioned earlier, we have also enjoyed a mutually fruitful relationship with the mechanical engineering department at Queen's University in Kingston, Ontario, where one of our former employees, Mike Birk, has been on the faculty since he left Davis more than 30 years ago.

Almost all of our key technologies had their origins in a branch of the Canadian government. More specifically:

- Work on **active shaft grounding (ASG)** began at the Defence Research Establishment Pacific (DREP) in Esquimalt in the 1960s. A patent filed by a DREP researcher as long ago as 1969 recognized ASG as a way of controlling shaft-bearing corrosion on naval vessels.
- **Infrared signature suppression (IRSS)** originated at the Defence Research Establishment Suffield (DRES).
- Davis's **Naval Threat Countermeasure Simulator (NTCS)** software model is a product of cooperation with the Defence Research Establishment Valcartier (DREV).

- The pioneering **segmented wave generator** would not have been possible without work done in the early 1980s by the National Research Council's hydraulics laboratory in Ottawa.

Not surprisingly, these and other relationships have evolved in various directions over the years. In the case of active shaft grounding, we have continued working with the Defence Research Establishment Pacific as we built and then marketed this unique anti-mine system around the world. We have also teamed up with customers in the United States and United Kingdom to meet their specific requirements for ASG systems.

On another front, our wave-generator technology ended up being more advanced than that of the NRC, where it originated, even though we continued to work with the council right up to the time we exited the business around 2007. We enjoyed an especially close relationship with Joe Ploeg, former head of the hydraulics laboratory, as well as his colleagues Ed Funke, Dan Pelletier, Mike Miles, and Peter Laurich. Our ties with the hydraulics lab took on a greater significance in 1984 when NRC management held a special ceremony at our facility on Cyrville Road to showcase a prototype of our segmented wave generator. Among those in attendance was the council's president Ross Pottie, the Minister of Supply and Services Harvie Andre, and representatives from the research division of the Department of Supply and Services (now Public Services and Procurement Canada) headed by Noel Bhumgara.

At the Honeywell plant in Phoenix. Jim Thompson (second row, second from left) and I (behind Jim) were there with Boeing to watch the engine test for the CH-47 Chinook helicopter.

Peter Laurich worked at the NRC in the late 1980s and early 1990s, and was instrumental in helping our son Tom understand the science behind wave generators. We continued to work with Peter after he left the council to start his own engineering firm, Akamina Technologies. In another example of our flexible approach to trusted partners, Davis took on the role of sub-contractor to Akamina for a contract in 2016 to install a new wave generator in St John's, Newfoundland. Akamina supplied the drive, controls, and software, while we handled the mechanical design.

We have pursued quite a different collaborative route on our other two key technologies, infrared signature suppression (IRSS) and the ShipIR software. In both cases, our capabilities surpassed those of the government laboratories early in the development process. Some have complained that Davis short-changed the Defence Research Establishment Suffield on royalty payments for the technology. Our view, however, is that the government's main contribution was to award Davis sole-source contracts—in other words, without a competitive bidding process—to build suppressors for the Canadian patrol frigates and Tribal class destroyers. Make no mistake, those contracts were invaluable to us. But Davis, not the DRES laboratory, deserves the bulk of the credit for developing the technology to its present sophisticated state. That said, we are grateful for the work and dedication of the scientists at DRES, especially Dr. Stephen Murray and Clay Coffee. I also want to recognize the major role that officials at National Defence headquarters played in helping to fit the technology to the patrol frigates and Tribal class destroyers. Two of them, Eric Wessman and Ole Bessmer, were also immensely helpful in guiding us through the Ottawa bureaucracy.

The frigate program was our showpiece, laying the groundwork for our future success in ship-borne infrared signature suppression. The contract began in 1977 with research and development work on fundamental suppression techniques. By 1990 we had delivered 12 shipsets in Canada, and the navy was sufficiently impressed with our work that it continued to award us sole-source contracts as a way of streamlining development of an important new technology. We were far ahead of any other potential supplier at that time. Although the Suffield laboratory was granted a patent for its DRES Ball in 1982, I have long taken the view that this degree of recognition was a stretch because the technology was not new. On the other hand, the patent helped secure our sole-source status because it put the Department of National Defence in a position to award Davis an exclusive licence to produce the system.

As we moved ahead with the Canadian frigates, other countries, notably the United States and United Kingdom, started to take notice. No wonder, because our technology was six times more effective than an alternative system, known as BLISS Cap, which the Americans were using at the time. Davis also developed the Eductor/Diffuser (E/D), the weight-saving device used for retro-fitting Canada's Tribal class destroyers, described in more detail in Chapter Two. The E/D also proved popular with other navies, who liked the fact that it was lighter and came with a lower price tag than the DRES Ball, our original suppression system.

We negotiated a licence for the DRES Ball in January 1987 with Canadian Patents and Development Limited (CPDL), a now-defunct agency that promoted the commercialization of inventions and discoveries by government and university researchers. The licence was transferred 5 years later to the Department of National Defence. Meanwhile, we successfully persuaded CDPL that the licence did not cover the Eductor/Diffuser, which meant that Davis was not obliged to pay licence fees or royalties on that product. In any case, the DRES Ball licence expired in 1999, which meant that from then on, Davis could reap the full benefits of any new technology that we developed.

Our next important suppressor licence, for the Canadian version of the Bell 412 light helicopter, known as the CH146, involved a tug-of-war between two government departments. As mentioned previously, in 1987 we started to design a film-cooled tailpipe that used a lobed nozzle with single tailpipe per engine to mask hot metal. We tested the tailpipe in Canada in 1995 and in NATO trials the following year. It performed so well that the Department of National Defence recommended awarding us a contract for 12 sets. This was in line with a long-standing though unwritten agreement that if Davis developed a product for the military, the department would reward us with either an exclusive licence or a sole-supply contract. What the department could not do was to use our design as a basis for soliciting other bids. However, the then-Department of Supply and Services, which was in charge of government procurement, saw things differently, and wanted to put the contract out to tender. Needless to say, we were not at all happy about that; nor, thankfully, were the military brass. The head of DND's research and development division, Dr. John Leggat, was especially supportive in this dispute.

The dispute escalated to the highest levels of the civil service, but the military eventually prevailed, and we were able to go ahead with a sole-source contract for the CH146. Fortunately, we were able to help the defence department make its case, pointing out that much of the technology we had developed was beyond the scope of our contract. In other words, we were able to show that the version of the CH146 suppressor for which Supply and Services wanted to seek competing bids was not the version that the military had contracted for but one that Davis had developed using our own financial resources.

A big step forward in forging partnerships beyond Canada's borders came in 1998 when we signed the licensing deal with Turkish Aerospace Industries for 170 infrared suppressors to be installed on the Turkish version of the single-engine Bell Huey helicopter. The contract was complicated, both technically and contractually. We had proposed a centre-body tailpipe that closely resembled a DRES Ball, and would be built in Ankara. Davis handled the design, which we would pass on to the Turks for manufacture. The negotiations kept the lawyers busy so that we could be sure our intellectual property was adequately protected.

Davis's dominance of the global suppressor market has put us in a strong position to retain control of our technology. Almost every customer since

2000, including giants such as Boeing, Airbus Industrie, and BAE Systems, has asked us to transfer intellectual property rights to them for any equipment developed during the course of our contracts. We have consistently refused on the grounds that, having pioneered a technology, we do not want to hand it over to anyone else, no matter who they may be. I'm pleased to say that all these customers, without exception, have eventually come round to the view that they would rather draw on our expertise to adapt the technology to their requirements than own the intellectual property themselves.

The National Research Council has been an especially valued partner over the years, underscoring its role as a catalyst for made-in-Canada innovation. Our association goes all the way back to my student days at Carleton University. My thesis supervisor and mentor Doug Millar once worked for the NRC and took the trouble to introduce me to many of his former colleagues there. I recognized early on that the council's resources were a great help in commercializing promising ideas, and we have made a point of staying in touch with the relevant engineering specialists over the years. Dr. Phil Cockshutt, Dr. Ross Pottie, Dr. Earl Dudgeon, and Dr. Don Stephenson, all former NRC department heads, have been very helpful and influential over the years.

Left to right: Rolly Davis with Doug Millar, professor, mentor, and employer, who was immensely helpful in Davis's growth. He provided an entry to the top levels of technology leadership in Canada.

Among many other joint projects, the NRC has made its facilities available for testing aircraft and helicopter engines fitted with Davis-designed suppressors. Some of the engines have come from the Department of National Defence, others we rented. The engine tests were mostly done at the engine lab located on the Montreal Road campus in Ottawa, while the structural tests were conducted at the aero-acoustic Lab at Uplands, near the Ottawa airport. Working together, we would mount our suppressor on a mechanized metal table, known as a shaker table, which over the course of a few days simulates the vibrations that the suppressor is likely to experience during the entire life of an aircraft. Over the years, we have also regularly used the NRC's flight research laboratory, and even hired NRC pilots and helicopters to test our devices before installing them on customers' aircraft.

We are also fortunate to have brought several NRC employees on board at Davis—among them Ian Jeffrey, who joined us in 1990 as manager of electrical engineering.

Davis began working with the NRC's hydraulics lab on wave generators in 1980, a project that would lead to sales totalling more than $20 million over a 10-year period. The earliest wave machines, built between 1980 and 1983, were single-board models of various widths. With the exception of one for Ontario Hydro, all these early models were built for the NRC. Meanwhile, the hydraulics lab was developing specifications for a machine that could generate irregular, three-dimensional waves, resulting in a joint project to build the first dual-mode segmented wave generator that was installed at the hydraulics lab in 1985. As mentioned in Chapter Three, the deadlines for this project were extremely tight given that the equipment was needed to investigate the causes of the Ocean Ranger oil rig tragedy off the coast of Newfoundland. Hot on the heels of the hydraulics lab installation came an order for another segmented generator for the NRC's Institute for Marine Dynamics in St. John's. Our son Tom, with lots of help from Steve Reinisch, cut his teeth at Davis on this project, which took several years to complete in the early 1980s.

In Chapter Two, I described the early development of ShipIR, the software used to calculate a ship's infrared signature, in conjunction with Defence Research Establishment Valcartier (DREV), starting in 1989 under the expert guidance of David Vaitekunas. This work took a big step forward in February 1995 when David was invited to the U.S. Naval Research Laboratory (NRL) in Washington, D.C., to present our ShipIR model. As things turned out, the project paved the way for a close long-term relationship with this prestigious military agency. A few months later we were invited to present a paper at a NATO conference in Paris analyzing the data that David and the NRL had compiled. Without our knowledge, the Americans had already conducted their own review of available U.S. codes to simulate naval ship infrared signatures, and had invited representatives from eight U.S. defence contractors to present their models and answer a set of 24 questions. The NRL gave these companies, including Aerodyne Research, McDonnell Douglas Technologies, and SAIC, the same dataset as they gave us to analyze at the Paris NATO workshop.

