BELDEN

Birth, Growth, Transformation

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The job of making Belden's products in the 1930s was a laborious one, requiring hand-spooling, winding and assembly of wire and cable for automobiles and aircraft, electrical appliances, lighting, telephone communication and radio. Women did much of the work at Belden factories in Chicago and Richmond, Indiana.

BELDEN

Birth, Growth, Transformation

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Contents

Belden's evolution from a maker of cable and wire just after the turn of the 20th century has put the company at the forefront in providing digital solutions that make buildings smarter; factories more productive; information more accessible, actionable and useful; and businesses more effective.

Foreword

Transformation is nothing new to Belden. We've been at the forefront of every advancement in electronics and communication since 1902. We have a history of changing the world for the better, setting industry standards and providing the technological underpinnings of a digitally interconnected planet.

Since the turn of the 20th century, Belden has powered telephone switchboards; made electrical systems in home appliances, cars and airplanes safe and reliable; enabled ground-to-air-communication, and kept tanks, planes and submarines running during wartime. We've made the picture clearer on television and enhanced connectivity in computing, broadcasting and cable TV.

Belden's innovation continues today, as we make industrial environments more efficient, mass transportation safer, wireless connectivity more accessible, and experiences at event venues more interactive and fun. This book tells those stories and reveals the role Belden has played in one major transformation after another—of technology, of business, of the country and our economy, even of life itself.

Belden is an amazing place, one that's always been poised for the future and driven by people who view our position as an industry leader with humility and responsibility. I'm honored to be a part of this great company, and I know you'll enjoy reading the many stories of those whose imagination, innovation, humanity and pursuit of greatness have made it possible for Belden to make an indelible mark on the past 120 years.

Roel Vestjens
President and CEO
October 2022

No longer confined to the wires and cables that carried the signals on which modern living and industry grew and now depend, Belden's innovation today powers sophisticated data management and communication solutions that leverage the digitization of information and machinery.

CHAPTER ONE

Innovation, Evolution, Transformation

With the benefit of hindsight, it's possible to believe that Belden's evolution was predestined—that the founder's faith in the ingenuity of his people to push beyond technical barriers and solve the problems of business would take the company to the top of its industry; that, as in all rags-to-riches stories, Belden was fated to become what it became, and what it is becoming.

Over 120 years, Belden has grown from a small manufacturer of magnet wire used primarily in telephone switchboards into a leading, global provider of end-to-end networking, security and connectivity solutions that help industrial and enterprise customers build their digital businesses of the future.

Through three industrial revolutions and now into a fourth, Belden has made an astonishing leap in product sophistication. But its beginnings were unspectacular. At its founding in 1902, the company was perched at the top floor of a rickety, five-story building in Chicago's Loop district. The modest factory's ten magnet wire machines were powered by a steam engine in the basement. To make ends meet, Belden engineered its first product diversification: making memo pads that attached to a telephone receiver.

> "We were enterprising enough to go after them"

Belden later moved its headquarters, first to Richmond, Indiana, and then to St. Louis, Missouri. Today it serves markets that include factory automation, automotive manufacturing, broadband, energy, transportation, wastewater facilities, smart grids, data centers and hospitality, among others. Products are manufactured, assembled or distributed at more than 20 locations, from Richmond, where Belden's traditional cable and wire products have been manufactured since 1928, to others in, for example, Neckartenzlingen, Germany; Budapest, Hungary; Monterrey, Mexico; and Pune, India. Altogether, some 7,700 employees work at Belden to support these operations.

The breadth and scope of the publicly traded company would amaze Joseph Belden, the co-founder and first president of the eponymous business. As befitting a global enterprise, Belden's current president and chief executive officer (CEO), Roel Vestjens, was born and educated in the Netherlands; began his professional career as a management consultant in Seattle, Washington; and later worked in Venlo in the Netherlands and Hong Kong before returning to the United States as a Belden executive vice president in 2014.

Belden structures its business in two platforms comprised of three business segments: an Industrial Solutions platform holds a single segment called Industrial Automation Solutions, and an Enterprise Solutions platform contains Broadband & 5G and Smart Buildings segments. Each business segment integrates Belden's comprehensive portfolio of products into compelling customer use cases that serve its customers' needs for digital transformation. Ashish Chand is executive vice president of Industrial Automation Solutions, Anshu Mehrotra executive vice president of Broadband & 5G, and Jay Wirts president of Smart Buildings.

Belden's product portfolio has dramatically expanded over the past two decades, from solely copper and fiber optic cable and wire products to an array of connectors, switches, routers and data networking technologies—just to scratch a deep surface. Belden integrates and customizes these products to automate manufacturing and industrial processes, wirelessly connect enterprises, and generate analytical insights from internal and external data for business decision-making.

Many of the products and technologies were developed by other innovative companies that Belden strategically acquired and integrated into the company over decades. Indeed, Belden is an amalgamation of dozens of other businesses, most of them picked up in prescient transactions that

Side by side, these images capture Belden's evolution from a regional provider of telephone switchboard wire into a global juggernaut of the Fourth Industrial Revolution focused on customers' digital transformations. At left, in the 1920s, is the coil winding department at Belden's plant in Chicago, where primarily female workers made wire using a process similar to sewing. Above, part of the manufacturing floor at Belden's state-of-the-art plant in Suzhou, China, which opened in 2009; the wrapping machines and winches shown are part of the cable manufacturing process.

BELDEN IN THE NEWS

During the 1920s, when aviation was all about derring-do exploits and barnstorming air shows that captivated the public, pilots like Charles Lindbergh relied on Belden wire in their airplanes' electrical systems. One year after "Lucky Lindy" flew nonstop across the Atlantic, the first pilot to achieve the feat, Belden advertised the use of its wire by the "nation's air hero" for dependable performance in the airplane's electric starter, landing lights and navigation lights.

It's often said that seemingly innocuous wire and cable products that transmit information and electrical power are the equivalent of blood vessels or nerves in the human body. The unassuming nature of Belden's products notwithstanding, the company's achievements over 120 years have given and sustained life in manufacturing, transportation, broadcasting, data management and telecommunications—enabling some of humanity's greatest accomplishments.

In the company's early years, Belden's revolutionary Beldenamel wire ushered in the manufacture of small motors, enabling the invention of small home appliances like toasters, coffee makers and waffle irons. A consumer products revolution arose on the electric signals safely and reliably transmitted by Belden.

The aviation industry also owes its development and progress in part to Belden wire and cables. Commander Richard Byrd's plane, the *Josephine Ford*, used Belden Shielded Aircraft Cable for radio communications in its historic flight over the North Pole in 1926. A year later, the cable was used to power the electric starter, navigation lights and landing lights of Colonel Charles Lindbergh's plane, *The Spirit of St. Louis*. Lindbergh felt the wire was more dependable than other makers' products.

Sharing this view was inventor and industrialist Thomas Edison, who ordered a steady supply of Belden magnet wire for his electrical distribution grid. During World War II, Belden's electrical wires powered motors, generators, radios, walkie talkies, control coils and relays for aviation, maritime and land-based applications. So important were these military operations that Belden's Richmond plant was turned over entirely to the production of these wires during the war.

After the war, Belden's unique insulated magnet wire was used in radar and then in televisions, computers, office copiers and communications equipment. In the late 1950s, Belden's low-loss, twin-lead cable improved television's picture quality, an important advancement in that nascent industry. A child watching *Batman* in the mid-1960s on a new color TV set enjoyed the high-quality image because of Belden wire.

In subsequent years, Belden's Beldfoil shielding tape was used in a variety of cable applications in the burgeoning data communications field. In broadcasting, Belden cables transmitted NBC's *Today* show and the Olympics to the public for decades. In 1991, some 100 miles of Belden cable were needed to broadcast the Goodwill Games from Seattle to the rest of the world.

Today, Belden is at the forefront of connecting people, machines, devices and applications in the data-driven, digital transformation of companies on a global scale. Extraordinary things are on the horizon that will make work—and, as a result, many aspects of life—simpler, more interesting and enjoyable, productive and mobile. Behind the effort to help businesses competitively differentiate their products and services, and seize these benefits of a digital world, is Belden—as it has been for nearly a century and a quarter.

furthered Belden's ability to solve ever more complex technological problems for its customers.

Through the years, Belden has demonstrated extraordinary dexterity, successfully pivoting and adapting to incessant market disruptions and quickly emerging new opportunities. The reasons? Stalwart and principled leadership, a "can do" culture and unsurpassed technological ingenuity. When confronted with a customer problem or market need, Beldenites, as employees dubbed themselves in the first decade of the 20th century, are undaunted. They've generated hundreds of patents and are credited with many other innovations and technical breakthroughs.

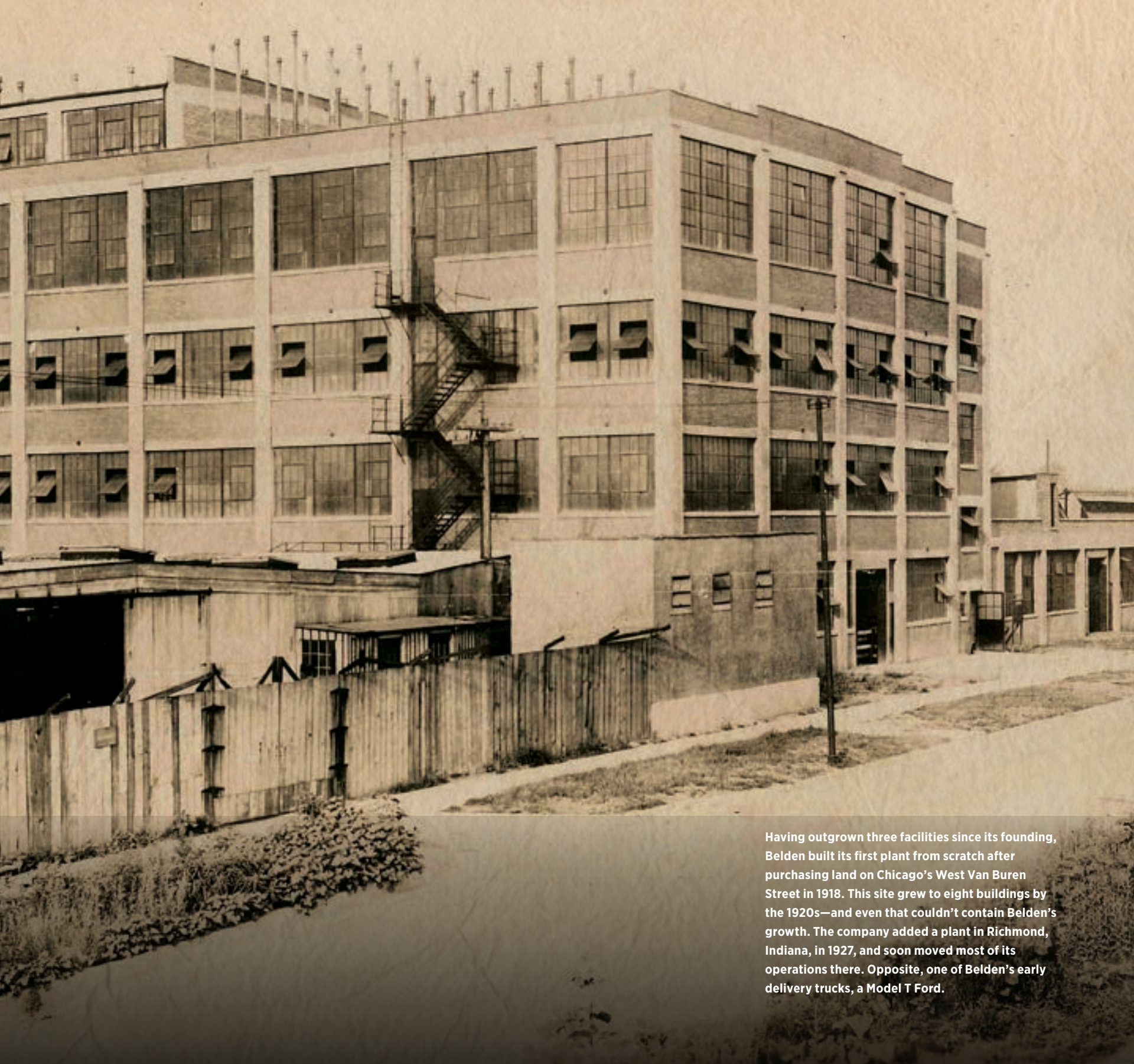
Joe Belden was one of the first Beldenites to receive a patent—two, in fact. Just like the company's present-day leadership, he was driven by market demands based on an emerging technology back in 1902 when he launched the business that still bears his surname. At the time, a Second Industrial Revolution was underway; with electric power newly available, American businesses were transforming into then-modern organizations. Joe Belden's natural curiosity, intelligence and ambition coalesced into a resolve to do his part to help those companies—and as he wrote in one of his journals, "We were enterprising enough to go after them."

Though Belden is a global enterprise spanning more than 30 facilities around the world, its success rides every day on the skill, passion and effort of 7,700 associates dedicated to their customers' success, to becoming better every day, reaching for greatness and playing to win. Above, Anita Bartkowska performs an audit before shipping connectivity products from Belden's plant in Neckartenzlingen, Germany.

CHAPTER TWO

Born Over a Beer

The bang, crash and deafening clatter of construction was a constant in cities and towns across America at the turn of the 20th century, as workers drilled into the ground and erected a forest of wooden utility poles, then strung them with miles of wire for telephone signals and electricity. Listening to the clamor outside his cramped office at Kellogg Switchboard and Supply Company in Chicago, Joseph C. Belden wondered what the future might hold.



Having outgrown three facilities since its founding, Belden built its first plant from scratch after purchasing land on Chicago's West Van Buren Street in 1918. This site grew to eight buildings by the 1920s—and even that couldn't contain Belden's growth. The company added a plant in Richmond, Indiana, in 1927, and soon moved most of its operations there. Opposite, one of Belden's early delivery trucks, a Model T Ford.

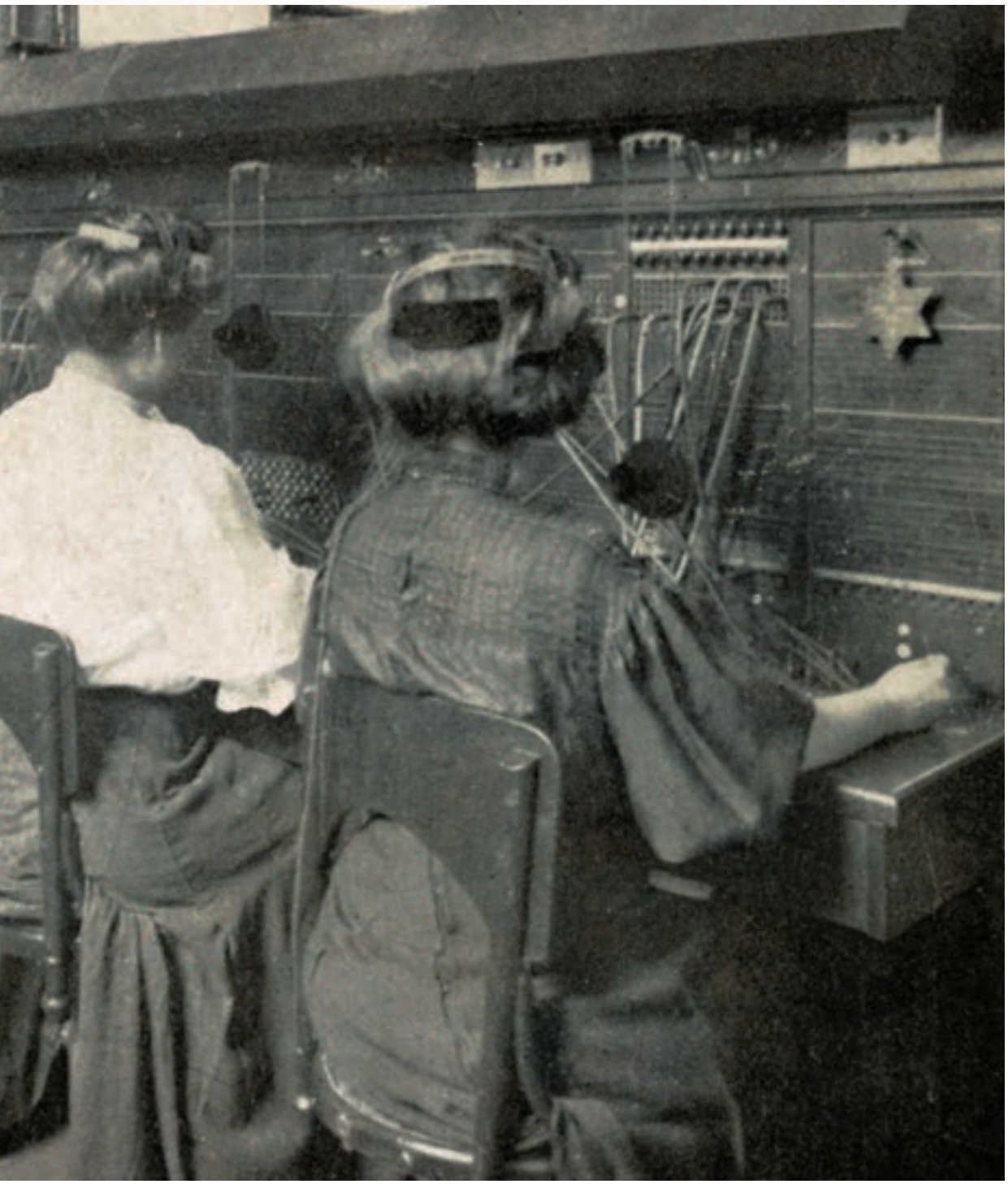
Belden was one of several purchasing agents at the five-year old manufacturer of telephone exchange equipment such as switchboards, which operators used at the time to manually connect one telephone caller with another. Kellogg was one of two companies in Chicago, Western Electric being the other, that supplied equipment to local telephone service providers like Bell Electric and General Telephone. Belden's job was to locate and buy parts for switchboards.

One essential component was extremely difficult to acquire, however: silk-insulated magnet wire, which was used to wind the relay coils in a switchboard's circuits. Demand for this wire far outstripped supply, and, struck by this fact, the 26-year-old mulled the idea of starting a business to pick up the slack. It was a huge gamble, he well understood. He had no idea how to make wire, but he believed he could figure it out.

"When you don't know something is impossible, it's easier to accomplish," he wrote in his unpublished memoirs.

Belden had graduated in 1897 from Yale University's prestigious Sheffield Scientific School, where he studied calculus, physics, chemistry, mathematics and civil engineering. Described by later colleagues as "modest and unassuming," he had tremendous faith in his business concept: he'd identified a clear need for a product, he anticipated that the market would be substantial, and he was confident in his abilities.

Serendipity intervened to push him into action. At lunch with a colleague one afternoon, Belden brought up his idea of launching a business to make insulated wire. The employee put him in touch with another Chicago native, Albert Beutler, who worked for Western Electric and had been the superintendent at the company's manufacturing plant in London, England. Beutler had not attended college, but he knew more about wire-making than men twice his age. As a 12-year-old boy, he had worked summer vacations in a machine shop, learning about wire-making processes like molding and extruding. Belden reached out to Beutler, and they agreed to meet.



"When you don't know something is impossible, it's easier to accomplish"

In the early days of telephones, switchboard operators like the women at left were needed to manually connect calls from one person to another. Crucial to the switchboards' operation was Belden magnet wire, which exchanged electrical energy with magnet energy. Opposite, a Belden sales catalog from the early 1900s advertised self-fluxing solders and insulated wire, such as the silk enameled wire beside it.

PORTRAIT OF A YOUNG MAN

Founder Joe Belden embodied many of the traits associated with great leaders of the early 20th century: a "can-do" optimism, strong writing and communication skills, practical business sense, and the foresight to prepare for economic upheaval.

Photos of Joe Belden throughout his life at the company often depict him in that most symbolic of business acts: just about to sign an important document, a fountain pen poised in his hand as he's interrupted by a photographer. A pen was an apt prop for Belden. He assiduously reported on the growth of Belden Manufacturing, his handwritten words typed up by an unknown assistant and later amended by him in ink.

Like many young men in the late 19th century, a time when most anything seemed possible in America, Belden dreamed of launching a modest business that would grow through the years by dint of hard work and ethical dealings. These were not idle dreams: he graduated in 1897 from Yale University's Sheffield Scientific School, one of the first institutions to teach applied science—the use of scientific methods to solve practical problems or achieve tangible goals, such as to create a product.

Feeling stuck in his job as a purchasing agent at a maker of telephone equipment, Belden and Albert Beutler met often at one Chicago watering hole or another, where they discussed these methods as they applied to the manufacture of insulated wire. Beutler worked in a machine shop and knew firsthand how to mold and extrude wire. Belden and Beutler made an odd pair—the college-educated, bespectacled thinker and the working-class craftsman, brought together over a stein of lager and an idea for a startup business.

People who knew Joe Belden often commented that he was "modest and unassuming" but possessed by a "strong tendency for the business to grow from the start." His "kindliness" and "consideration for others," they said, were balanced by such traits as "moral courage and integrity," "sincerity of purpose," and "honesty and fair dealing."

Belden's copious writings suggest that considerable intelligence was another of his traits. He understood, for example, the impact of geopolitical forces on supply and demand—a depth of economic knowledge likely beyond the grasp or interest of the typical purchasing agent. Belden Manufacturing, he wrote, would "sell on quality and not price." He also knew the limitations of a one-product business with a narrow market, and he made a point throughout his years of leadership to venture into product adjacencies and new markets—instilling the practice of constantly searching for what's next into the fabric of the company.

Despite appearances, he had a vibrant sense of humor and knew the value of color in his writings. He once wrote that a business conceived at such "dens of iniquity" as Hammer's Saloon "would not succeed in the story books." Unsatisfied, he took out his pen, crossed out the word "story" and changed it to "Sunday School books"—a far better turn of phrase. He then added another edit in ink: "We had little time or money to spend in saloons after operations were begun."

Belden's predisposition to lead a company that would "grow from the start" had sprouted.

"We met for half an hour after work in Hammer's Saloon on Adams Street," Belden recalled. "Sometimes we went to the old Bismarck Restaurant and had steak a la Bismarck and a stein of imported Pilsner. A business project in such dens of iniquity would not succeed in the Sunday School books, but it did not seem to make much difference with us one way or another."

Many other great companies were founded in similar fashion, the idea for the startup penciled out on a cocktail napkin. The men agreed that if Belden could secure $25,000 in capital, each would hand in his resignation, and they would combine their respective talents to get a new company off the ground. Belden drew from his slim savings, reached out to friends and business acquaintances for their financial assistance, and ultimately secured twice the needed capital.

On September 25, 1902, Belden Manufacturing Company was incorporated under the laws of the state of Illinois, with 26-year-old Joe Belden as president and Al Beutler as plant superintendent and, later, secretary. They rented the top floor of a five-story building at 116-118 Michigan Street in Chicago's Loop district to serve as a combined plant and corporate home office. The rent was an affordable $83.33 per month.

Belden focused his energies on the business side of things, recruiting employees to support the front-office sales organization and the back-office administrative functions. Beutler's focus was on the product. He designed and supervised construction of the plant and the installation of 10 magnet wire insulating machines, then hired machinists at 33 cents per hour to operate them. Manufacturing was rudimentary, to say the least. The building was not wired for electricity; power was furnished by a steam engine in the basement. Kerosene lamps hung from the ceilings lit the manufacturing floor and offices—barely.

Customers, breathless and panting

Business began modestly. One of the company's first purchases called for "two letter files, one ruler and pens as selected," wrote Jessie M. Cleveland, one of three women hired in a clerical capacity in 1905. "Apparently all were too busy to sit down until a few days later, when one office stool was ordered."

Belden's first office and plant, for roughly two years starting in 1902, was at 116-118 Michigan Street in Chicago, where the company rented the top floor.

Belden's Chicago offices in the early 1900s were not far from this downtown intersection, seen here congested by trolley cars, horse- and ox-drawn carts, and pedestrians. Albert Beutler, left, was an indispensable partner to Joe Belden in the launch of the company. Opposite, Belden moved from its original Michigan Street location to this six-story building on the same street in 1904; it's seen here circa 1908.

Cleveland described Belden Manufacturing's front-office operations as "casual." Clerks took orders by phone and then walked down the five flights of stairs to hand them to a shipping clerk at the ground-floor loading dock. It was not uncommon for the clerks to go up and down the stairs a dozen times a day. Customers who visited the office endured similar aerobic challenges—they were "breathless and panting" after trekking up "five dusty, dimly lighted flights of steep and dirty stairs," Cleveland wrote. Joe Belden also took phone orders and wrote them down on a piece of paper that he "stuck into his vest pocket. Sometimes orders were lost when he switched vests."

The weather in the Windy City, then as now, could be inhospitable. Streetcars, at five cents a ride to get employees to and from the plant, had straw on the floor "to keep passengers' feet from freezing," according to Cleveland. Joe Belden had a more comfortable mode of transport—his motorcar typically was the "only vehicle parked outside the plant."

The first month's orders totaled $520.36 (about $16,500 in today's money). Joe Belden himself packed and boxed the first order, which contained five spools of Belden No. 32 Single Silk Green magnet wire. The company delivered that box and all other products by horse and buggy to "large and small independent manufacturers of telephones … scattered throughout the Middle-West," Belden wrote in his reminiscences.

Six months after the company's founding, the small plant was operating at near capacity, producing some $5,000 worth of wire per month, albeit without a profit. To boost production, the board of directors in November 1903 increased Belden Manufacturing's authorized capital to $100,000. A few months later, Belden hired Newell B. Parsons as a salesman. Parsons, a salesman for a firm that made office furniture, had frequently called on Joe Belden at Kellogg Switchboard and Supply Company.

"I considered him [to be] one of the best salesmen [and] placed many orders with him," Belden said.

Parsons, who relieved Joe Belden from having to take telephone orders, proved so successful that he was made a vice president and member of the board of directors in 1904. That same year, the company moved to a rented, six-story building at 190-194 Michigan Street, a short distance from the original facility. Painted in large lettering on the façade above the building's first-floor windows were the words BELDEN MANUFACTURING COMPANY. Two floors above, a sign read ELECTRICAL WIRE AND CORDAGE.

"Hats use a lot of wire"

Although larger than the original, the new plant was not much of an improvement. The 100-by-50-foot building was poorly lighted, with windows only at the front and rear. Joe Belden had the manufacturing equipment installed on the top floor, where skylights provided better illumination. Occasionally, employees were "startled by the sound of gunshots," Cleveland wrote, pointing out that the county jail was located down the block and across the street.

Some offices were closer to street level, as they were situated on the third, fourth and fifth floors. Belden had sublet the basement and first and second floors to a wallpaper firm, "which lightened our burden of expense," he wrote.

By 1904, Belden Manufacturing's products included switchboard wire, telephone cords, rosin core solder for wires,

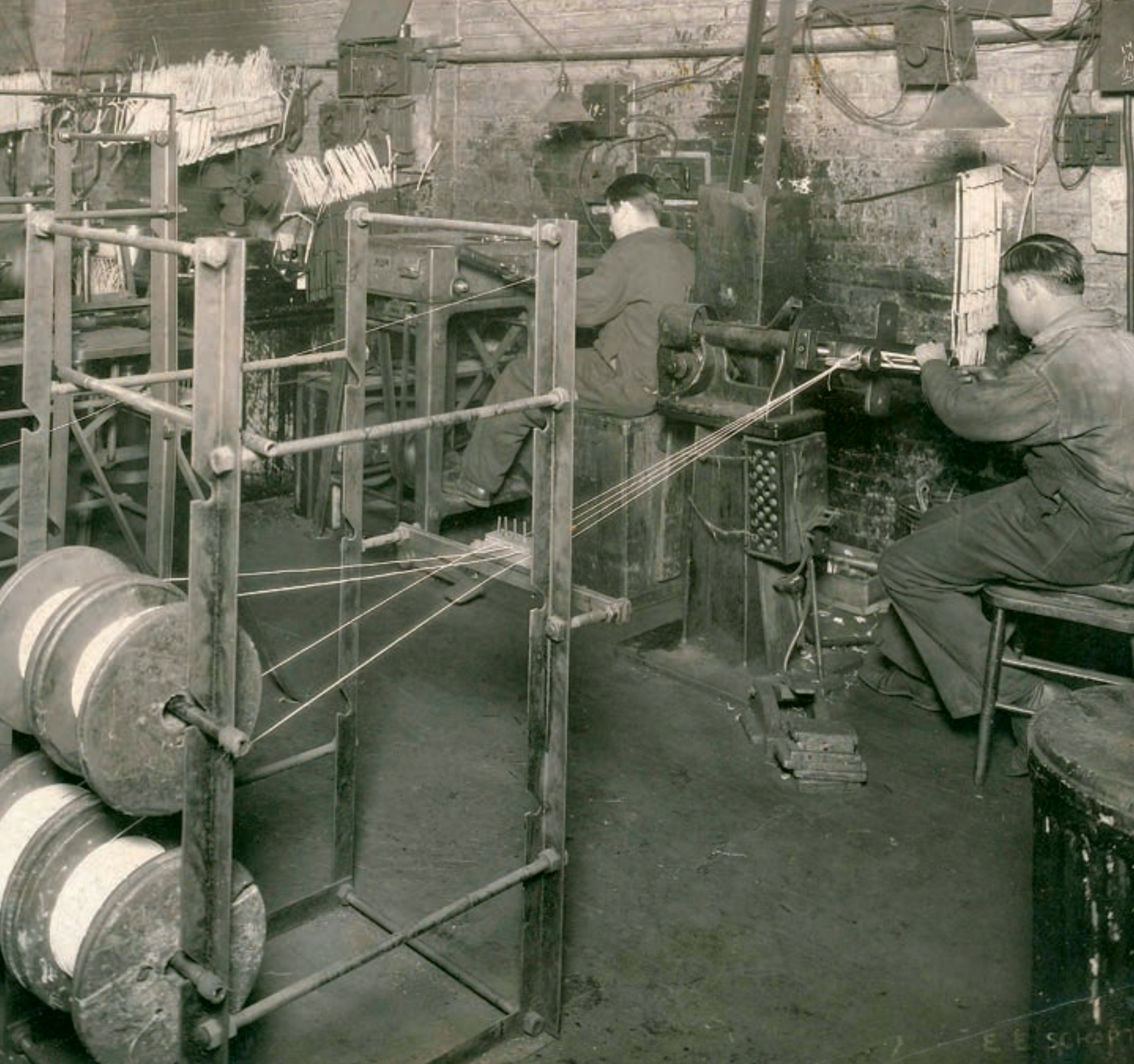
annunciator wire for electrical circuits, and telephone attachments. Among these last items was the Belden Handypad, a memo pad with a spring clip that users could attach to their desk phone or wall phone to write down important information. Belden and Beutler co-patented the pads. The *Chicago Daily News* bought thousands and printed the newspaper's banner on them for advertising purposes.

Another curious product was 20-gauge steel hat wire, shielded with cotton and a layer of dyed silk, that was sold to milliners to make hat frameworks. Belden wrote that "There was a large business of manufacturing the frames for women's bonnets in Chicago, and we thought we might apply our magnet wire experience to this line with some advantage, [making] our business more diversified. Hats with flowing plumes that women wore in those days used a lot of wire." Cleveland recalled that the standard colors for hat wire were black and white, "but we had one very choosy customer for whom we made a special run in red."

Belden exited the fashion business in 1906.

"Much of this new wire was used by small companies with no credit at all, either moral or financial," Joe Belden wrote. Some buyers blamed their monetary troubles on "the temper of the wire" and decided not to pay Belden Manufacturing, "leaving our stock obsolete and unsaleable," he groused.

As commercial trucks still do today, early delivery vehicles provided a high-visibility, moving canvas for advertisement. The Belden Manufacturing Company truck at left dates from 1910 or thereabouts, given the Western Avenue address, where the company was located from 1909 to 1918. Note the promotion of Beldenamel, the revolutionary product that changed the fortunes of Belden and the many industries it served. Opposite, the wire room at the Western Avenue plant, circa 1910.



"We decided we were not cut out for the hat wire business."

Other challenges emerged. The company's primary customers—local telephone equipment manufacturers—were not properly financed to withstand the Panic of 1907, the first worldwide economic recession in the 20th century.

"These companies went bankrupt by the scores," Belden wrote, noting that many were later absorbed by American Telephone and Telegraph Company. "Our sales to telephone manufacturers dwindled to almost nothing, and we were compelled to look elsewhere for … business."

Fortunately, two new markets picked up the slack: automobiles and electrical appliances. Every new product that had a motor needed wires—from electric fans and X-ray machines to vacuum cleaners and mass-produced cars and trucks, which used magnet wires for ignition coils. Every new device on the market "gave us an outlet," Belden wrote.

An assortment of Belden cable styles from the early 1900s.

Other wire manufacturers did the same, but few had Belden Manufacturing's quality standards and sheer inventiveness. A major problem at the time was the durability of insulated wires, which were inflexible and often broke. In 1908, Belden's researcher undertook experiments at the Michigan Street plant to develop a thinner, more elastic and less brittle wire insulation. Initial research focused on insulation made from enamel and cellulose. The tests failed to produce the desired properties.

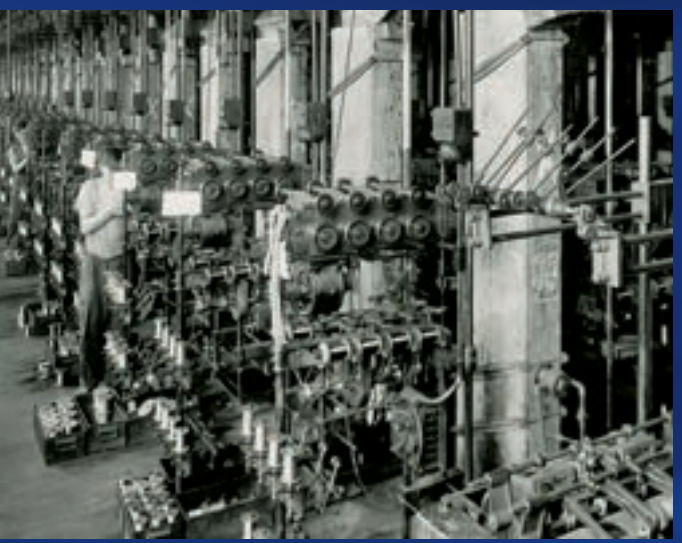
Varnish does the job

The following year, Belden hired British engineer Cyril A. Soans to assist the company's researcher, despite the fact that Soans had no experience in wire manufacturing. Soans requested Belden's permission to buy a variety of technical books on the subject of varnish manufacture, which "somewhat startled" the founder and other top executives like Beutler, since varnish was used to seal and protect wooden floors and boats.

Soans also reached out to the chief chemist at the Chicago Varnish Company for advice, and within a few months he had perfected an enamel insulation that achieved the intended goals in flexibility and durability—and was less costly to make than other wire coverings. Under the trade name Beldenamel, the revolutionary insulated wire altered the trajectory of diverse industries. For the first time, motors could be made much smaller, ushering in the development of uniquely American small home appliances such as toasters, sewing machines and electric kettles. The coils and transformers inside automobiles also could be made smaller without a commensurate loss in performance. Beldenamel marked such an advance that it became the industry standard for the next 40 years and enabled future refinements like ultra-fine-gauge magnet wire. It was an innovation that established Belden Manufacturing as the industry leader in applied research and product development.

Although business remained competitive, the company grew steadily, inking a profit of $26,860 on revenues of nearly $350,000 in 1909. Following the sale of 500 shares of stock later that year, the board authorized the rental of a six-story building at 2300 South Western Avenue that was nearly twice as large as the Michigan Street plant. Belden bought new manufacturing equipment, principally to make a new product line—rubber-insulated wire products for use as lamp cords, starter cables and portable cords for washing

ONCE MORE UNTO THE BREACH



Beldenamel put Belden Manufacturing Company on the map in much the same way as the Model T did with Ford Motor Company. Insulated with an enamel coating, the breakthrough wire offered greater flexibility and durability than competing wire to companies in diverse industries. Motors could be made smaller in appliances like toasters and sewing machines, allowing these appliances to be made small enough to appeal to consumers. The large number of machines in the enameled wire department in the 1920s, above, says something about the volume of business Belden was doing as Beldenamel became the industry standard.

Belden and its competitors were in a race to develop a new type of insulation for black magnet wire in the first decade of the 1900s. The stakes were high, as the thin layer of insulation on this copper wire used in the century's early home appliances and automobiles was fragile and easily breakable; cracked insulation exposed the wire, creating a risk of electric shock or fire. Whoever solved this problem would have the first shot at providing wire to manufacturers in a soon-to-explode American market for toasters, washing machines, sewing machines, vacuum cleaners and cars.

Belden was at the forefront of experiments to improve the insulation materials and performance of magnet wire. In his writings, Joe Belden recalled that the company hired "Mr. J. H. Lendi, formerly of the Western Electric Company, to make black enameled wire with various basic compounds of the nature of pitch. On several occasions, we thought a successful product had been developed, and a few thousand pounds of wire were manufactured and placed in stock."

Regrettably, after a few weeks, the insulation became hard and brittle.

"On picking up a spool of enameled wire, a crackling caused by pressure from the fingers could be heard, indicating [the] wire must be scrapped," Belden wrote. "This was discouraging."

As the old adage says, "If at first you don't succeed, try, try again," and that's what Joe Belden did. He recruited a Mr. A. D. Whipple, who, Belden wrote, "undertook to cover the wire with a cellulose film which could be dyed green, red or any color." While coloring the insulation provided a product enhancement that would help electricians forever easily determine which wire was which, the "experiments were unsuccessful, the work was discontinued, and Mr. Whipple left our employ," Belden succinctly stated.

The company gave it yet another try. In 1909, Belden hired British engineer Cyril A. Soans to do what his predecessors could not. Ultimately, he succeeded in perfecting an extremely flexible and durable enamel insulation, a compound based in part on the composition of varnish, thanks in no small part to Soans' "conversations with the Chief Chemist at the Chicago Varnish Company," Belden wrote.

Belden gave the insulation the trade name Beldenamel. Its development delivered the performance required and gave Belden the competitive difference its founder sought. In addition to making magnet wire less susceptible to breakage and safer to use, Beldenamel was less expensive to manufacture than extant enameled magnet wire. Virtually overnight, makers of small home appliances, and the manufacturers of coils and transformers used in motorcars rushed to buy the new wire.

Sales and profits soared at Belden in 1909 and for several years thereafter. As Joe Belden put it, "Substantially [and] without change, [Beldenamel] is the basis ... on which so much of the company's success has been based."

The development of wireless telephony—communication through space with no fixed or physical connection—required the use of magnet wire, which Belden sold to the military during World War I. Wrapped around the coils in headphones and radio receivers, the wire enabled aviators flying warplanes to communicate with ground troops. Opposite, Belden was a regular advertiser in *Aero Digest*.

machines. Another set of machines made Bakelite, a hard plastic that was molded into caps for telephone receivers and gearshift knobs for the Dodge Brothers' motorcars.

"Like nothing ever experienced"

In 1914, the countries of Russia and Britain—allied in support of Serbia in the first battles of World War I against Austria-Hungary and its backer Germany—mysteriously ordered several tons of Belden's magnet wire. At first, Joe Belden couldn't understand why the countries needed so much wire, but the secret eventually leaked out: they'd figured out how to communicate wirelessly between the ground and their warplanes.

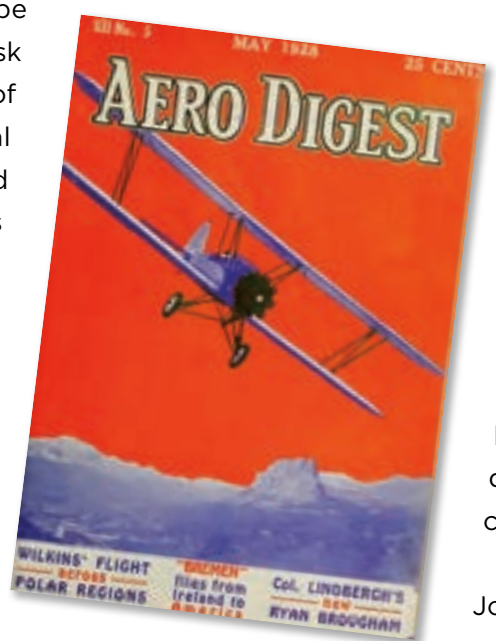
"Wireless telephony was then considered an inventor's dream," Belden wrote, "but it was learned that wireless telephone communication with airplanes had been accomplished. … [Our] wire was required to wind the coils of the head receivers. … Orders for both civilian and war needs from the combatant countries began as a trickle and soon was a roaring torrent."