Some of those models were also presented at the workshop, but none gave a detailed numerical comparison between the model and the infrared signature. Davis was the only one to present those results. Even though they showed our model in a less-than-flattering light, with differences ranging between 50 percent and 150 percent, David's honesty impressed the Americans. A senior NRL official, Doug Friedrich, made a telling comment to us after the presentation: "I'd rather work with someone who knows they have a bad model and has some idea of how to fix it or at least explain some of the large differences, as opposed to someone who knows they have a bad model, doesn't have any idea on how to fix it, and pretends that that's good enough."

Two important events occurred after the Paris workshop. First, the Office of Naval Research released funds to DREV to further improve ShipIR. Second, the NRL selected Davis's ShipIR as its model of choice for all future live-fire test and evaluation simulations, and started a 10-year period of development of the ShipIR model to meet its requirements. This valuable partnership between Davis and the U.S. Navy continues to this day.

Davis's electrical engineering business has also benefited greatly from our partnership with the Defence Research Establishment Pacific, or DREP, in Esquimalt, British Columbia, whose expertise is recognized around the world. Peter Holtham, a mine vulnerability analyst at DREP, has been invaluable to Davis, and it would have been virtually impossible for us to solidify our reputation in the naval suppressor field without his expert assistance. The fruits of our relationship with DREP include the active shaft grounding system and ship electromagnetic signature studies. Several large Davis contracts, including a role in laying a large underwater, electromagnetic surveillance system and developing a prototype of a NATO minesweeping system, have been a direct result of our association with this fine laboratory.

Our active shaft grounding technology also had its origins in Esquimalt as an outgrowth of the lab's work in electromagnetics and corrosion. As mentioned earlier, DREP's research showed that the system used to prevent corrosion of a ship's propeller and hull creates a current through the shaft bearings to the propeller and back to the hull. When interrupted by the rotating shaft, the current emits a strong and distinctive electromagnetic signal with an ultra-low frequency. This signal poses a potentially lethal danger to the vessel, not only enabling it to be identified and tracked, but also acting as a trigger for nearby mines.

We began collaborating with DREP in the late 1970s to develop a device that would weaken a ship's electromagnetic signal. This work took a step forward in 1983 with an agreement between the United States, United Kingdom, and Canada under which Ottawa would take the lead role and keep the other two countries informed of progress. Not long afterward the three navies began joint trials of an active shaft grounding system. The U.S. vessel used an efficient passive grounding system. The U.K. ship used a Morgan

Barclay active system, and Canada's contribution was the DREP-designed prototype, built by Davis. All agreed that the Canadian system produced the best results. DREP signed a deal in 1986 to transfer the intellectual rights for the 100-ampere active shaft grounding unit to Davis, and we immediately began building five prototypes, lending two to the U.S. Navy, selling them another two at a greatly reduced price, and keeping one ourselves for qualification testing.

Another breakthrough came in 1988 when Canadian Patents and Development Ltd. gave Davis a 20-year licence to make, use, and sell the active shaft grounding system worldwide in exchange for a 4 percent royalty. Production of the 100-ampere unit began the following year. Under an agreement with the Department of Supply and Services, we could recover our development costs from the first 40 units sold to either the U.S. or Canadian governments. Fortunately, the business took off quickly. By 1990 we had produced and installed units on two Canadian destroyers heading for duty in the Middle East, and had sold another two to the U.S. Navy for testing on its Los Angeles–class submarines. Soon afterward we also licensed Vickers Shipbuilding and Engineering in the United Kingdom to manufacture ASG systems for the European market. Vickers sold three units to the U.K. Defence Ministry, one to the French Navy, and one to the German Navy before terminating the licence in 1998. At about the same time, we convinced the U.S. Navy, with the help of our U.S. agent Tom Frenzinger, to mandate the installation of active shaft grounding on every new combat ship.

Mike Birk started at Davis as a young engineer in 1983. He stayed just 3 years, but his contribution to the company became, if anything, even more important over the three decades that followed. During his time at Davis, Mike was the lead engineer in the early development of infrared suppression technology for the Canadian patrol frigate, the TRUMP-class destroyer, and the Israeli Navy's SA'AR 5 corvette. The freedom of academic life then called, and he left to join the mechanical engineering department at Queen's University in Kingston. Mike describes what happened when he handed me his resignation:

> I met with Rolly and said, "I really love this place, but I'm leaving." He was kind enough to say, "Okay, so how are we going to keep you connected with Davis?" I had played a significant role in some of the early successes, and he explained that he wanted me to stay connected with the company. So I asked the university if I could come to Ottawa one a day a week. They said no problem, and I did that for a number of years.

That arrangement laid the foundation for Mike and, more generally, the mechanical engineering department at Queen's to be involved in Davis's IR suppression work for the next three decades. It was a mutually beneficial arrangement, with smart Queen's students helping us develop new products, and us giving them a valuable real-life training ground. One example was Jason Mateer, who started with Davis in 2004 and studied under Mike for his master's degree, focused on the Hercules C-130 suppressor. As time passed, Queen's also graduated several doctoral students who had spent time on Davis-related research projects, among them Jimmy Crawford in 2016 and Maverick Zawislak in 2021. These individuals have made a significant contribution to Davis's research and development in our quest to remain a world leader in the IR suppression field.

As part of our collaboration, Mike was instrumental in pulling together a 4-year research program in 2002 involving Davis, Queen's, the Department of National Defence, and the Natural Sciences and Engineering Research Council of Canada (NSERC). The agreement was part of the NSERC's collaborative research and development program, which offered $2 in cash for every $1 contributed by a private-sector partner. Davis, the Department of National Defence, and the NSERC between them agreed to contribute a total of almost $1 million over 4 years to support a full-time research engineer at Queen's plus a half dozen post-graduate students, with Mike as their supervisor. One of our best acquisitions from Mike was Bruce Hiscoke, who became a key man at Davis involved in many aspects of our business.

Mike has now retired from Queen's, though he still works for Davis as a consultant on new product development. But the research program is still going strong. Mike describes how it works:

> We come up with a list of projects, and I put PhD and MSc students on those projects. One example is computational fluid dynamics. In the early days at Davis we did not use real computational fluid dynamics because you needed powerful computers that were very expensive. Now you can buy an equivalent computer for a thousand bucks. But in those days it was in the hundreds of thousands of dollars. And so we were slow to take on that kind of work. But one of my early PhD students actually did some contract work for Davis involving proper computational fluid dynamics to demonstrate to Davis what we were capable of doing. That led to Davis buying its first fluid dynamics software, and it now relies very heavily on that technology.
>
> The arrangement has also had a secondary objective, what the NSERC calls "highly qualified personnel," where I was trying to train people specifically for Davis Engineering. When I saw somebody who was really good, I would come to the Davis management and say "This person is

really good. Hire them.” So a number of those graduates ended up at Davis.

Altogether, it’s been a great experience. Queen’s has quite an impressive lab. Davis built a large wind tunnel for us and delivered it as an in-kind contribution. If I had to beg for money from the federal funding agencies to buy this big equipment, I’d still be waiting. So I would be able to turn to Davis and say “I need a wind tunnel. Can you make me one?” And they’d say “Sure. Tell us what you want.” I would sketch something up, and their draftsmen would draw it up properly, and they would build it, deliver it, and set it up. As a university professor, you just dream of stuff like that. I am incredibly fortunate to have been in this situation. I have been well funded for over 30 years. It’s been, I think, a huge win for me, and I think there have been many wins for Davis. So it’s been great.

The highlights of my career are all associated with Davis. It’s been an absolute thrill to be associated with the company. I learned an incredible amount from Rolly. Lots of fun, and lots of fond memories travelling with Rolly on various jobs.

Customers and partners often ask why we have not patented our ground-breaking technologies. It’s a conundrum we often talk about, but we have so far taken the view that patents would not be worth the trouble and cost of enforcing them. While a patent may be an effective way of protecting an idea in North America, the same cannot be said for many other parts of the world where we now do so much of our business. The fact is that a patented product is out there for everyone to see and, if they so wish, to copy. Whether we like it or not, that has happened a couple of times. The Indian Navy bought Davis suppressors for three new frigates in 2002, then told us quite openly a year or two later that they had designed their own diesel units for the rest of their fleet. We also sold a shipset to the Japanese navy but never had another order, leaving us to assume that they decided to ask a domestic supplier to produce more using our design, with or without adaptation.

We are always concerned when a company or country thinks they can compete with us by appropriating our intellectual property. This has happened in the past and will no doubt continue in the future. Our belief is that it is difficult to protect our technologies with patents and that our best protection is to continue to enhance our products so that no one else can offer better value to our customers. Our concern is that, without the benefit of Davis's long-established design, manufacturing, and testing expertise, the customer will end up with an inferior suppressor that has neither the durability nor efficiency of the Davis product.

We sometimes hear outsiders say that a suppressor is little more than a bunch of duct pipes welded together. Not true. It is in fact a sophisticated piece of equipment. How one part is connected to another, and how it is mounted on the ship or aircraft, can significantly affect performance and durability. A lot of engineering work goes into figuring out the best way to build a suppressor, how to make it last, and how to accomplish all that at a reasonable price. As far as we are concerned, no other company in the world can build a high-quality suppressor as quickly or affordably as Davis Engineering. Jim Thompson, head of our aero/thermal and performance group, puts it succinctly: "Other people will say 'We're going to use a cheaper material, we're not going to use the same welding standards, we're not going to assemble it the same way." When that happens, they're going to get a product that's just not going to last."

In October 1991, I wrote in our company newsletter:

Our Canadian technology that has been developed with the National Research Council and the Department of National Defence continues to be highly thought of and adopted by other nations. I believe this speaks volumes about the relationship of research and development to our economic well-being.

Those sentiments remain as true today as they were more than 30 years ago.

CHAPTER 6

Foreign Affairs

You never know what the future holds, and one big surprise of my life is how much of the world Wendy and I have seen. Neither of our families travelled very far for most of their lives. My parents took a trip to London and Paris for the first time in their 70s when we gave them the airfare as their golden wedding anniversary gift.