Virtually overnight, the Belden name had become synonymous with product innovation and quality, particularly in addressing customers'

complex requirements—a company hallmark that remains true today. Revenues nearly tripled over four years, reaching $900,000 in 1917.

"Conditions during the last 12 months have been like nothing ever experienced by anyone connected with our sales department," the January 1917 issue of *Beldenews*, the company's employee magazine, declared.

The following year, the board authorized the purchase of a 153,550-square-foot parcel of land at 4647 West Van Buren Street to construct the first two of what were expected to be several manufacturing and office facilities. The days of renting floors of space would soon be gone forever. Belden began the laborious task of moving the equipment, including a set of new machines that made cotton electrical tape, which was used for coil coverings and for wrapping the cables inside the motors of electrical appliances.



On April 2, 1917, the United States entered the war in Europe. Belden provided wire and cords to the U.S. government for war-related applications like motorized transport and field telephone transmission. There were several orders for one-mile-long wires without splices. The new tape-making machinery produced webbing for military harnesses and belts.

When the Armistice was signed ending the war in November 1918, the company received a flood of orders that had been held back by the conflict. In addition, products Belden had developed for wartime use found commercial application in two markets new to the company: aviation and radio. Radio receiver pioneer RCA came calling, as did major aircraft manufacturers including Boeing and Curtiss Aviation.

In a May 1928 advertisement in *Aero Digest and Aviation* magazine, the company boasted that the "nation's air hero, Colonel Charles A. Lindbergh," used Belden wire "throughout for navigation lights, landing lights, electric starter and all other low-tension wiring." The previous year, Lindberg had successfully flown across the Atlantic Ocean from New York to Paris, becoming the first pilot to solo a nonstop transatlantic flight.

A new decade dawned, one that promised extraordinary economic growth based in large part on a new level of consumerism. American companies that mass-produced consumer goods like automobiles, vacuum cleaners, refrigerators, washing machines and radios enjoyed exceptional prosperity. So did their key suppliers like Belden Manufacturing, which booked more than $1 million in business in 1920. "But much more had been turned away," Joe Belden wrote.

To accommodate the great influx in orders, the Van Buren plant grew to eight buildings. Though they operated night and day, the company still couldn't satisfy its customers' demands.

"We were literally swamped by orders," Joe Belden recalled. The supply-demand ratio was so out of whack that Belden feared the onset of inflationary prices reaching "unreasonable and absurd heights. We were offered business which we could not deliver for many months [and] found ourselves obligated for materials for future delivery of upwards to a million dollars, far more than we ever held before. … This situation could only have one ending."

He didn't expect it to be a good one.

A Belden employee rolls a giant spool of cable down a corridor in Belden's stockroom during the 1920s. Opposite, a spool of #28 wire from the 1930s, carrying an apparent price tag of 25 cents.

CHAPTER THREE

Move Forward or Lose Ground

The first two years of the Roaring Twenties did not roar for many American businesses, Belden Manufacturing Company among them. Fourteen months after the end of World War I, an abrupt and severe recession, marked by the largest drop in wholesale prices since the American Revolution, gripped the United States and other countries.

Demand for Belden's wire, cable and cord products was as robust as ever, but margins were squeezed by the increased purchasing power of the currency. As Joe Belden wrote, "While a very large volume of business was done," it produced "very limited profits." The rapid onset of the bust of 1920-1921 caused Belden to mull in his writings about the harsh lessons he learned: "In each boom, a different set of conditions exist which make boom conditions look like permanent normal conditions. Trees never grow to the sky. Under boom conditions, a conservative policy must be followed."

The silver lining of the 18-month recession was a lasting demand for the company's products, in both established markets and newer ones like radio broadcasting. In November 1920, the world's first broadcast from a licensed radio station announced that Warren G. Harding had won the presidential election in a landslide. Overnight, radio stations sprouted like mushrooms across the nation.


Belden Radio Products

Beldentenna

A 7-Foot Combination Radio Antenna and Extension Cord

For radio stations to transmit electromagnetic waves to consumers' radios, the stations as well as the radio manufacturers needed low-tension cable, aerial wire and magnet wire. Belden made all three products and found a foothold selling directly to the manufacturers of broadcasting equipment, to radio stations and to the makers of radios. Belden also sold radio parts to "jobbers" in the nascent industry, marking the beginning of Belden's wholesale distribution arm.

Meanwhile, business in the automobile and electronics sectors continued to grow. Few wire makers were as highly regarded or as well known in the electronics industry as Belden Manufacturing, so it was not unusual for Joe Belden to receive a personal letter requesting 1,600 pounds of covered enameled wire in early 1920. What was uncommon and unexpected was the letter's writer—Thomas Edison.

"On this slender thread often rests the fate of men and battles"

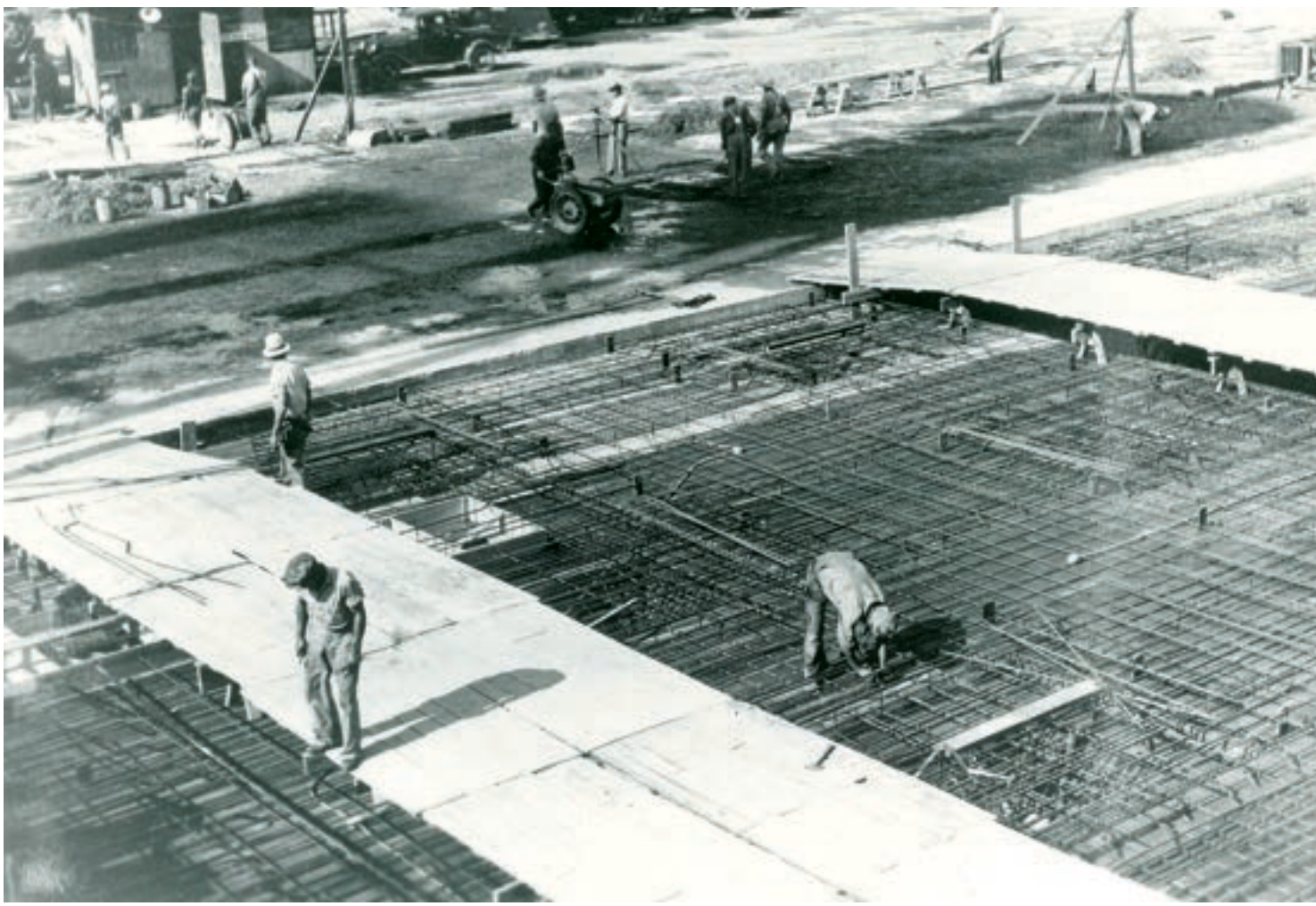
"For many years we have specified `Belden' for all magnet wire and now must look to your firm for relief in a very serious shortage," the great inventor wrote from his laboratory in Orange, New Jersey. "I feel sure you will, in some way, manage to accommodate us. I will not forget the favor." Joe Belden complied, and he preserved the letter as a keepsake; it is now framed and on display in the lobby of Belden's St. Louis headquarters.

The company's expanding reputation for manufacturing the highest-quality products attracted new markets in Western Europe beyond Great Britain. International business, done through the Foreign Sales Department, "proved quite successful," as Jessie Cleveland wrote in an issue of *Beldenews*.

New plant in Indiana

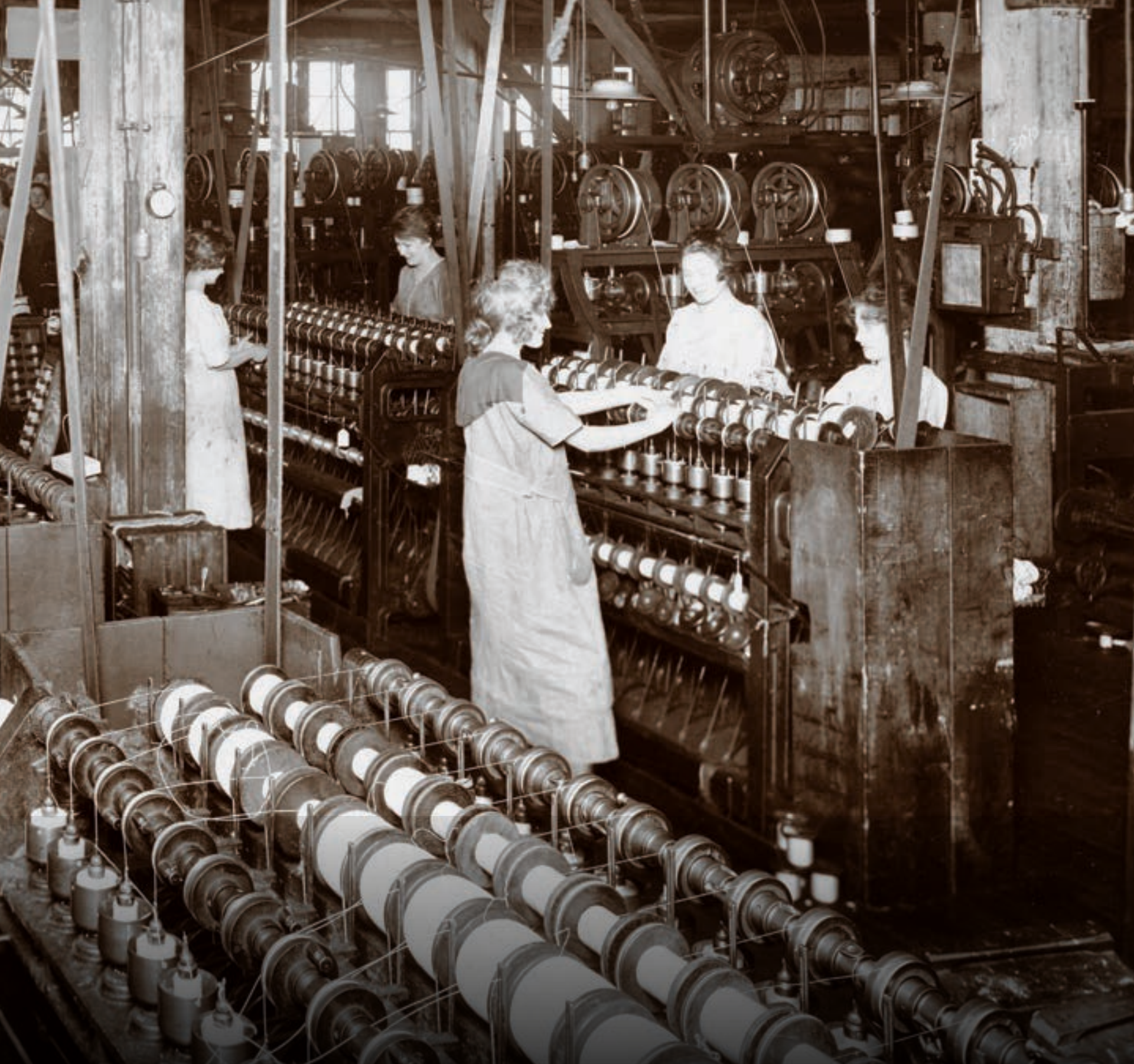
By the middle of the 1920s, Belden Manufacturing was profitable again, but the Van Buren Street plant in Chicago couldn't keep up with demand despite recent expansion. Belden established a committee in 1925 to evaluate sites in Chicago for a plant exclusively for the manufacture of rubber-covered electrical wire. A desirable location was elusive, as the city overflowed with manufacturing, and vacant industrial space was scarce.

The committee turned its attention then to other sites in Illinois, as well as in Indiana and Michigan. After months of research, the team told President Belden and the board about a 27-acre parcel in Richmond, Indiana, that would meet the company's present needs and provide ample room for future growth. The superb living conditions, school and park systems, and deep labor pool of the small city of about 26,000 people 250 miles southeast of Chicago were added plusses.



As radio stations popped onto the air across the country in the 1920s, consumers needed home antennas to capture the signals. Belden capitalized by introducing the Beldentenna, opposite, an innovative product that combined a radio antenna with an extension cord. Belden's growth took it to Richmond, Indiana, where it began construction of a new facility, right, in 1927.

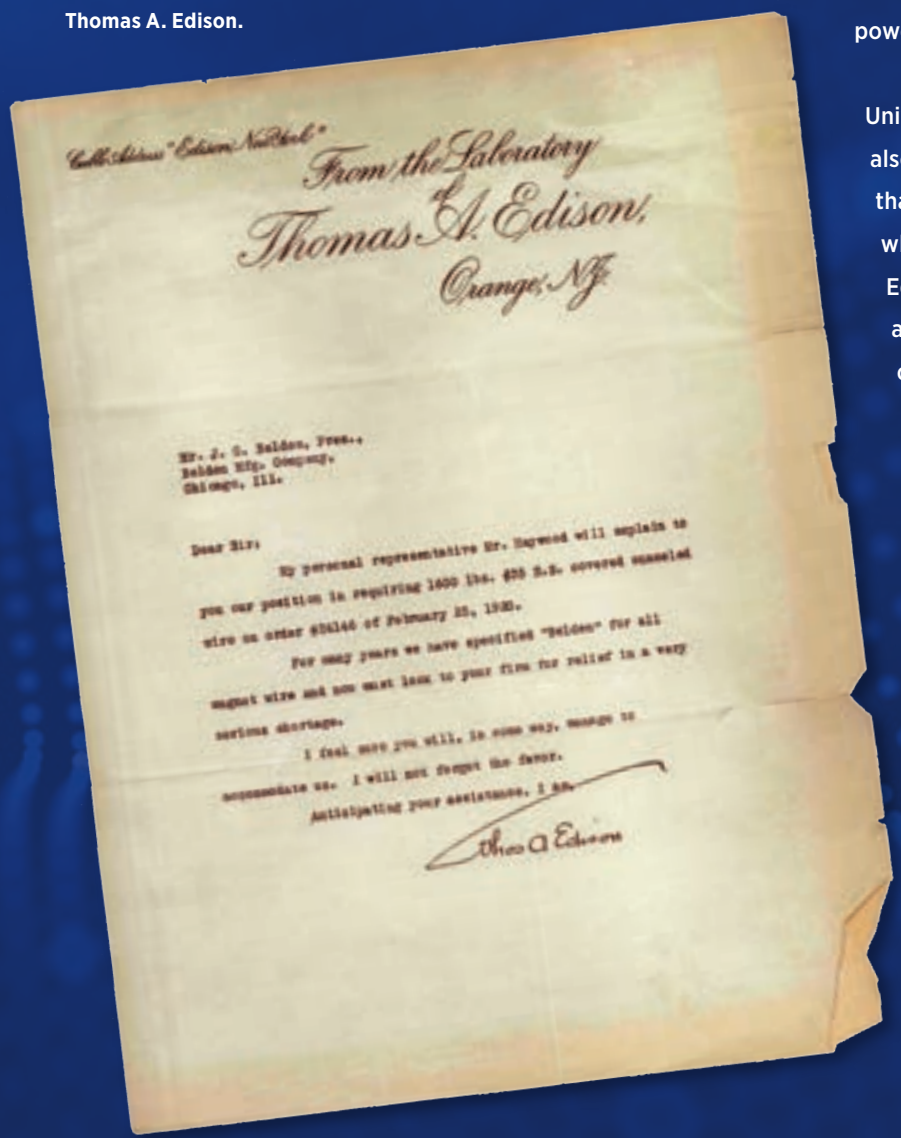
Women have been a mainstay of Belden's workforce since the company's earliest years. In this photo from the 1920s, an all-woman crew operates machinery in the magnet wire department.



A BRUSH WITH GREATNESS

Every successful leader needs a role model, an inspirational figure to emulate. Joe Belden's was a heroic figure of great stature, an American inventor and businessman whose innovations changed how people lived: Thomas Alva Edison.

Across his long life, Edison acquired a record 1,093 patents, singly or jointly. His inventions ranged from such conveniences as the first practical and affordable electric light bulb, motion pictures and the phonograph to the first commercial fluoroscope for X-ray examinations and the country's first electric power grid.


From the Laboratory of
Thomas A. Edison,
Orange, N.J.

Mr. J. G. Belden, Pres.,
Belden Mfg. Company,
Chicago, Ill.

Dear Sir:

My personal representative Mr. Dagwood will explain to you our position in requiring 1600 lbs. #35 B.S. covered enameled wire on order #26146 of February 25, 1930.

For many years we have specified "Belden" for all magnet wire and now must look to your firm for relief in a very serious shortage.

I feel sure you will, in some way, manage to accommodate us. I will not forget the favor.

Anticipating your assistance, I am,

Thos A Edison

Few historical items hold as much significance for Belden and its founder Joe Belden as this hand-signed letter from American inventor and industrialist Thomas A. Edison.

It's possible that Joe Belden came across Thomas Edison at Yale University's Sheffield Scientific School. Edison's son William Leslie Edison, also an inventor, graduated three years after Belden did. More certain is that the largely self-educated Edison's inventions were studied at Sheffield, which applied scientific methods to the development of products. Edison's name appears sporadically in Belden's writings along with that of another great industrialist, Henry Ford, also self-educated and Edison's close friend.

Joe Belden may never have met Thomas Edison, but he did have the pleasure of corresponding with his hero. In the first year of the economic boom known as the Roaring Twenties, a period when demand for enameled wire rocketed and resulted in scant supply, Edison wrote a personal letter to Belden asking for assistance. Noting that Thomas A. Edison, Inc., had long specified Belden for magnet wire, he asked Joe Belden to accommodate his company during a severe shortage—and for that, he said, "I will not forget the favor."

The letter was signed, with a flourish, "Thos A Edison." Belden supplied the wire, and whether or not Edison returned the favor is lost in the dustbins of history. What is known is that by the 1960s, the great General Electric, founded as Edison General Electric, was one of Belden's biggest customers. By then, both men had passed away, but Joe Belden would have appreciated this worthy twist of fate.

In 1927, a modern, one-story plant with 80,000 square feet of floor space rose on the property, and production began the following year under plant manager Walter Rudolphsen. To maintain uninterrupted service to customers, Belden executives and employees from Chicago trained 300 new hires in Richmond in how to operate and maintain the plant's equipment. Products initially made in Richmond ranged from insulated starter cables and headlight wires for automakers to small Bakelite parts, electrical cords and hard rubber cord-attachment plugs for appliance manufacturers.