My travels beyond Canada started in 1970, and they did not get off to an auspicious start. I flew to Germany and Belgium with Doug Millar to present papers at a number of conferences. We took a military shuttle to the Canadian Forces base at Lahr, Germany, but I forgot my passport at home. Fortunately, the authorities weren't put out, and we weren't delayed at all. That first trip was followed by three or four others in the early 70s for more presentations. One memorable conference in Cambridge was hosted by Sir John Horlock, a pioneer in research on gas-turbine engines. Sir John was the first director of the Whittle Laboratory, now a world leader in research to improve the performance of turbomachinery used to reduce the environmental impact of power generation and aviation.

During this period, we were also travelling to the United States and Europe to present papers at the annual International Conference on Advanced

Materials Sciences and Engineering. For a young engineer who had barely turned 30, these trips were a heady experience, not only professionally rewarding but also quite exciting given my lifelong interest in history.

The foreign adventures came to a virtual halt in the years after I set up the company in 1975, as all my efforts were focused on securing contracts in Canada. However, there were a couple of exceptions. Bofors, the Swedish armaments maker, was selling equipment to Canada, and the offset programs provided a potential opportunity for Davis. Under these programs, Bofors was required to buy from or invest in Canadian companies an amount equal to its contracts with the Armed Forces. I travelled to Sweden for talks, and stayed at Bofors' corporate hotel in Karlskoga, west of Stockholm. It was a most pleasant experience but, unfortunately, no business came out of it.

Another trip was to South Korea as part of our work with the two carmakers Hyundai and Kia. The 1973 OPEC oil crisis had sparked a wave of interest in fuel conservation, which led to Davis winning a contract with Transport Canada to measure the air resistance of heavy trucks. That work paved the way for the large, sculpted flaps attached to the top of rigs to deflect air around the trailer, now a common sight on North American highways. While we were working on this contract, word reached us that Hyundai and Kia were planning to import cars to North America for the first time, and had approached Transport Canada to conduct the safety tests required to certify their vehicles for Canadian roads. We bid on the contract, and so began a long and mutually rewarding series of partnerships between Davis and various customers in South Korea.

We initially built the testing equipment at Transport Canada's motor vehicle test centre in Blainville, Quebec, northwest of Montreal. That arrangement worked well for a while, but the Koreans were keen to test the vehicles where they were assembled, so they asked us to replicate the

Blainville equipment in Korea and show them how to use it. (Ironically, Hyundai ended up building its first North American assembly plant in 1989 in Bromont, about 120 kilometres from Blainville. The model produced at the Bromont plant, an early version of the now-popular Sonata, turned out to be a flop, and the factory closed just 4 years later.)

We were well aware that by helping Hyundai and Kia set up their own test facilities on the other side of the Pacific, we would be working ourselves out of a job. But our willingness to do so ended up having a huge upside in that we were able to put down roots in Korea and establish contacts that would be invaluable later on. One of the most rewarding relationships was with Y.C. Lee, an agent introduced to us by the Canadian embassy in Seoul.

I've visited Korea more than 20 times, and we've sent many engineers there, too. When we first took an interest in that part of the world, South Korea was by no means the economic powerhouse it is today. The Korean War still seemed to be very much on people's minds. The national anthem played on the radio at noon every day, and everyone would stand to attention wherever they were. It all struck me as a little old-fashioned but also quite heart-warming. The country was perpetually on guard against the North, with armed guards stationed at all major intersections in Seoul. Some nights we were told to stay in the hotel because the army was conducting military exercises. That meant a very limited choice for dinner, which often presented a problem for a foreign visitor. I've always been a bit of a picky eater, and I have to admit that Korean food was not my favourite back then. If I was scheduled to be out of town for a day, I would pack some chocolate bars in my briefcase so I would have something to eat without offending my hosts.

Our work with Hyundai and Kia wound down in 1983, and there was a gap in new business—and foreign travel—while we laid the groundwork for our first infrared signature suppression and active shaft grounding contracts. But by the late 80s, buoyed by the success of the Canadian patrol frigates and TRUMP-class destroyers, we began directing our marketing efforts beyond Canada's borders.

The U.S. Navy was a prime target. It had already installed an infrared suppression system called the Eductor BLISS on its frigate destroyers, but it was much inferior to our technology. The Pentagon was also considering active shaft grounding, which gave us an added incentive to focus on Washington. Our first agent there was Tom Frenzinger, who had retired from the navy and was keen to represent Canadian companies. Tom had spent time at the U.S. embassy in Ottawa as a naval attaché, and by coincidence had become good friends with an Ottawa couple whom I had known since high school. Tom helped us open doors in Washington for many years, and we owe him a huge debt of gratitude.

Among the numerous connections we made was the naval design firm of JJ McMullen and Associates, which was working for Ingalls Shipbuilding, a Mississippi-based company that has built almost 70 percent of the U.S. Navy's current fleet of surface warships. Ingalls' foreign customers included the Israeli Navy, which had awarded it the contract for a fleet of SA'AR-class corvettes.

The Israeli vessels presented a golden opportunity for Davis. Their hulls and superstructure were carefully contoured to minimize their radar signature, and signature suppression would give them even more protection. Our DRES Ball system was fitted to the gas-turbine and diesel engines using the same technology that we had supplied for the Canadian patrol frigates and the upgrade of the Canadian Navy's Tribal class destroyers.

We signed our first export contract for infrared signature suppression equipment with Ingalls in early 1990, and the SA'AR-5 work laid the foundation for a rewarding relationship with the shipyard that continues to this day. The contract also involved regular contact with an Israeli agent in Washington, D.C., plus several visits to Tel Aviv.

The late 80s to early 90s generally saw me spending much more time on the road or, to be more precise, in the air. The Blohm and Voss shipyard in Hamburg, Germany, became a frequent destination since we were proposing the Eductor/Diffuser for the Greek navy's new fleet of frigates being built by Blohm and Voss. Our bid required several trips to the Greek naval headquarters in Athens, but the time spent in airports and on planes paid off in the form of a contract for four ship sets.

The early 90s was the time when our work at Innes Road slowed dramatically, resulting in the departure of many of our staff and leaving me as the only one marketing and thus travelling. But there were signs of better times ahead, such as the Blohm and Voss contract for the Greek frigates and the contract we signed in 1992 for an active shaft grounding system for the U.S. Navy's new Seawolf class fast-attack nuclear submarine, its fastest sub at that time. Following that deal, the navy required active shaft grounding in all its new vessels, giving our business a huge boost.

Our foreign business was now growing so rapidly that our June 1994 newsletter was devoted almost entirely to contracts outside Canada—an order for wave generators from Spain; a progress report on the Israeli corvette sea trials; news that the Royal Navy was ordering active shaft grounding systems for 10 submarines; more ASG systems for 19 U.S. Navy destroyers; and delivery of a DRES Ball system to Sumitomo Heavy Industries in Japan. The only Canadian order mentioned was a contract with the Department of National Defence to develop an infrared suppressor for the Bell 212/412 Twin Huey helicopter. All in all, I was able to tell our customers and suppliers that, even though many Western economies were still in the doldrums, “interest in stealth technology continues to grow, with defence strategists holding firm in the face of shrinking budgets in their insistence upon protection.”

Japanese Asuka-class frigate fitted with DRES Ball, 1994. We supplied our Eductor/Diffuser and never heard from them again.

By 1995, we were bidding on new wave-generator projects in France and Taiwan, and had won an international contest to provide infrared signature management technology and software to the Indian Navy. Among other new customers was Karlskronavarvet AB, a Swedish shipyard with a history stretching back more than 300 years. The cherry on top was a decision by NATO to choose our NTCS/ShipIR software, developed by David Vaitekunas, as a common baseline tool for infrared ship signature modelling.

Within a couple of years, Davis had projects on the go in more than a dozen countries, including the United Kingdom, United States, the

Netherlands, Germany, France, Spain, Greece, Sweden, Japan, Korea, Singapore, India, and Taiwan. It had become clear that armed forces around the world now realized that infrared signature and active shaft grounding systems were an essential part of a warship, and our experience and technology were in growing demand. This shift in thinking put Davis Engineering on solid ground as it translated into firm orders.

It also meant I was travelling almost constantly. I tried to organize my trips so that I could visit as many places as possible in the shortest time. Carol Anderson was a genius at working it all out and making what were often complicated travel arrangements. There would inevitably be hiccups along the way, but I could call her at any time of the day or night and she always came to the rescue.

It was impossible to do business in many countries without a local representative on the ground. Some of these representatives were more efficient than others, but in general we were lucky and made excellent choices—often with the help of the local Canadian embassy and other contacts. India was a case in point. For many years our representative in Mumbai was Dave Kaushel, an older man who was rather paranoid about the Russian "bear." He was convinced that the Russians, who had a long history of supplying the Indian Armed Forces, were plotting against us. I was having dinner with Dave on September 11, 2001, when news appeared on a TV screen in the restaurant of the attacks on the World Trade Centre in New York and the Pentagon in Washington. Of course, we couldn't quite believe what was happening on the other side of the world.

I was booked to fly to Glasgow later that night (or, to be precise, early the next morning with a 3 a.m. departure). I've seldom seen such a massive deployment of security at an airport, but the flight went smoothly and Heathrow was very quiet. I was due to return home a couple of days later, and Carol assured me that my flight was booked and all would be well. However, when I arrived at Heathrow for the flight to Ottawa, the place was a zoo, and the check-in line snaked a long way through the terminal. I fought my way to the front of the line, knowing I had a confirmed seat, and was able to board.

Our relationship with Dave Kaushal ended abruptly a year or two later when we delivered the first suppressors to the Indian Navy. We had trouble getting paid, and Dave suggested that we find someone else to sort out the problem. A company that supplied services to commercial airlines, Millennium, had heard about us, and it seemed that they might make a good fit. We arranged to meet the second-in-command, Madhukar Parikh, in London for dinner. He turned out to be an invaluable contact, and our relationship with Millennium remains strong to this day. After this episode, Tom and Doug took over responsibility for our Indian business, and I seldom went there again. I can’t say I missed it, given that at least half my visits ended with nasty stomach problems.

At the end of one such trip, I was flying from New Delhi to Tokyo and was quite miserable on the flight. When I checked into the Imperial Hotel, the concierge told me that our daughter Courtney, who was studying at Queen’s, was trying to get hold of me. I was unable to call her immediately due to the time change and, like any parent, I began to worry about all manner of catastrophes. My upset stomach made me feel even worse. I was finally able to reach her and ask if everything was okay. Her reason for calling? “I just wanted to say hi!”