Back at the Chicago plant, chemist and research engineer Hugo Wermine was engaged in finding a new material to replace the hard rubber plugs, which were prone to breakage, resulting in costly service calls by appliance repairmen. Wermine experimented with other cladding materials like Bakelite, porcelain and metal. He subsequently developed and patented a compound for a soft rubber plug, a breakthrough that took the electrical industry by storm and burnished the company's reputation for innovation.

"[The new plug] has been accepted by the majority of manufacturers of high-grade electrical equipment as having a distinct advantage over the old type of plug," Joe Belden wrote. In 1940, the National Association of Manufacturers honored Wermine with the Modern Pioneer of the Frontier of American Industry award. The inventor chalked up an impressive 33 patents during his career.

The construction in 1929 of a new, 60,000-square-foot building gave the Richmond plant 140,000 square feet of floor space, and most of the company's manufacturing operations were moved from Chicago to Richmond. That left the Chicago plant to manufacture primarily magnet wire and enameled wire.

Belden's administrative offices remained in the Windy City to take advantage of the proximity to large customers. The company built a new headquarters at the corner of West Van Buren and Kilpatrick streets in 1930, on the land at 4647 West Van Buren that the company had acquired in 1918. The modern structure featured air conditioning, a cafeteria, soundproof ceilings, and—unlike many of the company's former environs—it was exceptionally well lit. Employees were provided with benefits such as group life insurance in 1931, and group accident, sickness and hospitalization insurance in 1939. The company established a retirement pension plan for employees in 1941.

The cure for Corditis

The company's print advertisements of the 1930s emphasized consumer convenience. Belden ads in *Time* and *Good Housekeeping* magazines claimed that Hugo Wermine's invention of the soft rubber electrical plug had saved the world from "Corditis." The ads described this as "a dangerous disease of electrical cords: the symptoms are frayed wire and broken plugs. It causes severe mental irritation and violent nervous disorders among electrical appliance users." One portrayed a group of executives as doctors working on a patient suffering from Corditis. The company also promoted Belden Floor Cords—inexpensive, flat extension cords of six feet to nine feet in length—for reducing the number of electrical outlets needed in homes.

"It lies flat under the rug!" one ad gushed. "No tools needed—Brings

More Than Just a Job

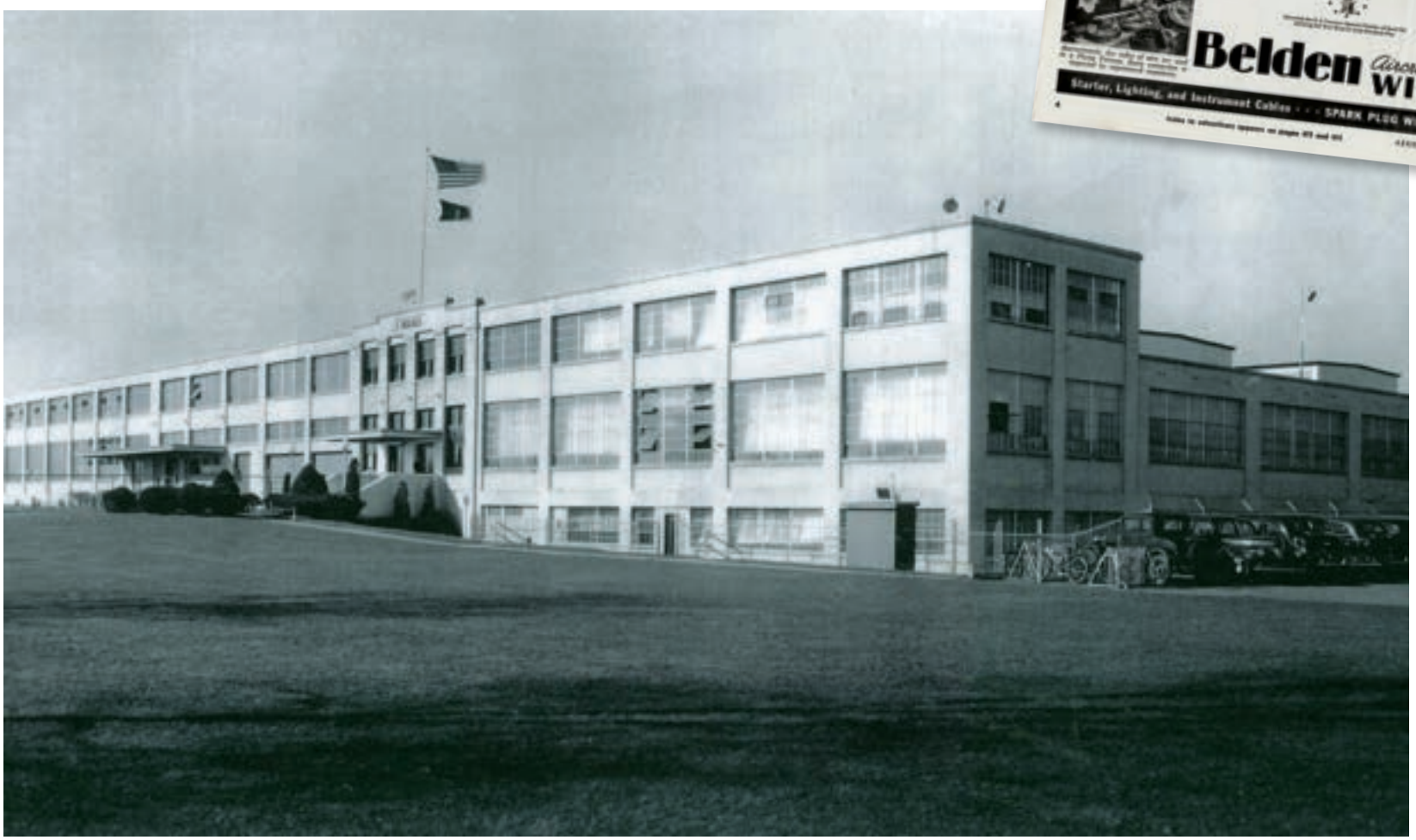
Belden has always been a company that encouraged its employees to form and maintain social bonds with one another outside the workplace, and it has provided a range of opportunities for them to do so. This was especially true in the first half of the 20th century in “company towns” like Richmond, Indiana, where Belden had its largest manufacturing facility from 1929 to 1973.

In the 1940s, Belden’s recreational programs included, clockwise from top left, men’s golf, dances and parties, women’s bowling, men’s baseball and women’s softball.

the new outlet where you want it—Move it as often as you wish."

Other advertisements extolled the benefits of Belden Shielded Aircraft Cable, used by major airplane manufacturers, including Boeing, Fokker and Curtiss, for radio communications. Ads in *Aviation* magazine touted the history-making (but now controversial) 1926 flight over the North Pole by Commander Richard Byrd, whose plane, the Josephine Ford, relied on Belden aircraft cable. "Another Outstanding Triumph," the ads crowed. (Byrd became a

Belden wire was instrumental in the safe operation of aircraft in the 1930s and '40s, and with the start of World War II, Belden promoted its products as "another example of the way American ingenuity is defeating dictatorship." Belden opened its Richmond plant in 1927 and expanded it in 1929 and, below, again in 1936.



Automotive aftermarket products became a company mainstay in the 1930s, as Belden battery cables and sparkplug wires became industry standards. Belden salespeople showed customers their products in colorful sample cases that graphically mapped their use by location on the car, and auto parts stores displayed Belden-branded products prominently.

national hero after he and co-pilot Floyd Bennett claimed to have flown over the North Pole, but evidence in Byrd's diary 70 years later seemed to indicate that the pair turned back short of the pole because of an oil leak. Nonetheless, Byrd's esteemed place in aviation history was sealed with his undisputed first flight over the South Pole in 1929 and his establishment of a U.S. base in Antarctica that same year.)

Nineteen-twenty-nine was also the year that Belden entered the automotive aftermarkets business. Print advertisements in automotive magazines encouraged readers to reach out to "Beldenjobbers" to buy Belden-branded ignition sets, battery cables and spark plug wires "built to car manufacturers' equipment standards," with resistance to "moisture, oil, corrosion, heat, vibration and corona." Other ads warned against the risks of buying "cheap spark plug wires" or "featherweight battery cables."

By serving both the automobile original equipment and replacement parts markets, Belden enjoyed demand for its products even during business downturns. When new car sales slacken, motorists tend to buy more battery cables and ignition sets in the aftermarket, where the profit margins are better than in the original equipment manufacturer (OEM) market. In 1932, the company solidified its place in the auto parts aftermarket by signing a major distribution agreement with the National Automotive Parts Association (NAPA), becoming NAPA's exclusive provider of replacement automotive wire, cord and cable products. Founded in 1925 to improve the distribution of aftermarket auto products to service shops and the driving public, NAPA immediately became Belden Manufacturing's single largest customer in the automotive industry.

Innovation flourished at Belden throughout the 1930s. In 1932, Gustav Andre patented the world's first automotive lead battery terminal, reducing if not eliminating the problem of corrosion from escaping battery acid. The battery terminal was among the many Belden products successfully marketed by NAPA.

PROFILE OF AN INNOVATOR

Richard Hirschmann, Industrial Automation

Richard Hirschmann, the founder of Hirschmann Automation and Control, invented the banana plug, a single-wire, two-part connector used for joining wires to electrical equipment, in 1924. Almost a century after its invention, the connector remains widely used in laboratory, workshop and industrial settings, as well as in the cabling of audio equipment and networking components.

Hirschmann's first banana connector was a compact plug with copper electrodes and Bakelite insulation; designed for heavier wires and higher-voltage requirements, it had banana-peel-shaped prongs that provided a strong grip on sockets. Starting his company in the same year he developed the plug, Hirschmann assembled and shipped the first products from the kitchen of his home in Germany. He patented the device in 1926 and updated it three years later.

Hirschmann's revised design simplified the connector, eliminating a small screw that held the wire in place, improving reliability and revolutionizing networking components. Offering thousands of different kinds of plugs, switches, antennas, networking and connecting devices, Hirschmann Automation became a household name in the connector, automotive and electronics industries. Belden acquired the company in 2007.

At the Richmond plant, Hugo Wermine experimented with the use of a new synthetic rubber compound, neoprene, invented by DuPont. Neoprene's properties included greater durability, flexibility, corrosion-resistance and high-temperature tolerance. These attributes made the substance a superior wire-insulating compound over natural rubber. In 1934, Belden introduced the first automotive wires insulated with neoprene for use in buses, trucks and tractors—which must operate reliably in severe weather. Two years later, Belden was among the first companies in any industry to acquire a continuous vulcanizer, which in a single operation hardened, extruded and reeled portable wires and cords onto spools.

The process of vulcanizing rubber to strengthen the material and provide greater resistance to swelling and abrasion, as well as increased tolerance of temperature ranges, had been invented by Charles Goodyear in 1839; a patent on the continuous vulcanizing machine acquired by Belden had been approved in 1934. The company constructed a new facility, Building No. 3, at the Richmond plant to house the new equipment, which reduced processing times from hours to minutes.

Braided auto battery cables, above, were among Belden's best-selling products in the 1930s and '40s. Opposite, Belden touted the benefit of "extra electrical outlets where you need them" in a series of 1930s ads for the Floor Cord, which "lies flat under the rug."

'Great loss to the whole business world'

Although the Great Depression caused Belden "three years of serious losses," the company "met and weathered" them by the middle of the decade. When so many other businesses foundered, Belden's sound management, diversified product lines, and expansion into the automotive and electrical replacement parts markets kept it sailing through turbulent times.

"When the upturn in business came, the plants and office force were ready to handle the demands made upon them," Jessie Cleveland wrote. These demands included the need to rush deliveries to customers on the East Coast; otherwise, the company risked losing business to wire, cable and cord manufacturers based there. In January 1935, Belden opened a branch plant in Philadelphia. It manufactured power supply cords and carried a complete stock of magnet wire in all sizes and insulations to provide rush deliveries to customers when necessary, enabling the company to match the service offered by the Eastern manufacturers.

In January 1939, Belden became a publicly traded company for the first time when its shares were listed on the Midwest Stock Exchange. The occasion was a personal triumph for the man who had founded and adroitly guided the company for the previous 37 years. Joe Belden was only able to savor the achievement for a short time, however; he died in his sleep just a few weeks later, on February 17, at the age of 62.

"The death of our beloved President," Cleveland wrote in *Beldenews*, "was a great loss—not only to his family and the Belden Manufacturing Company, but also to the whole business world, especially the wire industry."

Whipple Jacobs was appointed to succeed Belden as president. He had started working at the company as a temporary clerk in 1914, earning $9.10 a week. It was an inauspicious beginning that made him a firm believer in the power of individual and collective effort.

"Any measure that makes for better employee morale and contentment is reflected in better production records, fewer rejections [and] better products," Jacobs once said.

Products 'fighting on all fronts'

As war clouds gathered again in Europe, the United States was on the verge of becoming what President Franklin D. Roosevelt (FDR) described in a December 1940 speech as a "great arsenal of democracy." Though the country was officially neutral at this point in World War II, Congress authorized lending or leasing military equipment to American allies fighting the Axis powers. The United States geared up to send American-made tanks, trucks, Jeeps and battleships primarily to Great Britain at first, and all those vehicles needed wires, cords and cables—which Belden supplied. To meet demand, Belden enlarged the Richmond plant by 31,000 square feet in mid-1941.

In 1939, Belden became a public company for the first time, following the listing of shares on the Midwest Stock Exchange, the largest regional stock exchange in the United States at the time.

GROWTH AT RICHMOND

From the building of the first Belden plant in Richmond in 1927, the company embarked upon a series of expansions that increased the original 80,000 square feet to about a half-million square feet of floor space by 1968. Above, an unidentified Belden executive rehearses the presentation of a 1940s-era expansion plan.

When Belden's senior management decided that additional manufacturing space was needed to accommodate the growing demand for rubber-covered electrical wire in the 1920s, an internal committee was formed to look at available properties. The committee was advised to find a location with enough acreage to support future growth and an available workforce with a strong work ethic. Richmond, Indiana, met the need.

The team found a 27-acre site about a mile northwest of downtown Richmond, a city then of about 30,000 people some 75 miles east of Indianapolis and not far from the Ohio border. Richmond had been settled in 1806 by Quaker families from North Carolina, and it was all but predisposed to growth, given its location on the National Road, frequented by thousands of pioneers heading west, and on the bank of the Whitewater River, where access to hydropower was relatively cheap and easy. Richmond became a manufacturing center as the country industrialized and was once known as the "lawnmower city" since several early manufacturers of lawnmowers set up shop there.

Belden opened its first facility in Richmond, dubbed Building No. 1, in 1927. A one-story, modern factory with 80,000 square feet of floor space, it housed manufacturing for Belden's rubber-insulating lines, cords and molded rubber products, much of this output for use in home appliances. In that same year, Richmond's Gennett Recording Studio recorded the American jazz standard, "Stardust," by composer Hoagy Carmichael. Thereafter, a parade of jazz giants including Louis Armstrong, Jelly Roll Morton, Bix Beiderbecke and others rushed to the studio, whose acoustics were considered to have no equal. Before long, Richmond was called the "cradle of recorded jazz."

A parade of a different sort—expansion—took place at the new Belden plant. In 1929, the company added 60,000 square feet, and other additions soon followed: 33,600 square feet in 1936, 31,000 square feet in 1941 and 14,000 square feet in 1943, for a total of 218,000 square feet during World War II. The space was added in 1941 and 1943 to accommodate the U.S. military's wartime production needs at a time when all of Belden's capacity was dedicated to the war effort.

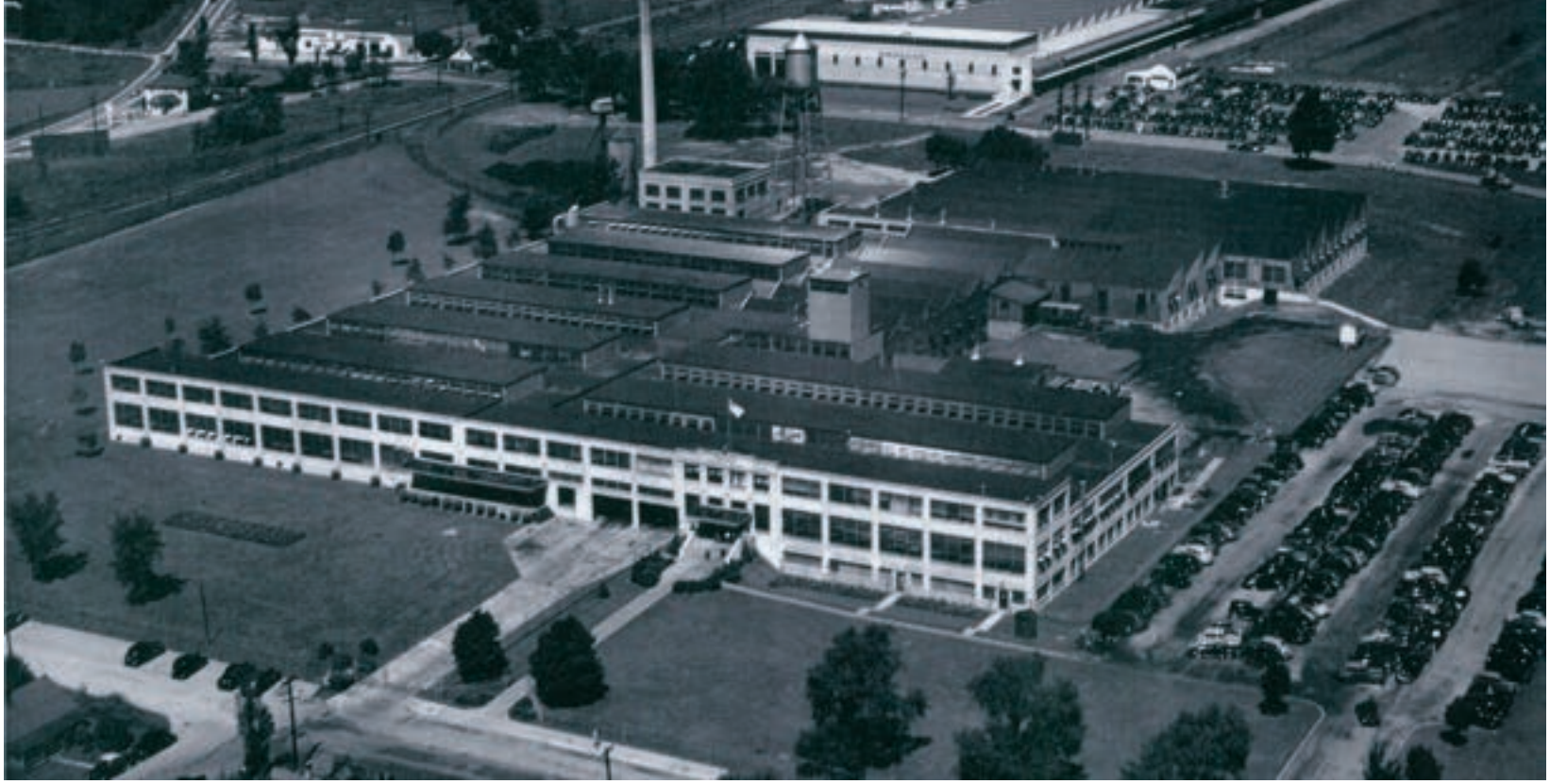
As the American economy roared back to life after the war, the plant continued to grow. Between 1947 and 1965, several other buildings were erected, more than doubling its wartime size. Employment grew as well, rising from about 850 people in 1948 to a peak of around 1,500 in the 1960s before retreating to 700 in 2002. About 400 people work there today.

Belden's 1941 annual report opened with a testament to the essential work the company was doing to support the Allied effort in World War II. Millions of feet of Belden wire was used to transmit electrical energy in battle equipment on land, on the water and in the sky. Opposite, the Richmond plant in 1947, its roof still darkened for wartime camouflage.

A few months later, on December 7, Japan's Navy Air Service attacked the U.S. Naval Base at Pearl Harbor, Hawaii, prompting Congress at FDR's urging to sign a declaration of war against Japan the following day; Japan's allies, Germany and Italy, responded by declaring war on the United States. Belden's products were soon in great demand "on land, sea and in the air," Jessie Cleveland reported in *Beldenews*, noting that the company's plants in Richmond and Chicago were "running 100 percent on war products." Operations were at full capacity.

"BELDEN Wires and Cables are Fighting on All Fronts," the back cover of the company's 40th annual report in 1942 boasted. Indeed, the military relied on the company for a vast range of products for aviation, maritime and land-based operations. With the United States fully engaged in the war, Belden's products now went into submarines and airplanes in addition to surface ships, tanks, Jeeps and trucks. They helped power all sorts of motors, generators, radios, walkie talkies, control coils and relays.