Almost every trip to India turned into an adventure of one kind or another, whether for me or other Davis staff. On one visit to Mumbai in the early 2000s, Bruce Hiscoke and Doug VanDam were sitting in the back of a cab taking them to Mazagon Dock Shipbuilders. The cabs were black and old, with an ancient-looking meter on the outside and no air conditioning. The oppressive heat meant that you had to leave the windows open, which made you prey to the hordes of street beggars who worked the never-ending traffic jams in Mumbai's downtown area.

The cab was slowly making its way through the dense traffic, which ranged from the ubiquitous TATA truck, belching black diesel exhaust, to two-wheeled handcarts pulled by a single man and carrying hundreds of pounds of steel pipe. The most eye-catching freight haulers, however, were the elephants that were still used at that time to ferry goods around industrial areas. At one point Doug and Bruce found themselves right behind one of these lumbering animals, led by a handler on foot. The cab pulled up directly behind it, stuck among too many cars in a very narrow street. The elephant chose just that moment to do what none of the other vehicles could, unloading an impressive pile of dung on the front hood of the taxi, splattering the driver and coating the windshield. Doug and Bruce could feel the cab lurch forward under the impact of the extra load.

Like a shot, the cabbie leaped out of the car to confront the elephant handler in the middle of the street. While the two yelled at each other and for a moment appeared close to blows, Bruce and Doug contemplated taking another cab and making a run for it. Perhaps realizing that he was about to lose his fare, the cabbie abruptly called off his argument and returned to his car muttering "Okay, okay" in as upbeat a manner as a man covered in elephant excrement could do. With the wipers going at full speed, he shot forward into an opening in the traffic, soon afterward delivering his two Canadian passengers safely at the docks.

The United Kingdom has been one of my most frequent and favourite travel destinations and, from a business point of view, one of the most rewarding. Air Canada's non-stop Ottawa–London flight has been a godsend, and a good way to start trips to Europe and beyond. I would often try to end my overseas trips in London in order to spend a night there and, if possible, take in a West End theatre performance.

As with the United States and Australia, our business in the United Kingdom kicked off with an active shaft grounding order. We developed the product jointly with the Ministry of Defence, whose procurement division was based in Foxhill, on the outskirts of the historic city of Bath, where I made Davis's first presentation in Britain.

Our first sale to the Royal Navy in 1989 included two 100-ampere ASG systems, followed by an operational evaluation in 1990. The tests were successful, and the Ministry of Defence signed a contract in August 1993 with Vickers Shipbuilding and Engineering Ltd. to supply 10 ASG systems for 7 Trafalgar-class and 3 Swiftsure nuclear submarines. Davis built the systems, then shipped them to Vickers under licence for installation on the boats. This cumbersome arrangement was necessary because, as with the U.S. Navy, our employees did not have the necessary security clearance to set foot on the vessels.

We had a rude awakening shortly after the deal was signed when Vickers decided that it could manufacture and supply the ASG system itself without any Davis involvement. I was tipped off to this surprise development just after arriving in London on other business, and I immediately called our litigation lawyer Bruce Carr-Harris in Ottawa. Bruce located a highly qualified (and also high-priced) solicitor in London to protect our interests. The introduction turned out to be well worth the expense. The British lawyer contacted Vickers' chief executive at home and was so forceful in putting forward our case that the executive quickly backed down. There was never any doubt in my mind that Vickers was in the wrong, given that the Ministry of Defence had effectively forced us into the licensing arrangement. The only mystery to me was how they thought they could get away with it.

While we were in the throes of nailing down the ASG contract, we were also promoting our infrared suppression signature system for a new Royal Navy frigate, known as the Type 45. A British firm, Darchem, had locked up this business for years with its "Cheesegrater" system, and was determined to keep its upstart Canadian rival at bay. At one point the Darchem people suggested that they wanted to invest in Davis, but it turned out to be a ploy. Through hard work and many trips to London and Glasgow, where the prime contractor BAE and its shipyard were located, we eventually prevailed with a contract for six shipsets. At about the same time, we also won a contract to supply an active shaft grounding system for the Royal Navy's new Astute submarine program.

All this marketing work in the United Kingdom plus attendance at the annual conference on stealth aircraft technology in London was no great hardship. I have always enjoyed exploring historic London, and nights out at the excellent theatre in the West End. As Wendy began to join me more often on these trips, we made a point of staying an extra day or two beyond my business commitments to take in plays, opera, and concerts. These pleasures were capped with the discovery of The Stafford, a perfect boutique hotel in St. James, which became our go-to accommodation. Frequent visits to Glasgow led me to another favourite hotel, One Devonshire Gardens, which happens to be the same place where Gordon Ramsay opened his first restaurant. We have been fortunate to dine at several of Ramsay's U.K. restaurants, including three in London, but we've always liked the Glasgow location the most.

The Royal Navy was—and still is—highly regarded in defence procurement circles around the world, and we have enjoyed a mutually rewarding relationship with the Brits to this day. Our largest contract was sealed in late 2013, when BAE chose Davis to design and supply the complete uptakes, downtakes, and infrared suppression systems for gas turbines and diesel generators on the Type 26 Global Combat Ship. The plan is to build eight of these vessels over the next decade, and our equipment will be on every one of them. More than that, the Canadian and Australian navies have chosen the Global Combat Ship as their next-generation frigate, for a potential total of more than 20 vessels, making this program one of our biggest projects ever. Courtney's husband, Patrick, is our technical authority on this vessel, and he has been kept busy with two contracts and a proposal —with, no doubt, more to come.

The Royal Navy's Type 26 frigate, selected by Canada (Global Combat Ship) and Australia (Hunter class).

Our work in Spain was another important stepping-stone toward Davis cementing an international reputation. It also made a significant contribution to our revenues. Our first contract there was in 1993 for a 72-segment wave generator ordered by the Centro de Estudios de Puertos y Costas laboratory, attached to the Department of Public Works in Madrid.

Other business soon followed. In 1997, we were contracted by Navantia, a state-owned shipbuilding company, to supply infrared suppression signature systems for the Spanish Navy's new F-100 Alvaro Bazán-class frigate. The vessels were delivered between 1999 and 2003, ensuring a steady supply of work during those years. In addition, the Royal Norwegian Navy chose a similar design for five new frigates in 2000. The Norwegian vessels were also built at the Navantia shipyard, and the Davis suppression signature system was incorporated into the design. No sooner had we completed work on these two contracts than we were asked to develop a suppressor for the CN-235 medium-range twin-engine transport aircraft developed for Spain's Construcciones Aeronáuticas SA (CASA) and for BAE.

Our agent in Spain was DTA, a family business run by Antonio Sebastian who had earlier taught at the Spanish Naval Academy and was well connected at the highest levels of government. We spent quite a bit time of together, since the naval shipyard was in Ferrol, a 6-hour drive from Madrid. Antonio became a good friend, and whenever Wendy was with me, he and his wife, Anna, would graciously entertain us at their home or at one of Madrid's many fine restaurants. He is an "old school" aristocratic gentleman and would often tease me about what he described as my rather boring taste in food. Touring the cultural treasures of Spain was always a treat, and Antonio was an excellent guide well versed in the history of his country. Among the highlights of our time with him were trips to Toledo and Santiago de

Compostel, and a tour of the Prado Museum in Madrid. Our hotel of choice was the Ritz.

I first started making marketing trips to Italy in the mid-1990s, and it soon became a favourite destination, often as a stopover on trips to other parts of Europe and beyond.

The initial motivation was Canada's selection of the Italian-built EH-101 helicopter back in 1990. The aircraft was to be deployed mainly on search-and-rescue missions, but it had the potential to be adapted for military use. However, Jean Chrétien's incoming Liberal government cancelled the contract in 1993, so no business came Davis's way. Then in 1996, we responded to a request for information from Fincantieri, a large shipbuilding group based in Milan, regarding a new pan-European frigate program, known as Horizon. This would have been a big deal for us since the plan was to build a total of eight ships for Italy, France, and the United Kingdom. In the end, the Royal Navy dropped out of the program, and France and Italy each built just two ships. Even so, this was a valuable bit of business for us and, since the program continued until 2004, it gave me numerous opportunities to explore Italy as a tourist.

Most of the business visits were to Milan, but Fincantieri also has offices in Genoa, so that city was often on the itinerary as well. One especially memorable trip took place shortly after Fincantieri completed the Horizon design concept and asked me to come over to negotiate a contract for four shipsets. I was brimming with optimism when I arrived for the meeting but was quickly brought down to earth when the Italians demanded that we cut our price by half. They stood firm, knowing I had crossed the Atlantic specifically in anticipation of nailing down a contract with them. However, there was no way we could accept these terms, which left me with little choice but to return to Ottawa empty-handed. I was in a bad mood when I arrived home. But the story did have a happy ending. It turned out that Fincantieri were unable to find any other suppliers, so we eventually landed the contract—at our asking price.

The Italian helicopter maker Agusta (now Leonardo) is also based in Milan, and since we were expanding into the helicopter market at that time, I had a good excuse to call on them, too. Before long we had picked up work for the Agusta A105, AB412, and AB205 models. We also won a contract for a dual-use exhaust cooler for the AB139 and a subsequent military version.

Indeed, Agusta has become a valuable customer and partner over the years. Thanks to our work with the Italians, we were successful in winning the infrared suppressor contract for the T129 helicopter. We became the preferred supplier for this equipment, which led to contracts for the AW149 and AW249 models.

Meanwhile, the Italian Navy has become a sizable customer for our Naval Threat Countermeasure Simulator software, developed by David Vaitekunas. Fincantieri stepped forward with an order in 1999, and David gave a training course in Livorno the following year. We have also supplied infrared signature suppression systems for an aircraft carrier and for FREMM, the European multipurpose frigate, as well as for the Horizon frigate and for the Qatari Emiri Navy.

Wendy and I have done our best over the years to take in as many of Italy's cultural treasures as possible. A memorable side-trip from Genoa was a weekend in Santa Margherita and Portofino, two beautiful historic seaside communities only a 30-kilometre drive along the coast. But for us, Italy has no bigger treasure than the La Scala opera house. As luck would have it, my favourite place to stay in Milan is the Grand Hotel, just down the street from La Scala.

My first experience of La Scala came when I was travelling solo. I asked the concierge at the Grand if he could get hold of a ticket to the opera that night and, sure enough, he managed to find a season-ticket holder willing to sell his premium seat. I jumped at it, but the concierge made it ever-so-politely clear that this visitor from the wilds of Canada would need to dress and act properly, which I duly promised to do. Whenever Wendy and I subsequently visited Milan, we made a point of taking in a performance at La Scala. We loved the place, so steeped in history and tradition. It is surely no accident that diners at the Grand Hotel can enjoy opera recordings with their meal.

All in all, Italy has been a rich and rewarding experience for both business and pleasure.

Wendy and I last travelled overseas together in early 2006, and a trip to South Korea in 2008 marked the end of my travels outside North America. These days, the only trips we take are to our winter home in South Carolina. But for other members of the Davis team, the schedule remains as hectic and demanding as ever. Tom and David are frequently away on marketing trips and at conferences, while Doug, Bruce, and our other engineers are on the go almost non-stop, helping customers install new equipment and ensuring that existing systems are working as they should.

CHAPTER 7

Our Most Valuable Assets

Of all the ways to measure Davis Engineering's success, none gives me more pride than the loyalty of our employees. The longevity of their service amply tells the story of their commitment. As of early 2022, the four most senior members of the management team, not counting our son Tom, had been with the company for a total of 120 years, equal to an average of 29 years each, an impressive number for a group of individuals who could easily land high-powered jobs at any number of other places. Their engineering and management skills are in demand around the world as the defence industry expands and military technology crosses exciting new frontiers. Yet they have chosen to hitch their wagons to a small firm in suburban Ottawa, and to stick with it through thick and thin. "It's kind of a dream job," says Jim Thompson, a 24-year veteran who heads Davis's aero/thermal and performance group. Mike Birk, whose association with Davis stretches back almost 40 years, adds that "the highlights of my career are all associated with Davis Engineering."

Besides these senior managers, Davis has been fortunate to attract many highly skilled technicians, designers, welders, and other artisans, several of whom have stayed with us for well over a decade and, in some cases, are still on the payroll. The same can be said for our alumni. Eric Poirier, whom we hired as a truck driver and just our third employee back in 1977, was with us for almost four decades until he retired as senior manager of manufacturing at the end of 2016. Mike Birk worked full-time for Davis for just 3 years in the mid-1980s, but—as detailed in Chapter Five—he has remained close to us, making an invaluable contribution to our success as a professor of mechanical engineering at Queen's.

Company group photo in front of 1260 Innes Road, about 1987.

As I put the finishing touches to this book in early 2022, our 160 employees make an impressive team. Jim Thompson puts it this way:

> Somehow it has happened that a large group of like-minded people have come together. Everybody seems to work on the same level. We all get each other and understand how everybody thinks. The team aspect of it is very strong. The guys in my group hang out together on weekends, and they're all friends.

These individuals' loyalty is doubly remarkable given that Davis is essentially a family business. Members of the Davis family are the sole shareholders, and no fewer than four of them, all engineers, are on the payroll. Son Tom has been president since I started to plan for retirement in 2002. As of mid-2022, daughter Courtney was director of business development, and her husband, Patrick Wagner, was a senior structural engineer. Finally, our youngest son, Andrew, 10 years younger than Tom, was senior liaison engineer.

Davis employees at 1260 Innes Road celebrating ISO certification.

Many of our employees, both family and non-family, have made the point over the years that a smallish company like Davis offers a far more satisfying work experience than a sprawling defence contractor. The large companies typically assign engineers to a single component or module, where red tape all too often dampens initiative, making projects more difficult and time-consuming to bring to fruition. My son Tom expresses it well:

> At Boeing and other big companies, a few people rise to a level where it's extremely interesting, but the vast majority are looking at something very focused, very small, and very specialized, and the scope of responsibility is probably a lot less than it is here. Most people are not as exposed to customers or to business development decisions. This is a small company, and the senior guys are involved in all the decision-making. Once they're done their development, they get to see this sophisticated piece of technology that no one else can do as well as we can on an aircraft as prestigious as the Chinook helicopter. It's a very real achievement for us all.

The Davis team has forged many close personal bonds. In the early years we hosted a social gathering each Friday afternoon at the end of the work week. The idea was to create a friendly workplace where everyone got along. Although work issues often cropped up at the Friday get-togethers, for the most part we just enjoyed a friendly game of poker and a couple of beers. Now that the company is much bigger, a committee of volunteers organizes events throughout the year such as barbeques, a Christmas party, golf tournaments, and various other activities. The COVID-19 pandemic put a stop to many of those activities, but I have no doubt they will resume, probably with even more gusto, as our lives return to a semblance of normality.

While I'm immensely grateful for the contribution that every one of our past and present employees has made to Davis over the years, it would be remiss not to pay special tribute to a few individuals.

Doug VanDam, our director of mechanical engineering, has been with the company since he graduated from Queen's University as a mechanical engineer in 1986. Doug has a quality that I've always admired: he never shies away from getting a job done, no matter what obstacles lie in his path. He proved that in spades in the early 1990s when we were bidding on the helicopter contract in Turkey, the project that ended up lifting our fortunes after the tough times of the previous few years and gave us a solid footing in the infrared suppressor business.

Speaking of Doug, it's worth retelling the story that gave this book its title. He was only in his early 30s when we put him in charge of designing the equipment for the Turkish air force. While we were confident that we could meet the Turks' specifications, the suppressor had not even been fully designed, much less built, at the time we signed the contract. I assured the Turkish officials that work was well advanced but that it just wasn't fully tested. In fact, even that was something of an exaggeration, but Doug and his team were confident they could keep our promises, and they made sure we did. Ever since, amid much mirth in the office, Doug has used the phrase "not fully tested" to describe an engineering challenge. And he has never failed to rise to it.

Doug VanDam's office, 2022. Left to right: Bruce Hiscoke, Tom Davis, Doug.

Bruce Hiscoke, head of mechanical engineering design, is one of the products of our close association with Mike Birk at Queen's University. In addition to Mike's long affiliation and contribution to Davis with his own work, he has also been an excellent resource for recruiting engineering talent. Mike, professor emeritus as of 2022, knows how Davis operates and is therefore able to recommend suitable candidates from the pool of graduate students at Queen's department of mechanical engineering. This arrangement goes back to 1994 with the hiring of Bruce Hiscoke and has extended to the present day.

Bruce was one of our first engineering hires after the painful downsizing in the early 90s, and was only the second mechanical engineer on a total staff of 25 people. He was finishing up his master's degree, working on a propane research project, when Mike suggested he go up to Ottawa for an interview with Davis. Bruce spent hours putting together a CV and cover letter ahead of the meeting. After he got back to Kingston, Mike asked him how it went. He replied, "Okay, I guess, but I don't know how many they're interviewing." Mike answered, "I think it's only you. If you didn't puke on their desks, I think you've got the job." Bruce was not amused after all the preparatory work he had done.

Bruce has the ability to synthesize detailed and voluminous information to provide direction to the engineers at Davis, as well as at our client companies. He has also been key to building the capabilities and processes that now enable Davis to function as a true aerospace company.

Jim Thompson, manager for aero/thermal and performance, came to us from Carleton University in 1996 with a master's degree in aerospace engineering. He was recommended by Steen Sjolander, a professor at Carleton and a friend of mine. Steen was on Jim's thesis defence board, and although he was tough on the thesis, he saw enough to convince him that Jim would make a good fit at Davis.

When Jim started, he *was* the aero/thermal and performance group, but he now has a team of five engineers working with him. He recalls the huge culture shift after we won the Chinook suppressor contract: "Up to that point we were really more of a craft-shop, hand-building everything. Having to change over to a company that could support a real volume product for a big, international user was a huge learning curve for us. We had a lot of struggles. We had to change the way we did things. But in the end, we were successful." Jim ascribes that transformation to teamwork and determination: "If we didn't have that core group, really smart people who worked together well, with a shared vision, we wouldn't have been able to succeed," he observes.

Over the years we have learned to deal with a myriad of sub-contractors, track every part, and put a much greater emphasis on quality control. But it's a source of great pride to me that we have also managed to retain some of the best qualities of a small company. As Jim notes: " We're a refreshing company to work with. We pick up the phone when our customers call, and we answer their questions. We're walking this line of doing business with the big boys but trying to keep this small craft-shop feel and responsiveness to the customer. And that's a big part of why we're successful."

In **David Vaitekunas,** we have almost a company within a company. David is of Lithuanian descent and grew up in a rural area in Quebec's Eastern Townships before heading to McGill University, where he graduated with a PhD in two-phase flow and heat transfer. For more than a quarter-century, he has written the software programs that simulate the protection that infrared suppressors provide for specific types of ships and aircraft. When he is not travelling, David spends a big chunk of his time in front of a computer screen, tracking interactions between blue (friendly) ships and aircraft, and red (enemy) missiles, and calculating how each is affected by variables such as speed, water, and air temperature, and the size of exhausts. Most NATO navies and air forces now use his software, and it is no exaggeration to say that he is the world's leading expert in this field.

David has probably seen more of the world than any other Davis employee, and he has enough business travel stories to fill a book. Among his most memorable trips was a three-week, round-the-world saga in the spring of 1997 that took him and his wife to a five-day training course in Australia, followed by a visit with me to New Delhi for talks with the Indian Navy, an early customer for our infrared suppressors.

Left to right: Dr. David Vaitekunas, Jim Thompson, Ian Jeffrey.

We hired **Eric Poirier** in the early days because we needed a skilled truck-and-trailer driver to help with on-road vehicle testing for our work with Transport Canada. Here's Eric's version of how he came to work for Davis:

> Back in 1977, I was working for an Ottawa company driving tractor trailers. One day this engineer named Sandy Patry walks into our dispatch office asking about hiring a temporary driver to help his company perform over-the-road aerodynamic testing on heavy trucks. For some reason, and

> fortunately for me, my boss picked me. Thirty-nine years later I retired from Davis.
>
> In the early years Davis sponsored my continuing education. For 3 years I attended night classes at Algonquin College studying industrial maintenance. This training included welding, machining, hydraulics, pneumatics, and electrical skills, which turned out to be a good fit for the type of manufacturing work we were doing, as well as my being responsible for our facilities and plant machinery.

Eric's versatility was on full display during the tough times of the early 90s. Besides his manufacturing duties, he helped with shipping and receiving, handled health and safety, and even took on human resources. As he puts it: "I wore so many different hats I needed a larger hat rack!" By the time he retired in 2016, he was in charge of our manufacturing operations, one of the most senior and demanding jobs in the company.

Eric has a treasure trove of memories from his 39 years at Davis:

> Most exciting to me were our times of growth and having multiple booked orders, which meant we were all very busy. It was during these times that we always seemed to operate most smoothly and were the most productive. I was often teased about saying that our schedules were "too tight," but in reality these schedules drove us to become more efficient. Rolly made some ballsy moves, in some cases, promising stuff that we hadn't even developed yet.