To accommodate the surging demand, Belden added another 14,000 square feet to the Richmond plant, bringing it to a total of 218,000 square feet. Employee productivity at both plants increased thanks to enhancements in machine capacity, material-saving techniques and more efficient manufacturing processes. In addition to supporting the war effort through manufacturing, Belden carried out what the *Richmond Sun-Telegraph* described in 1945 as "continuous research and engineering" at its laboratories—turning out new products that were crucial to victory. They included synthetic insulations made from plastics and other novel chemical compounds like vinyl, nylon and neoprene—each with its own set of unique properties. The company branded the new wire products as Beldure, Beldsol, Nyclad, Formvar and Celenamel. Replacing Beldenamel, Celenamel was the



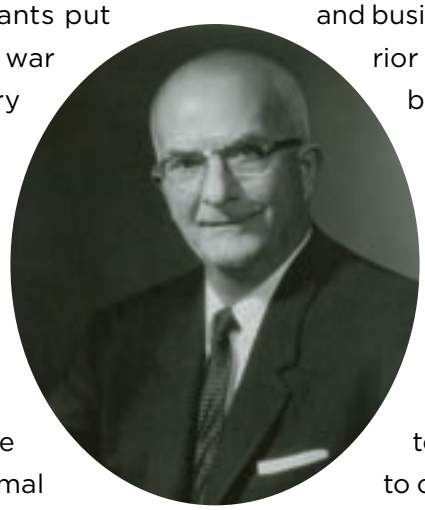
industry's first solderable enamel compound.

"Belden … is producing literally hundreds of millions of feet of wire ranging in thickness from half the width of a human hair to sturdier strands, to transmit the electrical energy for battle equipment," the *Sun-Telegraph* reported. "An insulated electrical wire may seem a tenuous and delicate object, yet on this slender thread often rests the fate of men and battles."

Distributors and other buyers of the company's products applauded its efforts during the war. Rodefield, a distributor of Belden automotive wire and cable, called the company "ESSENTIAL to the Prosecution of the War." The large national retail store chain Sears, Roebuck and Company ran advertisements featuring an illustration of the Boeing B-29 Superfortress high-altitude bomber, stating, "Best of luck as you continue to `spark,' with Belden Wire, the B-29." Belden was among the many great American companies whose production facilities received the Army-Navy "E" award for "Excellence in Production."

Like the rest of industry during World War II, the bulk of Belden's male employees and more than a few women served in the fighting in Europe, Asia and Africa. More than 480 Beldenites were on military leave of absence, and 13 gave their lives for their country. To boost morale and keep these brave men and women connected to their colleagues back home, Belden published a monthly newsletter and sent it to their locations overseas. Written by plant personnel, most of them women, it reported news about company events and other goings-on. Meanwhile, *Beldenews* published letters that the service men and women had written to their Belden colleagues in the states. Belden turned a recreation room at the Richmond plant over to these activities; a large bulletin board displayed an up-to-date listing of everyone's names and their service addresses.

Throughout the war, employees at the Richmond plant bonded with one another via picnics and dances and participation in the company's bowling, horseshoe, swimming, skating and women's softball teams, as well as membership in clubs like the Belden Spur and Saddle Club. Nearly 90 percent of the employees at all three plants put 10 percent of their earnings into government war bonds. For these contributions, the U.S. Treasury Department presented the company with a Minute Man flag, which was unfurled in a ceremony honoring employees' distinguished service to the National War Savings program.



The 'arteries and nerves' of electronics

When the war ended in September 1945, the branch plant in Philadelphia closed and normal hours resumed in Chicago and Richmond, but production was slowed for some time due to the sudden falloff in business caused by canceled military orders and a brief, postwar economic slump. But the future looked promising, in large part because Belden's technical advances in wire insulation during the war had improved the capabilities of such electronic devices as radar and two-way radios; they'd soon make their way into mass-market applications for businesses and consumers: radar-based meteorology, microwave transmission, television broadcasting, copiers and computers, and communications equipment.

"In all of them, insulated wires are the arteries and the nerves that electrify them in action," a company advertisement of the time stated.

By 1947, business had returned to prewar levels, prompting President Jacobs to order the construction of a four-story addition to the Chicago plant. The company was now supplying magnet wire in all types and sizes of insulation to large manufacturers of industrial power equipment like electric motors, generators, solenoids, switches, relays and control systems. It sold power supply cords and internal wiring to manufacturers of refrigerators and washing machines, toasters, fans and business machines. Electric welding products; interior and exterior lighting; electronics; and trucks, buses, ships and aircraft all depended on a variety of Belden products.

Belden distributed its products nationally and internationally. The sales organization was led by a vice president of sales, under whose direction were sales managers in two divisions: Industrial and Merchandise. It was not uncommon for the three sales executives to travel more than a million miles a year in total to call on customers and prospects. Each division had anywhere from six to more than a dozen highly trained salesmen. In the Industrial division, they sold directly to manufacturers of equipment and appliances. Salesmen in the Merchandise division sold to consumers through wholesalers; retailers; and automobile, radio and electrical shops. The company generated approximately 75 to 80 percent of its sales from the industrial sector.

Whipple Jacobs resigned in January 1949 to become president of Phelps-Dodge Copper Products. Succeeding him, as Belden's third president, was Executive Vice President Charles "Craig" Craigmile, who joined the company in 1915 as an electrical engineer and later served in multiple capacities as general foreman, chief inspector and vice president in charge of plant operations. Strategically, Craigmile de-emphasized the manufacture of commodity-type products, such as extension cords and automobile battery cables, in favor of highly engineered wire and cable

products—generating competitive differentiation and higher profit margins.

Like his predecessors, Craigmile believed that the success of the company, the individual achievements of employees, the fair treatment and unity of the workforce, and the health of the community were inextricably linked and mutually reinforcing. Recalled by many employees at the time for shaping Belden's business policies around the "Golden Rule," Craigmile formulated the company's inaugural guiding principles.

"Like an individual, an organization such as ours has a character and a personality of its own," Craigmile wrote. "Its employees are either proud or ashamed of it, and the community looks upon it as a real asset or just another plant. Our employees are our greatest asset and are always to be considered that way. We realize that any business has a definite responsibility to the community in which it is located. We accept our full share of civic responsibility and encourage our executives and employees to do their share in helping to carry on the public service."

The guiding principles were printed in a special, 1952 issue of *Beldenews*, which served to commemorate the company's 50th anniversary and describe Craigmile's long-range plans in the light of a postwar economic boom that had ignited in 1950. Among the plans: double the capacity of the Richmond plant, make better use of that facility's 27-acre property and enlarge the Chicago plant. Jessie Cleveland, Belden's redoubtable historian and by then longest-tenured employee, captured the pivotal moment best.

"As the demand for our products increases," she wrote, "it is in the best interests of our customers, employees and stockholders that our manufacturing facilities be expanded to meet the demand. … Companies must either move forward or lose ground. As we look back with pride on the achievements of the past, so do we look forward to even greater progress in the future."

The Belden Belles, posing for this formal photograph in 1940, are believed to have been a group of female secretarial and office staffers who produced newsletters, community bulletins and other communication materials. Opposite, Charles "Craig" Craigmile, named president in 1949, transformed Belden into a maker of less commoditized, more profitable engineered wire and cable products.

CHAPTER FOUR

Belden on the Move

The 1950s marked the beginnings of an extremely strong and sustained economy in the United States. The middle class expanded in both numbers and wealth, employment surged to near full levels, and many families that had endured hardships during the Great Depression and World War II found themselves with considerably more purchasing power.

A population boom in the 1950s produced an extraordinary demand for televisions, and by mid-decade, half of American homes had a TV; families gathered in their living rooms to watch black-and-white serials, variety shows and movies. One of the earliest television technologies, in the 1930s, relied on Belden Silkenamel wire; later, Belden's low-loss, twin-lead cable—an industry first—was inside most TVs of the 1950s. Opposite, Belden wire crimping tools, popular in automotive wiring at the time.

“We do not foresee any relief from the pressure of demand for our products”

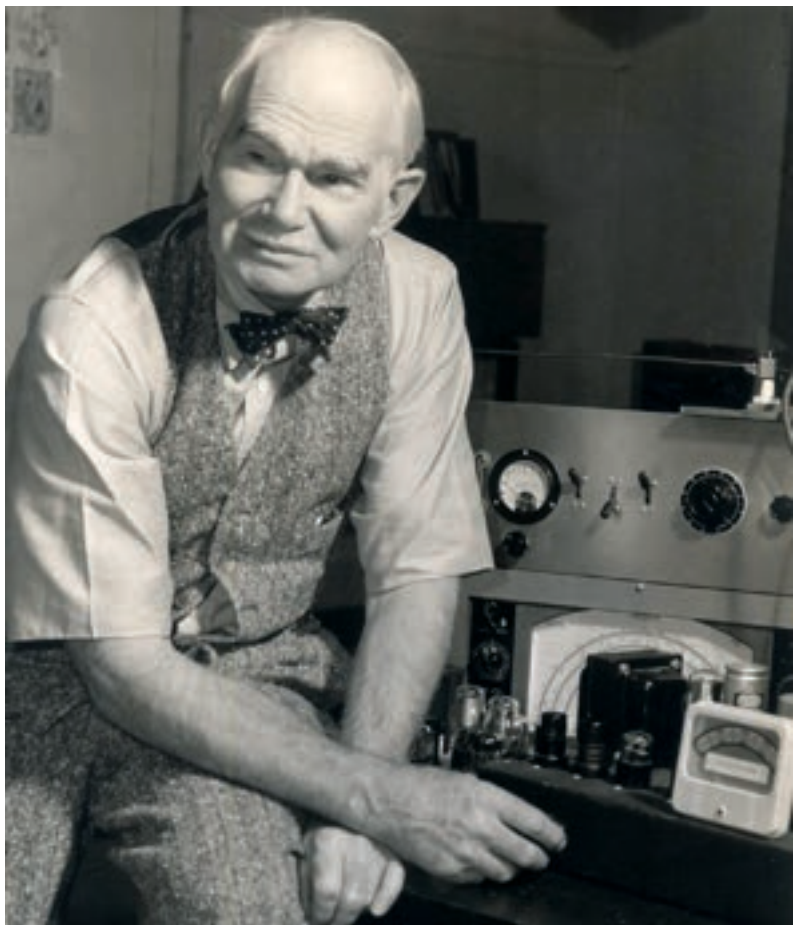
Belden cables reliably carried signals in early computers and data processing equipment, such as this UNIVAC used by the U.S. government to tabulate data from the 1954 census. Opposite, Lee de Forest, inventor of the radio vacuum tube, was a former Yale classmate of Joe Belden. He purchased “tons” of Belden Silkenamel wire for early experiments in the development of broadcast television.

Consumers made good use of the windfall, buying homes, cars, appliances, televisions and other essentials of the "American dream," powering a 37 percent rise in the gross domestic product during the decade. Manufacturers like Belden, and the diverse companies that bought its wire, cable and cord products, reached peaks of production. The period from 1945 until early in the 1970s would become known as the Golden Age of Capitalism.

New markets beckoned for Belden during the 1950s and 1960s, particularly in television and data processing. The company in fact played a major role in the evolution of TV. Back in 1932, Lee de Forest, the inventor of the radio vacuum tube and a man often called the "Father of Radio," wrote a letter to Joe Belden, his former classmate at Yale, requesting "tons" of the company's Silkenamel wire for "experimental purposes in connection with television." De Forest, who had sold his radio company to RCA, headed a company called American Television Laboratories that was researching technologies for broadcast TV. He told Joe Belden that he hoped to put televisions in every home across the country "during the next year. ... When that is done, I shall look forward again to a Yale reunion with the old feeling of anticipation and happiness!"

Belden supplied de Forest with the wire he needed, and American Television Laboratories developed a promising technology that never saw the light of day, as the company folded for lack of funds in 1933. It was RCA that put the first TVs in U.S. homes in 1936, and by the mid-1950s, there was a black-and-white TV in half of America's households.

Other emerging markets for Belden postwar included the manufacture of cords for companies in radar, sonar and electronics, and for manufacturers of refrigerators, vacuums, toasters, coffeemakers, fans, washing machines, dishwashers, air conditioners and scores of other consumer products.



Belden advertised to consumers in the *Saturday Evening Post* and *Popular Science* magazines. Achieving remarkable success in all of its markets, the company increased its cord output from 1 million cords per month in 1952 to nearly 1.5 million per month the following year.

Better reception

President Craigmile's plans to enlarge the Richmond plant saw fruition in 1953, when three new buildings—Nos. 7, 9 and 11—sprouted to provide another 83,000 square feet of manufacturing space. More than 1,550 people worked there

at the time, among them James Ramsay, whose first job in 1950 was to mold electric range cords.

"We were a big, family-type business," Ramsay recalled. "When it was someone's birthday in a particular part of the plant, everyone stopped working and a birthday cake was served. Every Christmas, we received a bonus of $5 for each year of service. We worked together and then played together on the company's softball and bowling teams. About a third of the plant's workforce was women. They attached wires to terminals and cut cords."

Nearly every employee spent his or her entire working life at Belden. Several reached 25, and even 50, years of service, their longevity commemorated with a feature in *Beldenews*. When an employee retired, the company hosted a party in the person's honor. Many employees' children applied for jobs at the plant, and multigenerational Belden families were common. Three of Ramsay's grown children joined him at Richmond in later years. Walter Rudolphsen remained in charge of the plant, as he had been since 1927.

"Walter walked the floor most every day and knew everyone by name," said Ramsay, who retired in 1991. "I learned how to do so many things, working in the braiding, extrusion, mechanical and other shops. It was a very good company in Richmond to work for."

As before, Belden's innovations changed the world for the better—in television, for example. Though highly popular, TV during the 1950s was characterized by poor picture quality, the result of very low image resolution. In 1957, Belden engineer Lawrence Ebel patented the broadcasting industry's first low-loss, twin-lead cable to carry radio frequency signals. Minimizing leakage, the invention greatly improved signal transmission and reception; TV viewers got a better picture, and Belden's leadership in broadcast television strengthened.

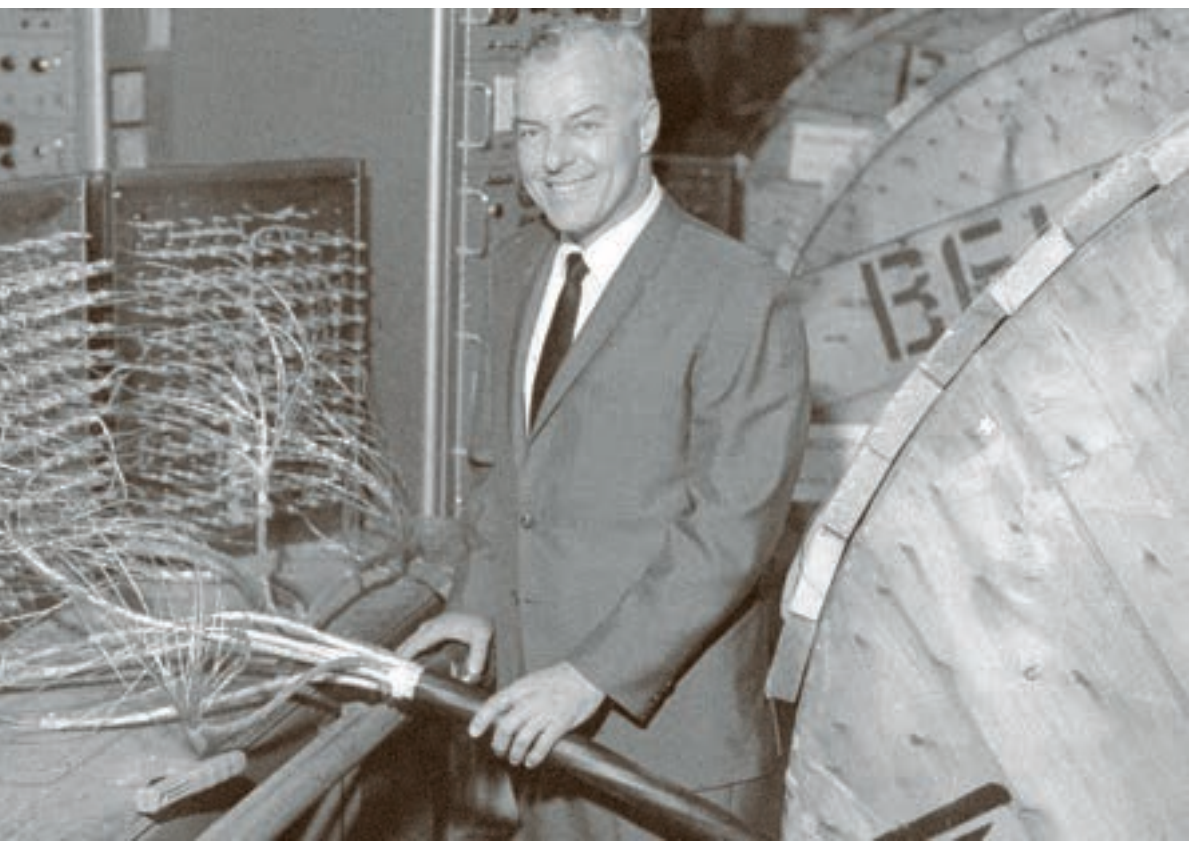
There were plenty of milestones and celebrations at Belden in the 1950s, including, far left, the day when longtime secretary and unofficial historian Jessie Cleveland received her 50-year anniversary pin from President Craig Craigmile. Cleveland was part of Belden's inner circle for much of her career. Near left, employees with 25 years of service in 1957 included Craigmile, Dick Sadlier and Rudolph Marvan. Opposite, members of the 25-Year Club in 1950.


BELDEN MANUFACTURING COMPANY
25 YEAR CLUB 1950

Getting into distribution

Other innovations burst forth from Belden's labs. Engineer Frank Timmons in 1962 patented a unique shielding tape made of aluminum foil and polyester film that provided an unprecedented ability to protect the cable from high-frequency interference. The aluminum foil provided the electrostatic shielding, while the polyester film added strength and another layer of isolation. Trademarked as Beldfoil, the tape was marketed for use in a variety of cable applications in data communications, audio speakers and fire alarms; it would remain the industry standard for 40 years.

Four other cables invented by Belden engineers in the 1960s and that included Belden-patented technologies are considered "industry legends today and are still selling," according to John Wojnicki, who joined the company at the Chicago customer service desk in 1972; he's currently global account director for Smart Buildings. The cables include Belden part number 8281, a precision broadcast video coaxial cable; part number 8760, a PVC-jacketed multiconductor data communications cable; part number 9451, a multiconductor, multipair cable designed to withstand rugged industrial tasks in electronics, audio, and control and instrumentation; and part number 8723, an audio, control and instrumentation cable jacketed in PVC with individually Beldfoil-shielded twisted pairs—two insulated copper wires wound together to eliminate exterior electromagnetic interference.



Having served Belden for more than 50 years, Craigmile retired in 1965. His greatest contribution in nearly 20 years of leading the company was probably his push to steer Belden's research and marketing organizations to develop highly engineered products that could have an important and lasting impact on fast-growing, high-technology markets. That strategy alone produced a more than doubling of revenues during his tenure. But Craigmile's leadership also is distinguished for its human touch and its positive impact on employee relations.

"No Belden executive has personally known more employees, nor has more real friends among them," *Beldenews* reported upon Craigmile's retirement.

Belden's board elected Robert Hawkinson, vice president of

Robert Hawkinson, opposite, was chosen to succeed Craig Craigmile as president and CEO of Belden in 1965. Hawkinson set the company on an aggressive, national expansion strategy in which the company acquired or built nine new plants during his tenure. They included, right, the company's first new manufacturing plant in 27 years, built in Franklin, North Carolina, in 1965. Hawkinson was a champion of production quality, and he instituted a Zero Defects campaign in 1966.

engineering, to succeed Craigmile as president and chief executive officer. Hawkinson had joined Belden in 1945 as an engineer in the magnet wire department. Like most other employees, he served in the military during World War II. As a fighter pilot in the U.S. Air Force, Captain Hawkinson flew 81 missions before being shot down behind enemy lines in France. He avoided capture and spent six months with the French Underground, until the liberation of France by Allied forces in September 1944. For his acts of heroism while in flight, Hawkinson was decorated with the Distinguished Flying Cross.