Eric remembers Davis as "a sort of big-family kind of environment. We were fortunate to hire a bunch of people who had a good work ethic, and who liked being here." He describes the satisfaction of producing a video for the 1999 Christmas party at the Delta Hotel in downtown Ottawa, which recapped the company's history and its products: "I did it for the benefit of the wives more than anything else, because most of them didn't know what their husbands did when they went off to work every day. I got a lot of kudos for that."

Left to right: Anne VanDam, Kaye and Eric Poirier. Eric was our first employee in 1976.

Ian Jeffrey retired at the same time as Eric after more than two decades at Davis. He came to us from the National Research Council and was responsible for all our electrical engineering work, notably the active shaft grounding system for naval vessels and the computer-controlled wave generator, both of which have proven to be valuable supplements to our infrared suppressor business. Ian continues to do consulting work for Davis a couple of days a week. His wife, Brooke, a political science professor at Concordia University, is a prominent member of the Liberal party, and we have enjoyed some informative and lively conversations over the years.

Besides the six individuals mentioned above, many others have played a hand in Davis Engineering's success. Here are just a few who also deserve special mention:

André Lacroix worked as an auto-body technician after graduating high school. He was often sick and steadily lost weight to the point where his doctor advised him to quit his job if he wanted to get better. He did just that and joined Davis in October 1982. André and his team of four were the first Davis employees to occupy our current premises at 1260 Old Innes Road. As André says: "It feels like I started at Davis right out of diapers. Hopefully I'll leave before I get back into them!"

During his first 7 years at Davis, André worked on the truck shelters that we built for the Canadian Army. His job involved taking the first unit of each type for an endurance test drive of over 100 kilometres. The tests were conducted at the National Defence proving grounds in Blackburn Hamlet, and involved doing circuits around the track and driving through an obstacle course. So rough was the ride that the drivers all wore kidney belts to protect themselves from the jostling. He also had no shortage of other adventures as he travelled the world installing suppressors and other equipment.

André earned a pilot's licence in 1988, and then put his aviation and technical skills to work restoring old aircraft. By late 2019, he had put seven planes back in the sky, and also restored several vintage sports cars, boats, and motorcycles. His knowledge of aircraft and his riveting skills made him a natural fit for the aviation side of our business once that started taking off in the mid-1990s.

Paul Sutton was doing construction welding jobs in the Ottawa area when his dad, who worked near Old Innes Road, suggested that he apply to Davis. He took the advice, and we hired him in May 1989. Paul remembers showing up for work on his first day, a Monday, walking in the door and being told "We're not hiring!" When he replied "You've already hired me!" they let him in after all. He soon switched to a night shift, doing welding work on wave-generating machines. He was laid off twice during the turbulent early 1990s but, fortunately for Davis, returned each time when we started rehiring.

Although welding is Paul's main skill, his versatility and ability to build just about anything have taken him to several other parts of the business, including hail gun installation and as the main technician for our brief foray into dehumidifiers. Since 1996, he has worked on the aerospace side doing whatever is asked of him, mostly welding, fitting components, and riveting. As of early 2022, Paul was the aerospace supervisor.

Brian Lucas went to school in Ottawa and then moved briefly to Toronto, where he worked for a few different construction companies as a structural welder. He first came to Davis in 1988, and it's a tribute to Brian's loyalty that, despite being laid off a few times in the early 90s, he always returned to us. He worked at the Boeing plant in Arnprior, Ontario, for a while, and his experience there made him a natural choice for Davis's expanding aerospace business. His attention to detail has been especially valuable in figuring out difficult manufacturing problems and prototypes.

Brian is known around the office as quite a character, although he has quietened down a bit since he became a grandfather. None of us will easily forget the Davis Christmas party a few years back when he started heckling the comedian to the point where the entertainer immortalized him with the nickname "sweater boy." At another year-end party, Brian found himself near a co-worker who was having a disagreement with hotel staff about booking a room for the night. The argument became so heated that the police were called. The fellow involved in the argument was nowhere to be seen, and the manager for some reason singled out Brian as the culprit. “I was dancing and then suddenly the police had me on the floor,” Brian recalls. He ended up in the back of a cruiser for a while before matters were sorted out, and he was let go without further incident.

Steve Reinisch started at Davis in 1986 and stayed with us for 27 years. He started in the drafting department when it was all drafting tables and pen and pencil drawings, and then helped oversee the transition to AutoCAD in the early 90s, eventually also leading the switch to the SolidWorks modelling software program in 2006. The downsizing in 1992–93 left Steve as the only remaining member of the drafting department, and he did all the drawings solo. He also led the survey and installation teams on our early aircraft suppressor contracts and was renowned around the office for always staying calm under pressure.

André Lavergne worked at Davis from 1984 until his retirement in 2010. He started as a welder, went on to be welding supervisor, and was instrumental in setting up the initial certifications and welding quality standards that helped make Davis’s product so successful.

Bernie Gagnon apprenticed as both a carpenter and a welder. He initially chose carpentry but soon figured he needed to strike out in a different direction when the carpentry union called its members out on strike shortly after he started his first job. We soon hired him as a welder, initially working on the marine IR suppressors before moving on to some of the wave-generator projects. As the tough times hit in 1992, Bernie warned his wife that he was sure to be laid off, so they decided to take a long vacation in Europe. As the departure date approached and other work colleagues were being given their pink slips, Bernie asked Eric Poirier, his boss at the time, "Aren't you going to lay me off too?" Eric responded, "Nope, I wasn't going to." Bernie shot back, "I have plane tickets to Europe booked. You've got to lay me off!" Eric then obliged.

After a stint as an independent contractor, Bernie rejoined Davis in 1995 and has been with us ever since, most recently as supervisor of marine manufacturing. As of mid-2022, Bernie remained an invaluable employee with his in-depth understanding of how to fabricate just about anything. "I think if we had been always making the same thing here, I wouldn't have lasted long," Bernie says. "What's interesting about Davis is the variety of different things we do. And the people have always been good to work with, too."

Carol Anderson was our long-suffering—and incredibly efficient and hard-working—office manager for more than 30 years, until she retired in 2015. She joined Davis in 1985, while we were preparing to move from Cyrville Road to our new building on Old Innes Road. It was an exciting time, with expansion of space and addition of staff, and everyone full of gung-ho optimism. Many members of the staff became good friends and spent much of their leisure time together, enjoying sports and parties. In fact, Carol struck up a romance with one of our engineers, Maxwell Miner. They were engaged on October 1, 1987, and, as of early 2022, were still happily married.

Others in that circle of friends included Kevin Smythe and his wife, Heidi, Brian Guthrie, Gary Roberts, Dave Anderson, Adri Coppens, Tim Dunn, and Ric Hyslop. Doug VanDam joined us during this time and fitted in well, given his love of parties and other social activities.

The period from 1985–89 was very busy, and Carol's organizing skills proved invaluable, both to the company and me personally. But her loyalty exacted a toll during the turbulent partnership with Kettlewell Kettlewell and Craig in 1989, so much so that Carol felt she had no choice but to leave. Fortunately, she was not gone for long. In my 1989 Christmas message to the staff, I reported that "the past year included the departure of some long-term employees, including Doug Wong, Tony Bosik, Tom Westran, and Laurie Corish. It also included the departure of my previous partners, KKC, and our general manager Pat Ross-Ross. It was, however, a great pleasure to see Carol Anderson reappear after an absence of about a year."

Carol was a casualty of the early-90s retrenchment, but she returned once again to assist our recovery and growth, taking on the roles of head of administration and executive assistant to the president. She was also a pillar of strength as I transferred my responsibilities to Tom, starting in 2003 until her retirement in 2015. What stands out in my mind about Carol's long and faithful service to Davis is how helpful she was in juggling my hectic travel schedule. Her organizing abilities knew no bounds. When my knee flared up in 1999, she quickly arranged an appointment at the Steadman Hawkins Clinic in Vail, Colorado, where I received excellent treatment.

A 1997 Dilbert cartoon neatly captured my dependence on Carol. Dilbert's hapless boss asks his secretary, aptly named Carol, how to address an envelope. She replies, "I'll do it" and goes on to explain, "I'm training him to be helpless. It's part of my master plan to eliminate him. I do everything for him. Soon he'll lose his ability to solve small problems alone. Then I'll 'accidentally' book him on a one-way trip to South Korea. Before he goes, I'll tell him they have a death penalty for speaking English. We'll never see him again. BUWAHAHA!" That exchange caused more than a few chortles on Old Innes Road.

Carol and her husband, Max, are avid wind surfers and travel to Oregon and North Carolina to surf in the winter.

Over the years, Carol and Max became avid—even obsessive—kite and windsurfers, travelling to Cape Hatteras, North Carolina, and Hood River, Oregon, as often as they could. Now that they are both retired, they head for Hood River each summer and Cape Hatteras in the spring and fall, spending about 6 months of the year in the United States.

The roster of employees closest to my heart would not be complete without mentioning the members of my own family. From the time our kids started working in the business as summer interns in the 1970s, I have been acutely aware of the special challenges of having family on the payroll. Can non-family staff ever forget that they are dealing with the boss's son or daughter? Do family employees have an unfair advantage over others when it comes to pay and promotion? How will they handle giving and taking instructions?

I'll leave others to answer those questions except to say that, in my opinion, Davis Engineering has been remarkably fortunate in navigating these potential pitfalls. I like to think that Eric Poirier's description of his 39 years with us is typical of many others, past and present: "Overall, my time at Davis was thoroughly enjoyed. Being a family type of business I always felt like part of the family, and the people that I worked with made it fun to go to work each day."

One anecdote involving our daughter Courtney illustrates just how well everyone gets on together. One August a few years back, Courtney was struggling to meet her deadline on an analysis that Jim Thompson needed for the Spanish Bazán frigates. The customer was asking for more and more data, and stepped up the pressure with an urgent fax message asking us to move the deadline forward. But Courtney was having computer problems, and they were getting worse. The screen would go choppy and processing times were slowing down. Her computer had been misbehaving for a while, which she ascribed to the fact that new hires, as she then was, often had to make do with someone else's cast-offs.

Jim had told her in the morning that he needed to see the results that afternoon so the report could be sent to Spain in time for the start of their day. The Spaniards also wanted the data presented in a really strange way. This forced her to replot everything from scratch, and not in the usual way. She was almost done, but then the screen went black again. If she rebooted, it would freeze or shut down entirely. She went to see Brett Brooking, who was in charge of IT when he wasn't doing his main job in engineering. But Brett told her he couldn't be of much help. He also had deadlines to meet and didn't have time to trouble-shoot someone else's dying computer.

Defeated, Courtney went to tell Jim that the Spaniards would not get their report on time. She explained how she had struggled right through the day, and how the job was almost done when her machine went down. Jim's serious expression gave way to a broad grin and suddenly everyone around them was cracking up with laughter. Needless to say, this was not the reaction Courtney was expecting. It really wasn't that funny, was it?

Her colleagues then explained that it was all an elaborate practical joke. The requirement for the report had been fabricated from the start, and the Spaniards had already left for their summer holidays. Jim had gone so far as authoring a fake fax with the typical wording and diction of the Spanish customer on the Bazán letterhead, and he had faxed the message to the Davis machine. Meantime, Brett had installed software on Courtney's machine that let him control it remotely. He had been randomly playing with it for a week to make her suspect that the computer was giving trouble. Even the computer crash was part of the hoax.

Courtney doubled down. No way, she insisted, would her colleagues have gone to that much trouble. Now they were trying to fool her by pretending it was all a practical joke. Didn't they realize this was serious? She wasn't convinced until Brett showed her how he could take control of her computer and restore it to full function, while Jim showed her the doctored "fax" file on his machine. The day ended with everyone, including Courtney, in fits of laughter.

Treating every employee with equal respect, no matter his or her seniority or background, has been a cornerstone of my business philosophy, and we have always tried to put that principle into practice. Every person in the company, whatever his or her title or job, benefits from our annual profit-sharing plan. I have made a point of asking senior managers for their views on the job performance of family members—and have been grateful for their candour in sharing those opinions. Likewise, we made sure to involve non-family colleagues in drawing up a succession plan as I was starting to contemplate retirement in 2001–02. We hired KPMG to help with the process, and their consultants interviewed the entire management team. The input we received was immensely helpful in laying the groundwork for a new generation, both family and non-family, to guide the company into the future.

All four of our children—three boys and one girl—studied engineering at university, so it made sense to offer them an opportunity to work at Davis during their summer vacations and after they graduated. Three eventually chose to make their careers with the company. Only the eldest, Steve, no longer works at Davis.

Tom, our second oldest, began working at Davis as a summer intern while he was studying engineering physics at Queen's. After graduation, he took a special interest in our wave-generator business, spending a couple of years helping the National Research Council install a system on the outskirts of St. John's, Newfoundland. He returned to Queen's to complete an MSc, and then took a job at Newbridge Networks, a giant in the Canadian technology sphere during the late-1990s tech boom.

Left to right: Rolly's daughter Courtney, sons Tom and Andrew, son-in-law Patrick Wagner.

One of the key conclusions of the succession planning exercise was that Tom was ideally suited to take over many of my responsibilities, and so we persuaded him to return to Davis in 2002. Tom is the first to acknowledge that the transition was not always easy. As he recalls: "At the end of my time at Newbridge, I was very much a technical specialist as an architect of application-specific integrated circuit development. Moving over to here was a different technology and a very different role with more customer interaction and more business development, which wasn't that natural for me."

The keys to making the adjustment, he says, were practice and observation. "One of the pieces of advice my father gave was 'Don't just talk, but listen, so you understand what people really care about.''' The phenomenal growth of the business since Tom took over is ample testament to his ability to do just that.

Tom has another good reason for his attachment to Davis: he met his wife there. Ramona Diepenbrock started her career at Davis without any connection to our family. Since her parents were both working in Brussels when she was a teenager, she attended the International School there before moving back to Canada to study mechanical engineering at Carleton University. She graduated in 1984 and worked for another Ottawa company for 5 years before being persuaded to join Davis by Glenn Long, a former military officer who was in charge of our business designing and building specialized military shelters for the Department of National Defence. Soon after, the shelter contract came to an end. Our joint venture Davis Eryou Wajax planned to submit a bid for a new contract and asked Ramona if they could submit her name as part of their team. She agreed, but Glenn—recognizing talent when he saw it—seized the initiative and offered her a job at Davis as a project manager. She worked for us from February 1992 to August 1993, mostly on the Israeli Navy's SA'AR 5 corvette, and on wave generators for France's national hydraulic laboratory and South Korea's ocean research institute. We also assigned her for a time to United Marine to help with their security system for the RCMP.

We were still quite a small company back then, so it wasn't long before she met Tom. I remember sitting at my desk during lunch hour one day looking out at the parking lot and noticed that she and Tom were heading off to play squash. I figured something more than squash was going on between them, and I was right. In the summer of 1993, after Tom had finished his master's degree at Queen's, the two of them took off for Saarbrucken in Germany, where he spent 6 months as an international student. We were able to have dinner together one evening during one of my business trips to Germany. On their return to Canada, Ramona rejoined Davis, this time in our quality department. One of her first jobs was to revise our quality procedures to comply with ISO 9001, the international standard for quality management systems. Fast forward to 2012, when she became the quality system auditor, a job she was still doing in early 2022.

Ramona has been not just a valued Davis employee for over 30 years but, more important, she has been a member of our family. Tom and Ramona's daughters, Miranda and Kiara, have followed family tradition, in that both are engineering graduates from the University of Toronto. Both went on to graduate school in Switzerland, earning master's degrees. Miranda continued studying in Switzerland and started a PhD program in 2022.

Tom and Ramona at the Blue Mosque in Istanbul, Turkey, 2022.

I may have inadvertently played a bigger role in Courtney's choice of career than was the case with our other three offspring. I'll let her tell the story:

> When I was in grade nine choosing my courses for grade 10, I decided to switch from French immersion to English. My guidance counsellor told me that the grade 10 math and English teacher was very difficult, and that most kids really struggled in his class. She suggested that I drop math and take family studies (home economics) instead. I told her that my dad would not be impressed if I did that. Her response was that I don't have to do everything my father tells me, and I said "Yes, I do." I finished the year with a 98 percent average in math, and my future career was sealed.

Courtney also went on to Queen's, graduating as a mechanical engineer. I used to joke that we sent her there on a "recruiting mission" for new hires. My prediction turned out to be correct but not quite in the way I expected. The recruit she found was Patrick Wagner, another mechanical engineer whom she started dating while they were both on campus. Then, not long after Courtney graduated, Doug VanDam was looking for an engineer. Patrick fit the bill perfectly, and we were pleased to welcome him to Old Innes Road and, before long, to the Davis family.

Shortly after Patrick started, Bruce Hiscoke and Don Lovegrove, who had come aboard to help sell our new line of aircraft water tanks, were travelling together to a meeting.

"What do you think of that new guy, Patrick?" Don asked Bruce at a stopover on the way.

"I don't really know, haven't had much chance to deal with him," Bruce replied. "He just started and then it was Christmas."

"Well, I'll say one thing for him: he's a fast operator," declared Don.

"What do you mean by that?"

“Well,” said Don conspiratorially, “he hasn’t even been here two weeks, and I think he and Courtney are already an item!”

Bruce decided not to break the news to him: “Yeah, Don, I guess he is a real fast operator, isn’t he?” Courtney and Patrick tied the knot soon afterward.

Courtney’s first job at Davis was on the very lowest rung of the corporate ladder, counting and sorting nuts, bolts, and washers as part of inventory control. We gave her ever greater responsibilities, and a few years later asked her and Patrick to open a branch in Barbados, partly for tax reasons but also to facilitate our export business in some sensitive markets. They ran the business from their home overlooking the ocean, and Wendy and I would go down three or four times a year. We kept the office open for about two-and-a-half years. Since returning to Ottawa, Courtney has taken on wider responsibilities in design, engineering, and management, while Patrick has gained a reputation as one of our smartest engineers, always game to tackle the toughest challenges.

Andrew, our youngest son, was once the rebel of the family, interrupting his studies at Queen’s to spend time on the ski slopes at Whistler, British Columbia. But after a year, he wisely decided to return to university, graduated as a mechanical engineer, and signed on as a full-time employee at Davis in 2001. He quickly established a close working relationship with his colleagues in the shop, enduring the usual “new guy” hazing—such as being handed a hacksaw instead of an angle grinder to cut through a piece of metal. “Hey, if they want to pay me for spending all day cutting through this piece of metal, then that’s what I’ll do,” said Andrew good-naturedly. He also worked with Jim Thompson’s group during the summer breaks, helping to operate the hot gas wind tunnel.

He later moved to structural analysis, taking on the job of lead cognizant engineer with overall technical responsibility for many of our marine projects. Much of this business was with the South Korean Navy and involved dealing with a very demanding customer. Andrew worked on a variety of tasks, including many of the so-called “bility” jobs (reliability, maintainability, producibility, and so on) that were new to Davis as we became a mainstream aerospace contractor. He took part in many off-site visits for ship and aircraft testing, and advanced from helper to test engineer in charge of installing and testing Davis products.

Andrew’s practical common sense and affinity for the hardware side of the business have helped him advance to a more production-facing role as an engineering liaison between production and the material review board. In other words, he is the first person to be called when a problem needs to be sorted out in either receipt inspection or manufacturing. He is keenly interested in solving production problems, not just when they occur but as the voice that reminds everyone during the design process “Hey, remember when we did that the last time and it didn’t work so well?”

He is unlikely ever to forget one urgent mission to a customer in Florida during his early days with the company. He and Bruce Hiscoke flew in late at night, but in collecting his luggage at the carousel, Andrew overlooked one precious piece of equipment—an infrared camera worth about $150,000. He was convinced at first that the airline had lost it, but Bruce was certain that he had seen the camera on the carousel. Andrew ended up having to make the one-hour drive back to the airport the next morning in the hope that no one had made off with the camera. Luckily, he found it safely stored at the lost luggage counter.

No book on Davis Engineering would be complete without giving credit to my wife, Wendy, who has never had a formal role in the company but has been a tower of support since the earliest days. We've enjoyed an extremely close marriage and a wonderful family life, both of which, I believe, have been a huge help in building the company. My family has provided a strong and secure foundation, giving me a degree of stability that has made me pretty much unafraid of anything that life at the office might throw my way.

Wendy is a registered nurse by training (she practised briefly in Vancouver and Ottawa after graduation), but she has always taken a keen interest in the business, and her wisdom and common sense have been indispensable as I have confronted difficult situations, big and small, over the years. She has kept me company on innumerable business trips, not all in the easiest of circumstances. Some of our overseas agents—Y.C. Lee in South Korea and Sumitomo in Japan, to name just two—would go to a great deal of trouble to arrange special sight-seeing programs and other outings for her. But not all the trips were quite so relaxing. She had little choice but to cut short one visit to Mumbai after a series of encounters with aggressive panhandlers on the street forced her into virtual seclusion in our hotel.