Belden's new president embarked on an aggressive production strategy designed to capitalize on opportunities in the booming television and data processing markets. In spite of the plant expansions in Richmond and Chicago in the 1950s, demand continued to outpace the company's ability to satisfy it.

"We do not foresee any relief from the pressure of demand for our products," Hawkinson said in announcing his strategy, under which Belden would acquire or build from scratch nine new plants in the eastern half of North America. The first, built in Franklin, North Carolina, in 1965, was the company's first new plant since 1938. Belden constructed a new facility in Pontotoc, Mississippi, in 1967 to manufacture magnet wire, and another in Jena, Louisiana, in 1968 to make products for the transportation sector. To further boost production capacity, the company acquired General Wire & Cable Company—established in a garage in 1955 by German-born entrepreneur Karl Fabricius—in 1969. The deal gave Belden two manufacturing plants in Cobourg, Ontario, expanding the company's presence in rapidly growing Canadian markets.

Hawkinson was just warming up.

To increase profitability and burnish Belden's brand image, he sought to diversify the company beyond manufacturing. Leveraging its expertise in distribution, Belden opened a network of warehouse centers to supply customers with leading brands of industrial and electrical supplies and parts—not just Belden's. Reflecting the company's now-larger vision, it changed its name in 1966 from Belden Manufacturing Company to Belden Corporation.

MOVE OVER, KING KONG

The challenge of experimentation and problem-solving has been a hallmark of Belden since its founding—the innovation continuous whether conducted as part of a broad, centralized effort or focused within the company's product development and engineering groups.

New York City's 102-story Empire State Building was famed for holding the title of the world's tallest building from 1931 to 1970, and its Art Deco spire drew world renown for its starring role in the original *King Kong* movie (and subsequent remakes). In an unforgettable scene at the movie's climax, the enormous gorilla climbs to the top of the building, clutching actress Fay Wray in one hand and the building's spire in the other as he bellows at swooping biplanes.

Though not seen in the movie, atop that spire was a radio (and later television) antenna that brought the building's height to 1,454 feet. First erected in 1931 for broadcasts by NBC (National Broadcasting Company), the antenna is struck by lightning an average of 25 times a year, according to the National Weather Service; in one particularly strong thunderstorm, it was hit eight times in 24 minutes.

Lightning-induced static interrupted NBC's broadcasts for 40 years, until NBC resolved to fix the problem in the 1970s. The network entrusted the work to a large manufacturer of optical fiber cables. That company, now a major competitor of Belden's, reached out to Belden's Technical Research Center in Geneva, Illinois, for assistance.

"The company looked to us to develop the jacketing material for the fiber optic cables that would run from NBC's transmission point to the receiving point," recalled engineer John Valentine, who retired from Belden in 2016 as special project manager. "They had excellent fiber glass capabilities. We had the packaging expertise."

The fiber optic company's own experiments with insulation materials had come up short. Not only did the jacketing fail to prevent the disruption in transmission caused by lightning, the insulation also was prone to leakage.

"We were asked to jacket the fiber so it was environmentally safe—water couldn't get into it and it wouldn't be affected by lightning," Valentine said.

The Geneva Technical Center saw the task as a "fun hobby," he said. "It was the Empire State Building, after all. Our engineers would have something to tell their grandchildren while watching *King Kong*. But as they worked on the project, it dawned on them that there was a future in fiber optics. The culture here was so ingrained in copper wires. The engineering staff started to experiment with fiber optics, making light do different things."

This skunkworks persisted for a few years into the early 1980s.

"Unfortunately, Belden management decided that fiber was so off the beaten path, it didn't want to invest in it," said Valentine. "By that time, I was one of seven engineers working on the project. We all knew this stuff would replace copper someday, but we took the news the best we could."

Much like remakes of the *King Kong* movie surface every decade or so to capture the attention of new generations of filmgoers, fiber optics emerged to regain the attention of Belden's management in the 2010s. Driven by the demands of high-bandwidth digital data transmission and communication, the company now manufactures a wide range of indoor and outdoor fiber optic cables suited to different industrial environments and needs.

Belden undertook a series of acquisitions in support of its distribution arm, beginning with the 1967 purchase of Complete-Reading Company, a distributor of industrial and electric supplies and motor parts, with six warehouses. The following year, Belden acquired two more companies: Southern Electric Sales Company, a Dallas-based distributor of electrical wire, insulating material and replacement parts; and Insulation & Copper Sales, a distributor of magnet wire, lead wire and associated products, with headquarters in Detroit.

In 1969, via a stock swap, Belden picked up Electrical Specialty Company and added it to its web of distribution centers; the San Francisco-based manufacturer of insulating materials, industrial plastics and shop equipment owned six warehouses in the West, complementing Belden's 10 centers primarily in Eastern, Southern and Midwestern states. Two more distributors joined Belden in 1970 through the acquisitions of Manufacturers Specialties Company of Milwaukee and D. A. James Company of St. Louis.

Fine-tuning for four markets

Hawkinson made two other key decisions to further Belden's technological and market leadership: centralizing research, and decentralizing production, marketing and sales.

Wire and cable manufacturing became less manual and more automated in the 1960s, as new machines produced goods with consistency and ever-greater speed. Nevertheless, skilled craftsmen were needed to make sure quality remained high. From top, Belden's rod mill, where raw wire is rolled to the proper dimension for a finished product; the rubber room, where insulation is applied to the wire; and an Artos stripping machine, whose cutting blades strip off enough insulation for a connector to be crimped onto the bare ends of a wire harness.

Astronaut Buzz Aldrin's "one small step" might not have been possible without Belden's ultra-fine magnet wire (one-quarter the diameter of a human hair), which was used in relays aboard the Apollo 11 spacecraft that carried Aldrin and Neil Armstrong to the moon in 1969.

For decades, Belden had conducted separate research activities at its various plants, but Belden's leaders saw an opportunity to create efficiencies and further fuel innovation via collaborative idea generation, experimentation and product development. To coordinate these disparate efforts, in 1967 Belden purchased a building in Geneva, Illinois, a suburb west of Chicago, for a Technical Research Center. For the next 20 years, nearly all company research would be done there.

Hawkinson's decentralization of Belden's activities beyond research was intended to fine-tune product development, manufacturing, marketing and delivery to the needs of the four principal customer segments the company served at the time: electronics, electrical, consumer and transportation.

The electronics industry was Belden's largest market, generating around 40 percent of sales. Manufacturers and other businesses engaged in television and radio broadcasting, computers and data processing, field communications, public address systems, and even oceanography relied on a variety of Belden wires, cords and cables.

The electrical sector accounted for about a quarter of the company's sales. Products included magnet wire used for the windings in motors, transformers and generators, and lead wire that connected the windings to power sources. Major customers included original equipment manufacturers such as General Electric, 3M, Westinghouse and Black & Decker.

About 20 percent of sales derived from the consumer market. Hobbyists and owners of radios, TVs, appliances and other electronic and electrical devices could buy Belden wire and cable, replacement appliance cords and even television antennas; the smaller items were sold in see-through Bubble-Paks at hardware stores, home service distributors, mass merchandising centers and electronic parts outlets.

The transportation market accounted for the remainder of Belden's sales. Buyers included manufacturers of automobiles, trucks, boats, marine engines, outboard motors and snowmobiles. This sector also included the company's aftermarket business, in which it sold automotive parts and supplies through distributors. In 1968, the company leased a 75,000-square-foot automotive aftermarket facility near the plant in Jena, Louisiana.

Belden's expansion of its markets and rising sales figures began to attract the attention of the national business media. *Barron's National Business* magazine reported in December 1969 that "The company has no single across-the-board competitor; it serves more than 3,000 OEMs and 6,500 jobbers and distributors."

Belden's sales the next year exceeded $100 million for the first time—more than double those of five years earlier—and the company began listing its shares on the New York Stock Exchange (NYSE) under the ticker symbol BEL.

Although there was no bell ringing ceremony at the NYSE at the time, the decision to list its shares on the venerable stock exchange marked a new stage in Belden's maturity and renown. The company now had production plants and distribution centers across the United States and in Canada; Richmond was by far the largest facility, with more than 500,000 square feet of production space as the result of 15 expansion projects since its construction starting in 1927. Of the 27-acre site, Hawkinson said, "There's no room anymore for expansion."

At Richmond, Wojnicki said, the company had trouble keeping up with demand, and there were often shortages. In spite of the pressure for ever higher performance and greater production, he said the plant retained its "family feeling and paternalistic management culture. People retired, came back, retired and came back again." It was a vibrant, busy place, key to Belden's success and to its future. The same couldn't be said for the plant and headquarters in Chicago.

"Growing faster than ever before"

Belden's long association with the city of its birth ended when the company closed its Chicago plant in 1976. Belden was far from alone among manufacturers leaving the Windy City. Due to a confluence of factors, one factory after another closed its doors. An old saying was that a plant worker in Chicago "could quit a job on one side of the street and get hired across the street." The manufacturing sector in Chicago employed more than half a million people in 1960, but by 2021, fewer than 7 percent of Chicagoans worked in manufacturing. As the last Belden plant worker exited the Chicago facility and turned off the lights, an era in the city's history darkened as well.

Three years earlier, Hawkinson had relocated Belden's headquarters to a five-story office building near the Technical Research Center in Geneva. At the research center, in the 1970s and '80s alone, engineers—leveraging the co-location of the company's R&D operations—developed more than 130 new electronic cable and wire products for use in the communications, data processing, and instrumentation and control fields. They included SEED, a testing device used to evaluate the shielding effectiveness of CATV (Community Antenna Television) drop cables, a type of short cable that connected televisions

to a cable wall plate. Effective CATV cable shielding was needed to prevent interference with over-the-air communications bands; testing the shielding was therefore a crucial concern for the cable industry. SEED instantly became the industry standard.

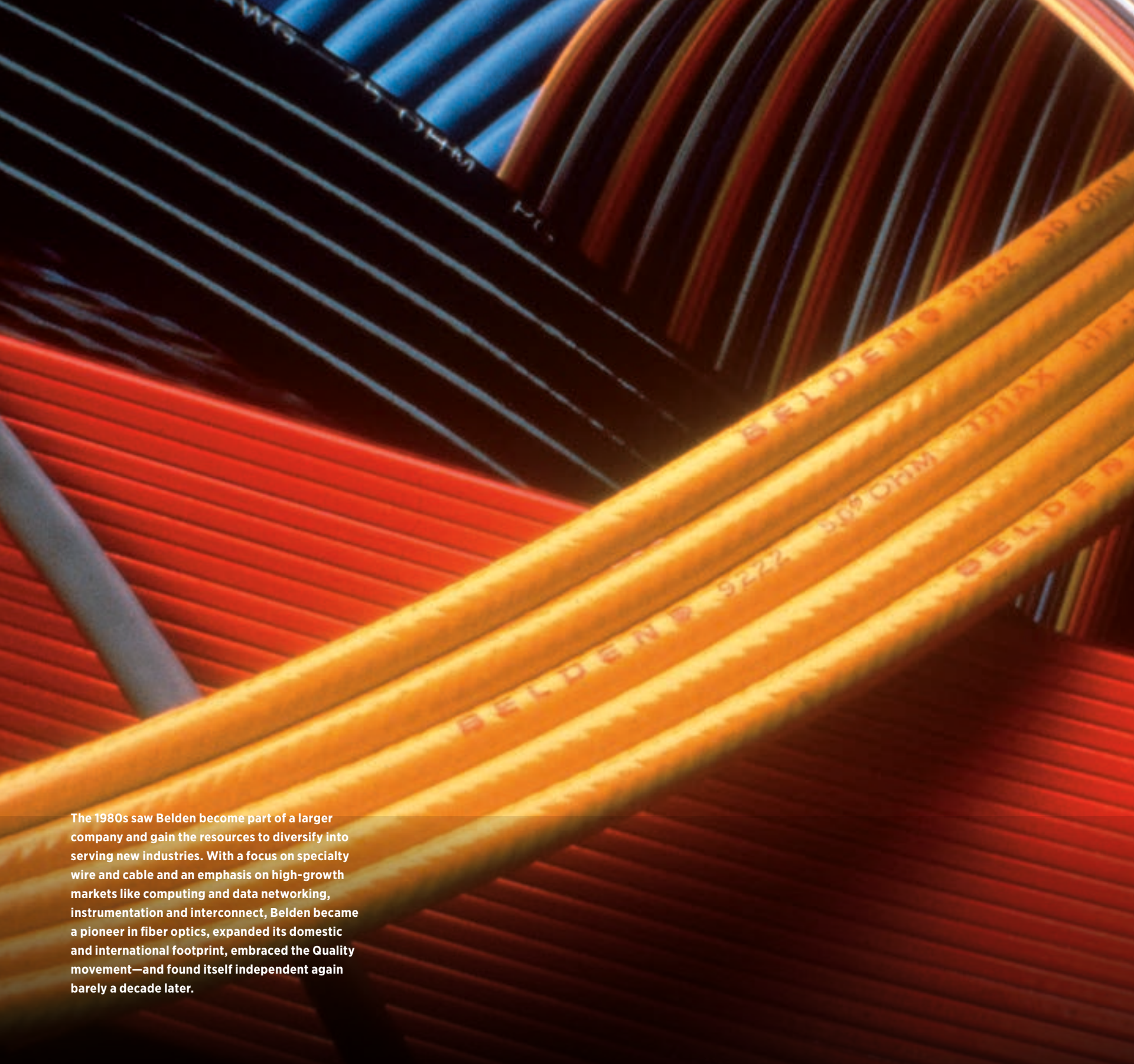
Hawkinson continued to pursue his audacious acquisition and diversification strategy throughout the 1970s. Belden leased plants in Clinton, Arkansas, in 1972; Monticello, Kentucky, in 1973; and Dumas, Arkansas, in 1976. In 1973, Belden acquired an 80 percent interest in Phoenix-Hecht Inc., a provider of computer business services to more than 60 major U.S. banks. Belden contracted with Phoenix-Hecht to manage a new data center at the Geneva headquarters, utilizing an IBM 370 mainframe computer. That same year, Belden bought a 50 percent interest in Geneva-Pacific Corporation; the company owned leases for copper-bearing deposits in Alaska, providing a more reliable and cost-effective supply of the mineral for use in wire.

By 1977, Belden's 75th anniversary year, the company reached proportions that would have astonished Joe Belden. It had 43 facilities in the United States and Canada, including 10 manufacturing plants and 25 distribution subsidiaries. Under Hawkinson's leadership, Belden had grown from a company with two plants and $42.3 million in annual sales into a diversified corporation in two major lines of business and annual sales of $187 million. In a publication commemorating the diamond jubilee, Hawkinson observed, "Belden is on the move, growing faster than ever before."

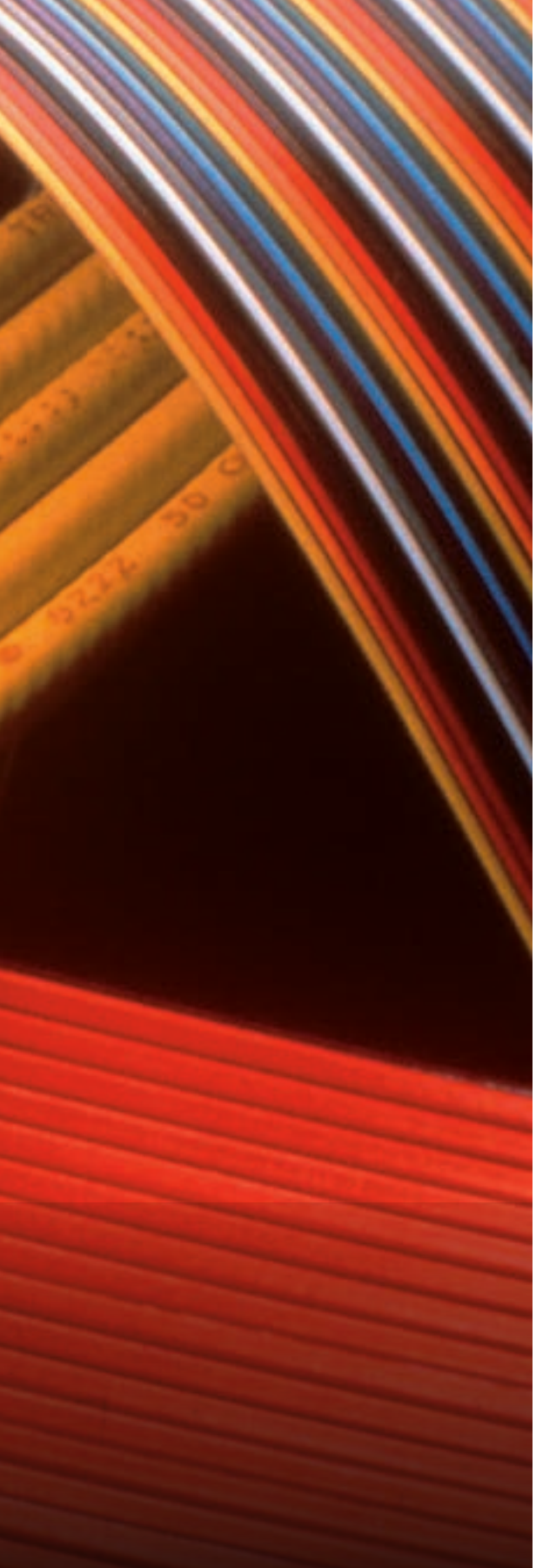
It was not an exaggeration. The following year, Belden's sales ticked up again, at an annual rate of 28 percent, to reach $240 million. Meanwhile, the acquisition spree was far from over. The company acquired Cable Concepts Corporation in 1978, and Magnum Electrics, Western Controls and EDCON in 1979. By the end of 1979, Belden realized $290 million in annual revenue and had a workforce of more than 4,000.

The esteemed aviator's growth strategy had been a wild success. But as Hawkinson and the rest of management set their plans for the 1980s, Belden's stellar growth had not gone unnoticed. External events were stirring that would imperil Belden's survival as an independent company.

A parade of acquisitions, new plants and other fast-paced changes took place at Belden in the 1970s, and employees kept up with it all through the monthly magazine *Beldenews*, opposite. Right, employees left the newly renovated Richmond plant after a day of work in 1973.



The 1980s saw Belden become part of a larger company and gain the resources to diversify into serving new industries. With a focus on specialty wire and cable and an emphasis on high-growth markets like computing and data networking, instrumentation and interconnect, Belden became a pioneer in fiber optics, expanded its domestic and international footprint, embraced the Quality movement—and found itself independent again barely a decade later.



CHAPTER FIVE

A View of the Future

One of the worst nightmares for the management of a publicly traded corporation in the 1980s was sluggish growth in the company's stock price. Junk bonds made financing easy at the time, even in a severe recession. Opportunistic companies as well as corporate raiders scanned the markets for undervalued businesses—opposing managements and going directly to stockholders with a pitch to take over a company, streamline operations and increase the value of their shares.

In the summer of 1980, Belden all but had a target on its back: it was in growth markets and had record sales and earnings, but its stock price had lagged. In July that year, Belden's board of directors received an unsolicited takeover bid from Ampco-Pittsburgh, an industrial metals manufacturer. The board rejected the offer, but because Belden was a public company, its fate would ultimately be in shareholders' hands.

At a board meeting, member Chris Witting, CEO and chairman of Crouse-Hinds, a Syracuse, New York-based manufacturer and distributor of electrical and lighting products, suggested an alternate course: a defensive merger between Belden and Crouse-Hinds. Because Belden CEO Bob Hawkinson was a member of Crouse-Hinds' board, the companies' managements were familiar with one another's missions and strategies, product lines, financial positions and leadership. Hawkinson liked the idea, and on September 9, the boards of Belden and Crouse-Hinds confidently announced that they had agreed to merge—ending the threat from Ampco-Pittsburgh. Or so they thought.

> "We simply came along for the ride, and we knew it"

Their plans came apart almost immediately. Unbeknownst to anyone at Crouse-Hinds and Belden during their negotiations, an Omaha, Nebraska-based operator of natural gas pipelines had been preparing an unfriendly bid for Crouse-Hinds for nearly a year. Three days after Belden and Crouse-Hinds announced their planned merger, InterNorth—a major Crouse-Hinds customer—made its overture to Crouse-Hinds' shareholders.

To thwart what it saw as a hostile takeover designed to defeat its planned merger with Belden, Crouse-Hinds' board went looking for a "white knight" of its own—a friendly suitor that might make a better offer than InterNorth. Crouse-Hinds found its partner in Cooper Industries, Inc., a company with interests in energy, mining, aircraft services, the automotive aftermarket, and consumer and industrial tools.

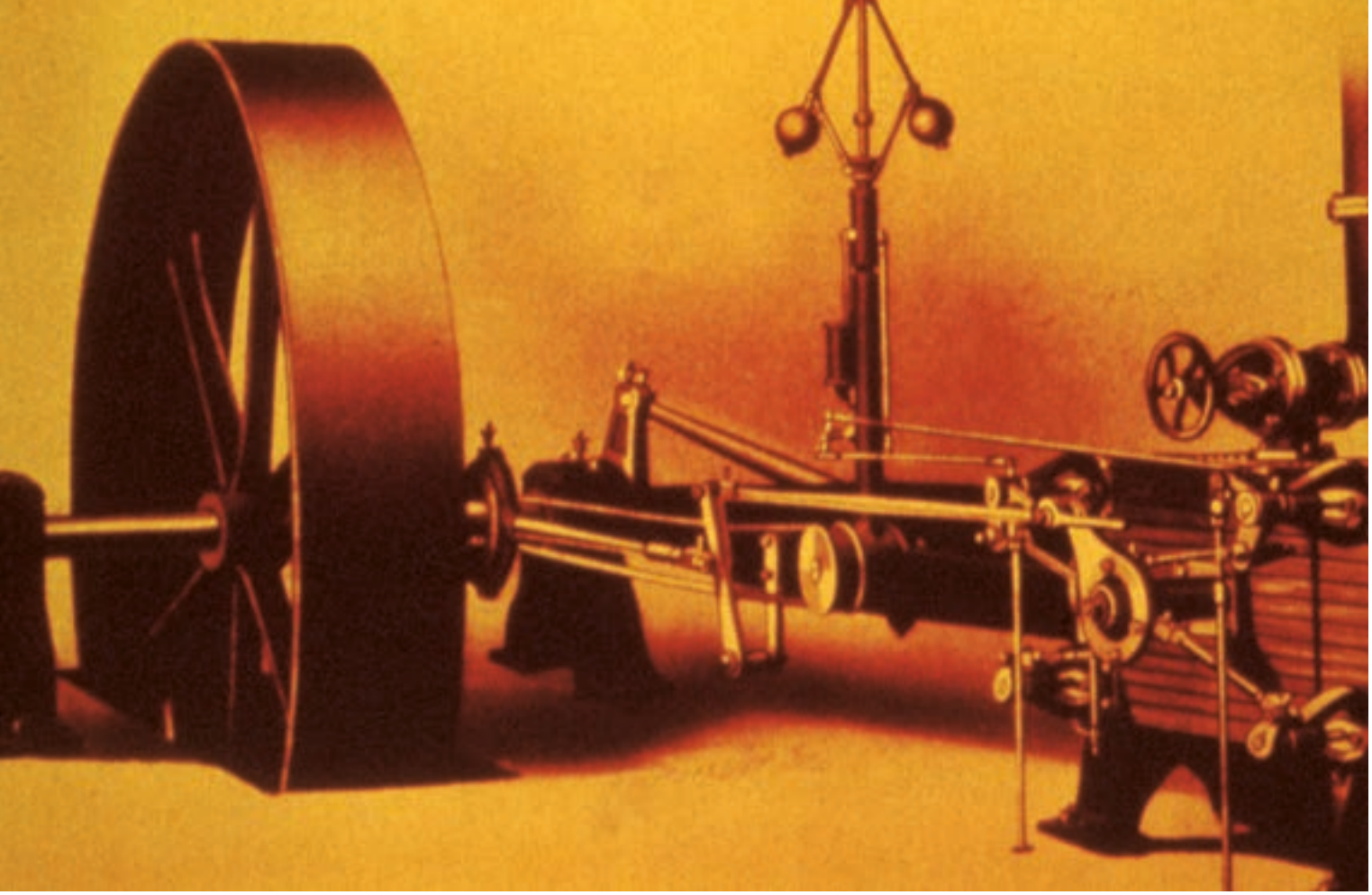
On November 25, Crouse-Hinds and Cooper announced that they had reached a merger agreement via an exchange of stock, and on Wednesday, December 10, following resolution of one of many lawsuits over the transaction, Belden was merged into a unit of Crouse-Hinds. InterNorth continued to pursue Crouse-Hinds, however. It finally conceded defeat in January 1981, enabling the Cooper-Crouse-Hinds merger to take place upon Cooper shareholders' approval that April.

In a later merger with Houston Natural Gas, InterNorth adopted a new name: Enron. Serendipitously, Belden had avoided becoming enmeshed in an organization that went down in flames 20 years later in a massive accounting fraud and the then-largest Chapter 11 bankruptcy in U.S. history.

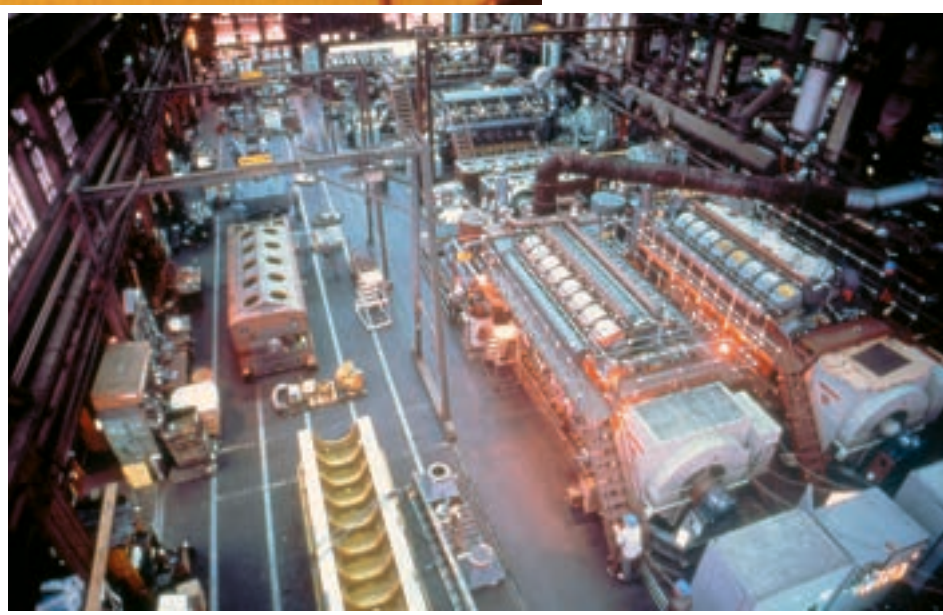
"Cooper wanted the future"

Following the back-to-back mergers, Belden became the Belden Electrical & Electronics Products division of Cooper Industries. It was one of three Cooper divisions, the other two being Tools & Hardware and Compression & Drilling Equipment.

A strategic review by Cooper's management concluded that Belden's operations should be streamlined to focus on the specialty wire and cable business. Cooper gradually phased out magnet wire operations and divested noncore operations like Geneva-Pacific, the mineral-exploration



Cooper Industries, which became Belden's parent company at the end of 1980, was founded in 1833, initially as a foundry making hog troughs, plows and stoves. Later diversifying into gas engines, its gas-powered pipeline compression engines, left, fueled the growth of the oil-and-gas industry. In a related transaction at roughly the same time, Belden was merged into Crouse-Hinds, which was established in 1897 as a maker of traffic signals and controllers; below is a 1980s-era Crouse-Hinds factory floor. Bottom left, how Cooper represented its many business segments at around the time of the mergers.



COOPER INDUSTRIES AND CROUSE-HINDS

The logos of Cooper Industries and Crouse-Hinds as they appeared in the 1980s, a period of intense corporate takeover activity that included Cooper's acquisition of Belden and Crouse-Hinds. Ironically, of the three companies today, only Belden remains an independent public company.

The hostile takeovers of the 1980s had all the elements of great tragedy—greedy opportunists buying up scores of companies to tear them apart, sell off the pieces and pink-slip the workforce with scant thought to employees' well-being. Of course, that's just one view of the tender offers and leveraged buyouts that predominated during the decade.

Certainly, the shareholders of the acquired companies raked in substantial gains. But when Ampco-Pittsburgh came calling with an unsolicited takeover of Belden, Belden's senior management and board believed that the company's shareholders' best interests would not be served—in spite of Belden's sluggish stock price.

When Ampco-Pittsburgh bought 6.1 percent of Belden's stock in July 1980 and sent notice to the board of a takeover, Belden made plans to merge with Crouse-Hinds as a defensive maneuver. Before these plans came to fruition, Crouse-Hinds needed its own "white knight" to ward off its own unsolicited takeover bid. Cooper Industries came to Crouse-Hinds' rescue, at which point Belden became a division of Cooper.

Crouse-Hinds was a good match for Belden, as its respective CEOs—Bob Hawkinson at Belden and Chris Witting at Crouse-Hinds—served on each other's boards of directors. At the time, Syracuse, New York-based Crouse-Hinds, founded in 1897, was a global provider of high-quality electrical fittings, couplings, enclosures, switches, lighting fixtures, aviation equipment and switchboards—a quirk of fate since Belden's first market at its founding was switchboard wire, a business it had exited decades earlier.

Crouse-Hinds was founded by Huntington Crouse, who, like Joe Belden, was in his mid-20s. As Joe Belden reached out to Albert Beutler for his know-how, Crouse did the same, teaming up with Jeff Hinds, a factory superintendent and former mechanic at the Electric Engineering and Supply Company.

"Several parallels existed between histories of the two companies," business historian David N. Keller wrote in his 1983 book *Cooper Industries: 1833-1983*.

There was one big difference between the founders: Huntington Crouse had inherited a large sum of money from his late uncle to start Crouse-Hinds, whereas Joe Belden assiduously raised capital, hat-in-hand, to launch Belden Manufacturing.

Cooper Industries was older than both Crouse-Hinds and Belden. The company was founded by brothers Charles and Elias Cooper in 1833 to manufacture plows, hog troughs, kettles and stoves. In the late 19th century, C&E Cooper Company, as it was then called, shifted to manufacturing gas-fueled internal combustion engines, primarily for the oil and gas industry. During World War II, Cooper Industries supplied engine components that powered the Navy's minesweeper fleet. At the end of the war, the company shifted into electrical products and solutions.

Although Belden was cleaved from Cooper Industries following its successful IPO in June 1993, Crouse-Hinds remained a Cooper subsidiary. In November 2012, Cooper was acquired for $13 billion by Eaton Corporation, a 101-year-old diversified industrial manufacturer. Unlike in the hostile takeover mania of the 1980s, the transaction was welcomed by both boards.

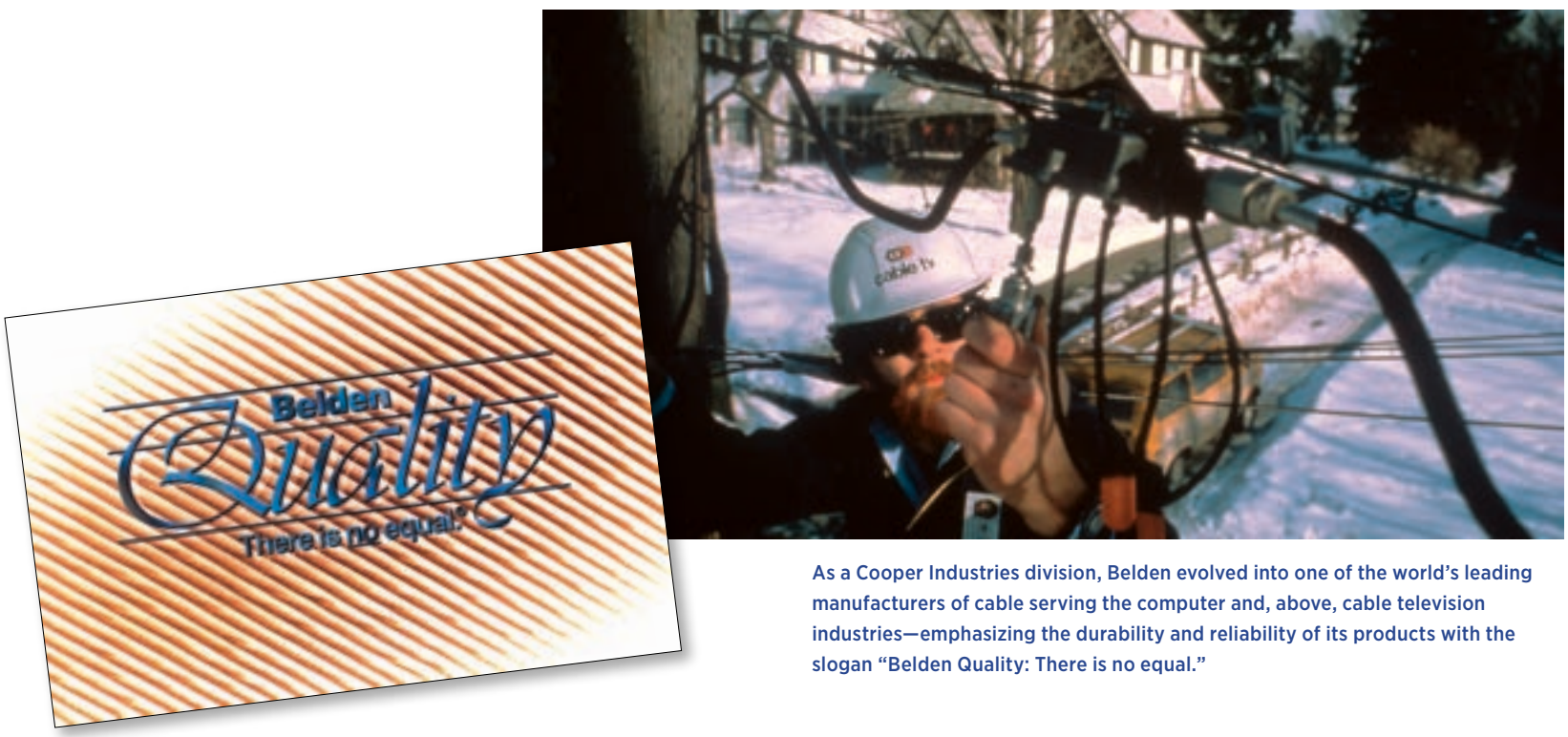
company, and Complete-Reading, the electrical supplies distributor. It closed the plant in Pontotoc, Mississippi, and the corporate office building in Geneva. Headquarters was relocated to Richmond.

Also falling under the axe was the Geneva Technical Research Center, whose operations Cooper began phasing out shortly after the acquisition. Belden maintained its high standards for innovation and production quality by shifting research to Richmond's engineering team and the company's manufacturing operations. Geneva would be fully shut down by 1989, when all R&D activities were consolidated at a new Belden Engineering Center in Richmond.

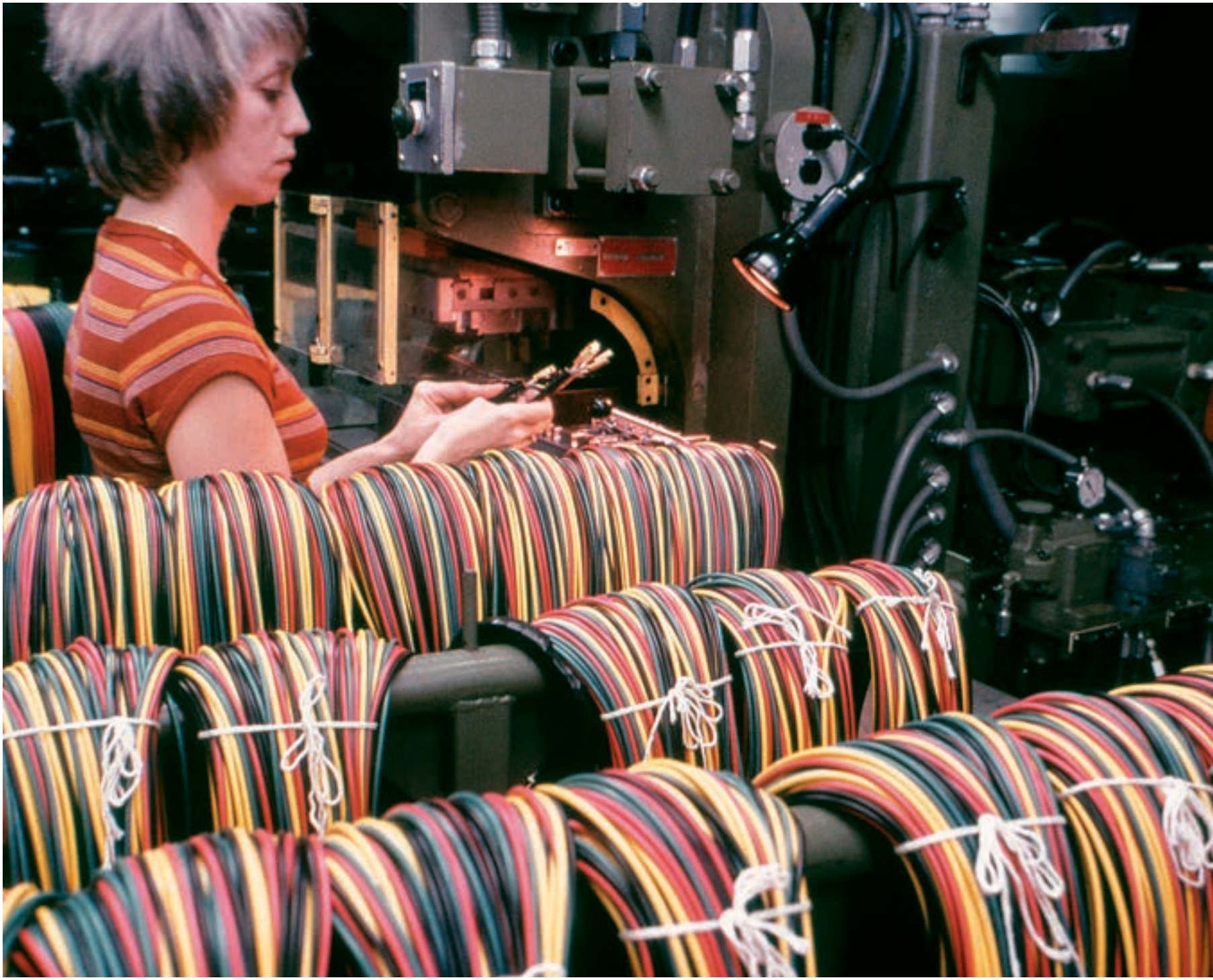
Bob Hawkinson left the company not long after the merger. He was succeeded in 1982 by Roger Cornett, who had joined Belden as an industrial engineer in 1962, was named general manager of the Belden division and then president in 1986. For the most part, Cooper let Cornett run the company "almost as a standalone operation," according to Art Yaroch, who had been with Belden since 1979 when he joined as an accountant; he later managed the Richmond plant. "It was a relatively arms-length relationship. We were pretty independent," Yaroch said.

Yaroch, by the way, was a nearly 40-year Belden employee who grew up in and worked in almost every area of the business. As president or vice president of various Belden divisions, the former college football quarterback was a trusted advisor to senior management, and a valued mentor to young employees. One of his favorite sayings—"Hope is not a plan"—echoes throughout Belden today.

The Belden division's "leading products" in the mid-1980s, according to Cooper Industries' public affairs department, included multi-conductor cables, used to transmit low-power, low-voltage, high-integrity signals in data control; signal and communications circuits; flat cables and connectors serving



As a Cooper Industries division, Belden evolved into one of the world's leading manufacturers of cable serving the computer and, above, cable television industries—emphasizing the durability and reliability of its products with the slogan "Belden Quality: There is no equal."



fast-growth markets in wiring for computers, instrumentation and interconnect equipment; cords sold to manufacturers of industrial, home power tools and appliances; and coaxial cables for radio frequency transmission. Cooper promoted Belden's products, starting in 1983, with the slogan, "Belden Quality—There is No Equal."

Under Cornett's leadership, the Belden division focused on further penetrating the high value-added computer and electronics markets. The transition from large mainframes to microcomputers to desktop and personal computers, and then the networking of those devices provided the company with a tremendous platform. Desktop computers and early versions of networks began to appear, primarily in technology companies and university research settings, in the mid-1970s; the technology that ultimately shook out in the 1980s as a standard for networking was a communication protocol called Ethernet, which is still dominant today.