The Davis family is a close-knit one, and we spend many weekends together at our property in the Gatineau Hills, north of Ottawa, where all four of our offspring have built their own cottages. There's plenty to do on the lake during the summer, and when the snow comes, we often head to the ski hill just a 20-minute drive away. Although we see a lot of each other and our 12 grandchildren at the lake, we seldom talk business. There's no rule against it, it just seems to be an unwritten and unspoken way of getting along. Work has always been in a different sphere, and we've managed to keep it there, no doubt one reason why we all get along so well.

When it comes to the people in my life, both at home and at the office, I certainly have much to be thankful for.

EPILOGUE

Reflections on the Future

As I write this in early 2022, we are hopefully nearing the tail end of the COVID-19 pandemic, which has been an unpleasant experience for all of us. I'm proud to say that Davis Engineering did not miss a single day of work during the disruptions and lockdowns of the past 2 years; on the contrary, the business enjoyed strong growth. Nonetheless, the pandemic marked a key milestone for me. While I started gradually withdrawing from active involvement at Old Innes Road around 2005–07, I continued to visit occasionally and still maintained an office there. But with a younger generation now firmly at the helm and not wanting to put either myself or the staff at risk during the pandemic, I decided to move my office permanently to our home on the lake. Future visits to Davis will now be few and far between.

The path to retirement has been quite a long and hectic one. I was in my late 50s, shortly after the start of the new millennium, when my thoughts started turning seriously to succession planning. Business at the time was booming, with new projects on the go in Norway, Italy, the United Kingdom, South Korea, India, and, of course, the United States. The landmark Chinook helicopter project kept me very busy and involved from 2004, when we paid our first visit to Honeywell in Phoenix, until 2007, when we finally secured the production contract.

The years from 2001 to 2008 were also a time of almost constant travel for Wendy and me. It was exhilarating in terms of both business and leisure, but the long stretches away from home and the packed itineraries were also physically and mentally demanding. During one 8-week period in 2004, we were away for 6 weeks. There were so many customers and potential customers to meet—not to mention conferences to attend and other duties, such as directors' meetings at our offshore affiliate in Barbados—that I could have been away from Ottawa for 12 months of the year and the benefits to the company would still have far outweighed the costs. I noted in my diary that these years were "the most exciting time ever."

With new contracts rolling in and Wendy and I spending more and more time away from Ottawa, it made sense to turn my attention to the future. As described earlier, I started the succession process in 2001 by asking KPMG to help draw up a succession plan. After extensive interviews with family and senior staff, we decided that Tom would gradually take over the role of chief executive, and we started the transition process in earnest in September 2002.

Meantime, other family members were also becoming increasingly active in the business. Andrew graduated and started as an engineer in May 2002. At the end of that year, Courtney and Patrick returned from Barbados and came back to work at Old Innes Road. We hired a professional manager in Barbados and kept the office open for a few more years, until KPMG advised that it no longer fulfilled a useful function. However, we still had to go down four times a year for directors' meetings, which were always an enjoyable experience.

My frequent absences had an important upside in that they helped Tom ease into the role of chief executive, and gave Doug VanDam, Bruce Hiscoke, and other senior managers a bigger say in day-to-day operations. By the time 2005 rolled around, I was spending only about half of my time in the office, even when I was in Ottawa. Tom and his team increasingly took charge of all aspects of Davis Engineering's business. As I put the finishing touches to this book in early 2022, I no longer have any operational role in the company but continue to take a keen interest as chairman of the board and a major shareholder.

Handing over more and more of my responsibilities to Tom opened up exciting new horizons for Wendy and me. The thought of escaping Ottawa's ice and snow during the long winter months became ever more appealing, and we spent many hours discussing options for a getaway in the sun. One possibility was Barbados, but we felt it was a little far away. A far better solution presented itself on New Year's Day 2006 over lunch with friends at the lake. One of our guests mentioned a community of 300 homes in the Lowcountry of South Carolina, not far from Hilton Head. He told us that it offered a variety of amenities, including golf, fishing, hunting, riding, and shooting, and seemed ideal for cottagers like us. We flew down there less than 3 months later and were so impressed that we immediately bought a property.

As I pulled back from Davis, we spent more and more time at our winter home, to the point where—COVID-19 permitting—we are now in South Carolina for almost half of the year, typically from October to early May. Only five of the other residents are Canadian, but the Americans are of a similar age as us, many also with successful business backgrounds and much the same outside interests.

Not long after we started wintering in South Carolina, I met Landon Thorne, one of the original owners in the community whose family had been travelling from New York to the Lowcountry for over 200 years. Landon spent much of his career with the U.S. military, serving as a Marine pilot in Vietnam and in Operation Desert Storm in Iraq, and then spending 20 years in the Marine Reserve. As a result, he had many high-level contacts in the military, and was a partner in a Washington, D.C., consulting firm. What's more, he was (and still is) an active investor, always on the lookout for new opportunities. It seemed natural to invite him to lunch and fill him in on Davis's activities in the United States and internationally.

That gesture turned out to be a smart move. With Landon's help, Davis has retained four former Pentagon generals as directors of Davis Engineering USA. Indeed, our U.S. operations have gone from strength to strength, including a high-security manufacturing facility in Florida that is critical to maintaining our business with the U.S. military.

It has been very satisfying and heart-warming for me to watch Davis's progress since I stepped back. Over the past 15 years, the business has grown by leaps and bounds, far exceeding my expectations thanks to our well-established credibility around the world and a talented team of engineers who are eager and able to solve new problems. What makes the current management's performance even more remarkable is that, as I have noted elsewhere in this book, timeframes in the defence industry tend to be long, and negotiations often difficult and drawn out. Patience and persistence are essential. Our work on suppressors for the C-130 Hercules aircraft is one example. We started on the project as far back as 1996, initially forging partnerships with two large U.S. companies. Neither worked out, though not because of any short-coming in our technology. The U.S. Air Force encouraged us to keep going, and we were eventually rewarded—more than

20 years after the work first began—with a substantial contract that seems to hold much promise for the future.

Family gathering at Rolly's birthday dinner at the Rideau Club, 2021. Left to right: Courtney, Becky and Andrew, Rolly and Wendy, Patrick (behind), Tom and Ramona, Penny and Steve.

Hundreds of aircraft around the world, including the C-130J Hercules, are fitted with Davis anti-missile suppressors.

As Davis Engineering nears its 50th anniversary in 2025, the time has come to think about the next stage in its growth, including the next generation of leaders. We are fortunate to have a strong bench ready to keep the business moving forward, and I am confident that a sparkling future lies ahead for our company and all those associated with it.

Acknowledgments

The seeds for this book were sown a few years ago when I told my friend Fred Eaton an amusing story about one of Davis Engineering's biggest breakthroughs in the U.S. market. It was 2004, and we were trying to interest the U.S. Army in our infrared suppressors for its large fleet of CH-47 Chinook helicopters. One of my early presentations was to a group of senior officers at the army's Special Operations unit in Newport News, Virginia. No sooner had the meeting started when the head of the aviation integration directorate blurted out "Get that Canadian out of here." He was apparently ticked off that I didn't have the necessary security clearance and that he was having to waste his time listening to a company he had never heard of from the frozen north.

Fred, who was just putting the finishing touches on a memoir about his own family business, one of the most storied names in Canadian retailing, immediately suggested that the Chinook story would make a great nugget in a book about WR Davis Engineering, and he encouraged me to start writing. He certainly got me thinking. Engineers seldom make riveting writers, but I began to wonder whether, with a bit of help, I might be able to pull it off. Fred, who sadly passed away in 2021, put me in touch with his publisher, Sarah Scott, publisher of Barlow Books, and Sarah in turn introduced me to

Bernard Simon, a former Canadian correspondent for the *Financial Times* now working as a freelance writer, editor, and teacher.

Bernard turned out to be an ideal choice, and I have very much enjoyed working with him. As I hope readers of this book will agree, we have made a fine team. Bernard spent a good deal of time interviewing me and members of my family, as well as many of Davis Engineering's other senior managers and long-time employees. He has helped put into words so many experiences over the past 50 years that would otherwise have gone no further than my memory, my filing cabinet, and my computer's hard drive. His interviews have had the unexpected benefit of revealing a wealth of fresh insights and reminiscences from people I have known for decades.

I also owe a huge debt of gratitude to Sarah and her team at Barlow Books. Their guidance and expertise have been invaluable in pulling the book together, especially in the final editing and production stages.

Another big thank-you goes to family members, friends, and associates who have encouraged me and shown great patience as we peppered them with questions on Davis Engineering's history and current business. Among those who deserve a special mention is my son Tom, currently Davis's chief executive, who contributed much valuable information on the period of rapid growth since I stepped away from active involvement in the business.

Most of all, neither this book nor much of what I have achieved over the past 50 years would have been possible without the wisdom and guidance of Wendy, my wife. Trained as a nurse, Wendy has become an expert management consultant, acting as a sounding board at every step of my business career. Indeed, she has been one of the driving forces behind this book. Like me, she is deeply grateful for the many business associates, employees, and friends who have been so instrumental in Davis

Engineering's success over the years. As we see it, this project enables us to recognize those contributions in a lasting way.

Finally, many thanks to the past and present members of the Davis team who have shared reminiscences about their time with the company and helped with fact checking. Your anecdotes and insights have not only brought the book to life but will forever remind me of the talent and friendship that have made Davis what it is today—an innovative player in the big leagues of the international defence industry that Canada can be truly proud of.

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WR Davis Engineering was set up, in Ottawa, as a one-man engineering consultancy in 1975. Since then, Davis has become a global leader in defence, a world leader in the stealth technology that shields military aircraft and naval ships from heat-seeking missiles and mines. How did a small Ottawa company get into the big leagues of defence and stay there? Rolly Davis tells the story in *Fully Tested*.

ROLLY DAVIS is founder and chair of Ottawa-based WR Davis Engineering, a world leader in the technology that repels heat-seeking missiles used to attack aircraft and ships. Born in Smiths Falls, Ontario, Davis trained as a mechanical engineer at Carleton University and started the company that bears his name in 1975. Its initial growth came from a diverse range of businesses, from crash barriers to simulate vehicle accidents to wave generators and water tanks for regional jets. However, since the late 1980s, Davis Engineering's expertise has increasingly focused on anti-missile equipment and technology. Over the past 15 years, Davis has gradually handed over the chief executive role to his son Tom. Two of his other three children, as well as his son-in-law, also work for the company. Davis now divides his time between Ottawa, his family's lakeside compound in Quebec, and a home in South Carolina.

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