In the early 1980s, Belden became the first in the industry to market Ethernet cables, which carried high-speed signals among computers, modems, routers and other networked devices. As companies began installing local area networks (LANs) in their offices and factories, and then connected them into enterprise-scale wide-area networks (WANs), Belden was there. Its engineers researched and developed cabling products that formed the arteries of early LANs and later WANs.

"Cooper saw that we had a foot in the door on this new future and felt if they invested capital in our R&D, we would be an early mover with a product that could lead to further penetrating the market down the line," said John Valentine, an engineer who joined Belden in 1981. "We jointly developed a cable with three other suppliers for IBM for a network called a Token Ring, which was one of the first local area networks." Token Ring, which IBM introduced in 1984, was a rival technology to Ethernet, and Belden had its feet in both camps.

As Belden further penetrated the computer, data and cable TV markets, associates like Bob Mann at the Richmond plant made sure the company's reputation for quality remained excellent; above, Mann applies tape and binder onto cable for jacketing. Opposite, a Belden employee crimps connectors onto stripped wire harnesses.

As WANs proliferated in the mid-1980s, Belden engineers experimented with different shielding materials to reduce electromagnetic interference; they ultimately invented the first twisted-pair cables incorporating electrical shielding in a foil. The new cables were marketed to the computing and networking industries under the brand name Beldfoil, which became the industry standard.

"Cooper wanted the future, and we showed it to them in interconnect cables letting computers talk to other computers," said Valentine, obviously proud of the opportunity to work on these projects with fellow engineers.

"We have THE cable"

Belden also was the first company to market fiber optic cables for industrial use. Since the early 1800s, nearly all wire and cable had relied on strands of copper to transmit electrical and electronic signals. But in 1970, an American glass manufacturer developed the first optical fiber suitable for transmitting communication signals. From that breakthrough, the first commercial fiber optic communication systems emerged in the mid-1970s, and a second generation led to widespread adoption in the early 1980s.

Belden had been working with the glass company, conducting research and development work that resulted in a high-performance cable practical for everyday commercial use. It wasn't easy. After all, optical fiber was an entirely new material and technology for Belden's engineers.

"The other company had developed fiber optic glass but had difficulty commercializing it," Valentine said. "They didn't know how to package [insulate] the cable so the glass could be protected from contamination by water and from impact-induced breakage. We were ingrained in a copper-culture. Fiber optics was so outside the box. But after we researched it, we agreed there was a definite future here. We put together a skunkworks that worked hand-in-hand with their engineers and eventually developed a fiber optic cable with a jacket that met the need."

Cooper Industries did its part to successfully market Belden's specialty wire and cable products.

"We had engineers, plants and salespeople, but Cooper came in and said, 'You don't have a marketing organization and need it,' and they started one for us," said Art Yaroch. "They weren't timid when it came to spending money on our behalf."

This was also the case when it came to international expansion. Whereas Belden in the past sold products on a global basis, it didn't lease or own any production or distribution facilities outside North America. Cooper Industries' new CEO, Robert Cizik, earmarked capital for the company to establish a distribution center in Neuss, Germany, giving

Belden's skunkworks in the 1980s experimented with fiber optics, producing cables made of glass strands protected by an insulated casing for telecommunications and data applications. Opposite, an employee at the Richmond plant uses a forklift to place a pallet of shrink-wrapped cable onto a shelf for inventory.

Belden a foothold from which to enlarge its presence throughout Europe.

In Canada, where Belden already had two plants in Cobourg, Ontario, Cooper sprang for construction of a new manufacturing plant on 26 acres of land at a cost of $8.6 million. The facility, which opened in 1986, replaced the two older and less efficient facilities. It was subsequently expanded to provide more than 215,000 square feet of manufacturing space.

Cooper also built Belden a new plant in Essex Junction, Vermont, close to a 25,000-square-foot plant in Williston, Vermont, that Belden had acquired in 1980 when it acquired Millibride, a maker of high-temperature specialty wire insulated with Teflon materials. That specialty product was used in high-temperature applications at commercial power plants, chemical plants and nuclear plants, in addition to military applications. The rapid growth in the market for high-temperature wires precipitated the construction of yet another plant in Essex Junction, this one 77,400 square feet in size.

Pushing ahead in quality

As Cooper Industries invested generously in Belden's high-growth operations, it wasn't hesitant to pull back, seek efficiencies in or get out of slower-growth business. Cooper transferred Belden's automotive aftermarket products business to its own Automotive Group, which subsequently assumed management of Belden's Dumas, Arkansas, plant. Cooper eventually sold the automotive division altogether to Federal-Mogul Corporation, although under a licensing arrangement, the products continue to be marketed and sold under the Belden name.

In 1989, Nishan Teshosian, a Cooper Industries manufacturing executive, replaced Cornett as president of the Belden

Belden broke ground on a new engineering center at the Richmond plant in 1989. Its more than 70,000 square feet contained offices, laboratories, an auditorium and a place to manufacture product prototypes.

division. Teshosian built upon his predecessor's plans to make the company the premier manufacturer of specialty wire and cable. He led a further streamlining of operations, closing plants in Jena, Louisiana, and Clinton, Arkansas, and replacing the latter with a new facility.

Meanwhile, managers were recruited from outside Belden to modernize manufacturing systems and processes. Their work led to the implementation of two key initiatives in 1989. One was a Quality Improvement Policy established at all of the company's plants, in which the very notion of quality was redefined from a customer perspective, and the responsibility for achieving defined measures of quality put in the hands of plant managers.

The second major initiative involved shifting the Richmond plant to an approach called cellular manufacturing. The company created discrete work cells and located them strategically to facilitate faster assembly, inventory turns and cycle times; to improve product quality and reduce waste; and to boost delivery performance. Over the next four years, all of Belden's product lines were organized into manufacturing cells. The success of its Quality program made Belden the first company in the industry to obtain ISO 9000 certification—after a rigorous evaluation of the company's customer focus, engagement of top management, and measurable achievements in processes and continuous improvement.

PROFILE OF AN INNOVATOR

Noah Montena, Broadband & 5G

PPC's most prolific inventor is Noah Montena, whose name is synonymous with universal connectors.

In 1997, Montena designed a coaxial cable connector that reliably fit different sizes and types of cables, addressing performance gaps and inconsistencies that had long vexed the industry. His Universal Compression connector took the guesswork and craft error out of product installation, and has been used for decades in practically every U.S. residential and commercial setting for cable television, sound systems, internet access and many common electronics applications. Montena holds three U.S. patents on the device. At its height, PPC was selling 400 million pieces annually, and more than 3 billion have been sold worldwide, generating more than $900 million in revenue for PPC to date.

Montena holds eight U.S. patents on another invention, AquaTight, which was the first universal weather-seal connector design that enabled a coaxial cable connector to efficiently and reliably seal different sizes and types of ports in outdoor applications; it mitigated the problem of poor contact in wet or stormy weather and from loose or improperly fastened connections.

Montena also devised other drop-connector designs, in widespread use in the coaxial cable market, that enable a connector to establish a ground path with a port. They and other PPC-patented inventions have revolutionized the industry and generated significant annual licensing royalties.

Before the decade concluded, Teshosian made another decision important to Belden's future when he revived the centralized approach to research and engineering that had been abandoned with the closing of the Geneva Technical Research Center eight years earlier. A new Belden Engineering Center made its debut in 1989 following major renovations in Richmond. The state-of-the-art facility consisted of 27,000 square feet of offices and laboratories, and a large auditorium

for seminars and customer visits; another 44,000 square feet was dedicated to the manufacture of product prototypes for customers.

Approximately 90 engineers, technicians and support staff worked at the center in pure research, product development, process engineering, quality systems development, tool design, compound engineering, equipment development and other activities. Their objective was to ensure that Belden kept pace with the fast-moving electronics market—being "first in innovation, product performance and quality," as the company stated. Equipped with the latest instruments and technologies like computer-aided design (CAD) to conduct physical, environmental, electronic, analytical and other tests, the Belden Engineering Center was well positioned to pursue the goal.

Independent again

As the calendar turned to a new decade, Belden's financial prospects turned upwards. The division's operating income soared 87 percent to record levels between 1990 and 1992 on the strength of its process improvements and better product and market focus in a booming economy. The following year, Cooper Industries reassessed its corporate strategy and concluded that Belden could be sold for a considerable profit, with the proceeds deployed into areas more aligned with Cooper's core competencies.

To prepare Belden for an initial public offering (IPO), Cooper incorporated the Belden division as a separate entity, Belden Wire & Cable Company, on June 28, 1993. C. Baker Cunningham, an executive vice president in charge of Cooper Industries' Tools & Hardware division and Automotive Group, was named Belden's new chairman, president and CEO.

Cunningham's background was in finance, and he spent much of the summer of 1993 putting together a

PROFILE OF AN INNOVATOR

Helmut Fuchs and Lothar Fuhrmeister, Industrial Automation Solutions

Lothar Fuhrmeister and Helmut Fuchs in 1999 designed and patented an innovative plug assembly that provided a tight and sealed connection for solenoid valves.

Many electrical elements like the solenoid valves in internal combustion engines contain outward-facing connector prongs; a conductor attached to the prongs connects to a power supply, receives sensor data and/or communicates electrically with the device. Typically, the conductors were designed to fit over the solenoid prongs, with a skirt covering them for protection. However, different materials were used to construct the body and the cap, and the parts were not physically bonded together. This allowed them to separate with age and wear, and as the skirt cracked or pulled away, water and foreign materials could enter, fouling the contacts and damaging the solenoid.

The improved plug assembly featured multiple electrical contacts fixed in pockets of the assembly body, and a cover formed from a flexible elastomeric plastic that completely surrounded the body except for the pockets. It also included a protective web assembly and a polyurethane skirt; the fork-shaped contacts embedded in the body were protected by the skirt. This provided a far tighter contact, reduced motion, limited wear, and better protected the electrical contacts and elements from erosion; it vastly improved the valve's performance and lifespan.

team to take Belden public. Since Belden was a division within Cooper Industries, he needed to re-establish functions like legal, finance, human resources and accounting. He also needed to assemble a board of directors, line up bankers for financing, prepare the IPO documents and pilot the customary road show to sell the value of the company to investors.

"We promoted the company to investors on the promise of Belden's signal transmission, data transmission and data networking capabilities, which was the largest part of the business and differentiated us from commodity-oriented producers," Cunningham recalled. "Our ambition was clear—to become the world's No. 1 specialty wire and cable company. At $400 million, it was a pretty big IPO at the time."

When Belden began trading on the New York Stock Exchange under the ticker symbol BWC on October 1, 1993, veteran Belden employees rejoiced.

"We were generating a ton of cash for Cooper, but Belden had never been a good fit for them," Yaroch recalled. "When Cooper acquired Crouse-Hinds, we simply came along for the ride and we knew it, so it was a huge thing for us to be on our own again as a standalone company."

Shortly after the IPO, Belden began shipping the first products to result from another of its engineering triumphs: bonded-pair technology, in which the individual electrical conductors in a cable are bonded along the longitudinal axis.

"Nonbonded-pair cables are subject to physical structure changes caused when a cable is stressed by bending and pulling, which adversely affects signal performance," John Wojnicki explained. "With bonding, we were able to guarantee extremely uniform spacing within each twisted pair, a key factor in maintaining consistent signal transmission."

Belden was competing with other manufacturers to offer data communications customers the highest-performance cables possible. Bonded-pair technology represented Belden's effort to improve on category 5, the industry's top category. A jingle, "5e by '93," rallied employees around the almost two-year effort to develop an "enhanced" category 5 product.

The cable (Belden part number 9689) continues to be a major seller today. "We're the only ones that make it and remain the market leader," Wojnicki said. "Nobody else could figure out how we did it. We have THE cable."

In 1994, Cunningham orchestrated a move of Belden's headquarters from Richmond to St. Louis—a major, centrally located city with excellent domestic and international airline service plus access to top-flight talent, banks, and business and management consultants.

Belden became an independent public company again in 1993 with an initial public offering of stock. A souvenir of the cover of the offering document shows that 21 million shares were made available at a price of $14.25 per share.

Growth of the inorganic kind

Cunningham's strategy as CEO, adopted by Belden just four years after the first dial-up internet service provider opened for business, didn't venture far afield from the plans in place when Cooper Industries owned the company.

"I wanted to ride the explosion of data networks in office environments, developing new products for the electronics industry as well as new growth markets brought about by the public internet and corporate intranets," he said. "And I hoped to build upon our strong niche position in broadcasting. Our reputation in both markets was solid and strong."

Belden's well-known achievements in the broadcasting industry included wiring NBC's Studio One for *The Today Show*, supplying cabling for the Olympics for 20 years, and providing 100 miles of cable to broadcast the Goodwill Games from Seattle to the rest of the world in 1990.

Where Cunningham departed from the Cooper strategy was in his plan to generate growth inorganically. He embarked on an acquisition spree reminiscent of former President and CEO Bob Hawkinson's investments in the 1960s, albeit with a bigger focus on international expansion.

C. Baker Cunningham was named Belden's chairman, president and CEO in 1993. His aggressive acquisition strategy expanded the company's global presence.

The first of these acquisitions, in 1995, was of American Electric Cordsets, a $24 million company that became part of a newly formed Cord Products Division. Two years later, Belden acquired two cable companies, Cowen Cable and Intech Cable. Also in 1997, the company acquired an Elizabeth, New Jersey-based division of Alpha Wire for $70 million. The division (also known as Alpha Wire) manufactured multi-conductor cables, hook-up wire, tubing and other products for the electronic and electrical markets; it also made wire and cables used in security operations, alarms, factory floor automation and robotics.

"It was one of our best acquisitions, a diamond in the rough that paid off in three years," John Valentine said in reference to Alpha Wire.

Alpha Wire's close proximity to New Jersey's Newark Airport was another factor in making it a prescient acquisition.

"The company sold a high-margin product with a specific service model involving next-day shipments," said former Belden Chief Financial Officer (CFO) Henk Derksen. "If a customer ordered the product before four o'clock in the afternoon, they had it the next morning. That model became a building block for the future."

In 1999, Belden acquired Cable Systems International (CSI), formerly Phoenix Works of AT&T, for $180 million; it was the company's largest acquisition up to that time. CSI was the second-largest manufacturer of copper telephone cable in the United States. The acquisition formed the basis for the Belden Communications Division and was a key factor in Belden's strategy to become a top supplier of "last-mile" cable to major telecommunications companies worldwide for voice, video, data and internet connection systems. The transaction included CSI's Phoenix, Arizona, plant, which Cunningham planned to upgrade over the next three years at a cost of $25 million.

Internationally, Belden acquired rival Pope Cable and Wire in Venlo, the Netherlands, in 1995, then Olex Communications Cable in Australia and Germany's Elektro-Isolierwerke in 1998.

THE RISE AND FALL (AND RISE AGAIN) OF FIBER OPTICS

Fiber optic cables provide extremely high transmission speeds, flexibility, enhanced latency and security.

For more than half a century, the capabilities of fiber optics have promised a future in which these cables crisscross the world to transmit data and communications, improving the way people connect, work, communicate and even play with one another. Instead, the fiber optic market has endured a boom-bust cycle—and it is once again booming, providing significant growth opportunities for Belden.

A fiber optic cable—strands of pure glass inside an insulating jacket—transmits data as pulses of light. Copper cables also transmit signals, but typically only over a distance of a few hundred meters depending on frequency, compared to 25 miles and more by fiber optics. Whereas copper cables lose about 90 percent of a signal every 100 meters, fiber optic loses roughly 3 percent.

Another distinct advantage of fiber is the elimination of electromagnetic interference. Copper cables conduct electricity and are susceptible to electrical surges. Since fiber optic cables carry light and not electricity, they are free from such disruptions in data transmission. Other advantages include increased durability, security and very high bandwidth support.

Despite these benefits, the fiber optic market has endured a rocky path. Given its position as a major manufacturer of cable and wire, Belden was engaged in early research, design and development, creating the first fiber optic cables for industrial use in 1976. Prospects appeared bullish in the late 1990s as the internet blossomed along with a growing field of dot-com companies doing business over the vast network.

In anticipation of a financial heyday, the telecommunications industry invested more than $500 billion, most of it financed through debt, into laying fiber optic cable across the country. As transmission capacity outstripped demand, the dot-com bubble burst in 2001, wiping out $2 trillion in stock market wealth. The following year, sales of Belden's fiber optics cables fell 60 percent.

Nearly a decade would pass before demand returned in the United States. An estimated 19 million miles of fiber optic cables were installed in 2011, the most since the boom year of 2000. This miniboom lasted through 2016, when interest in fiber optic technology again cooled.

In 2022, with companies across industry sectors transforming their operations and workforces around data-generated insights, another boom is underway. Several research reports forecast a compound annual growth rate of more than 9 percent through 2025. Large cloud computing vendors are building fiber optic networks with speeds as high as 100 billion bits per second (BPS), with speeds of 400 billion BPS anticipated in the future.

This technological breakthrough in bandwidth offers the opportunity for ever-growing volumes of data to be transmitted and analyzed using artificial intelligence tools like machine learning. As more and more businesses transform to exploit the opportunities presented by data-driven insight, Belden's fiber optic cables and the company's focus on enterprise end-to-end connectivity solutions position the company well for this projected turnaround.

More Than Just a Job

As the world became smaller through computerization, global communication and data exchange, and then the emergence of the internet, Belden's people were engaged in some of the most important technological achievements of the era—a legacy of purposeful and meaningful work that continues today.

Clockwise from top left, checking engineering specifications on a computer, technicians at work in Belden's Test Lab, tin-plating copper bobbin wire in the Wire Room, engineers monitoring Wardwell braiding machines, an employee applying braided shield to cable.

All three companies manufactured cables for industrial and computer networking. In 1999, Belden acquired two other major wire and cable businesses in Europe from the German conglomerate Siemens, which was in the thick of a major restructuring: Dorfler Kabelwerk GmbH in Klosterneuburg, Austria, and Duna Kabel Kft in Budapest, Hungary.

As Belden's market position in Europe expanded, the company set up a sales office and warehousing operation in Düsseldorf, Germany. The strategy to build a larger global presence was a terrific success, and by the late 1990s, Belden's international sales exceeded 25 percent of total sales.

The CEO continued Cooper's strategy of discontinuing certain low-margin products in slow-growth markets; he sold off the recently created Cord Products Division. To maintain cost discipline, he also emphasized continuous improvements in manufacturing efficiency and quality. Together, the focus on quality and efficiency, the cost-cutting measures and aggressive acquisition strategy helped lift Belden's earnings to $35.9 million in 1999 on sales of $818.6 million.

The CSI acquisition in particular paid off handsomely. The deal helped the new Belden Communications Division win a five-year, $700 million contract to supply SBC Communications with copper-telecom cables for the last mile of its communications networks. The acquisition contributed to a nearly 85 percent increase in Belden's networking sales in 1999, nearly one quarter of the company's total sales.

As planned, the Belden Communications Division built on the foundation of the CSI acquisition to spread its wings internationally. In 2000, Belden acquired the metallic cable telecommunications business of Corning Glass Works near Manchester, England. The deal made Belden the sole supplier of metallic telecom-cable products to the United Kingdom's largest phone company, British Telecommunications.

Belden supplies metallic cable products to British Telecom (BT), the largest provider of fixed-line, broadband and mobile services in the United Kingdom. Above, BT's iconic office tower in London.

The 21st century beckons

Belden's return as an NYSE-listed public company was a standout success. Press releases throughout the 1990s apprised the public about such notable achievements as the making of cables to monitor patients suffering heart ailments and the body functions of astronauts in space flight, as well as the use of Belden fiber optic cables to provide bandwidth for internet connections. Belden DataTwist cables broadcast daily feeds from the U.S. Senate floor to the C-Span television network and provided every senator's desk with high-quality sound of the body's proceedings.

The in-house cable TV systems, broadcast systems and sound systems of the new Coors Field baseball stadium in Denver, as well as those at professional basketball and hockey arenas in Portland, Oregon, and Vancouver, British Columbia, were all wired with Belden cable. The MSNBC network paved the way to multimedia broadcasting with more than 2 million feet of Belden cables, and the Golf Channel depended on Belden's precision video cables to support the network's digital broadcasting. In July 2000, a peak year in the wire and cable industry, Charter Communications bought more than 5 million feet of Belden coaxial cable. Belden's sales catapulted to $1.13 billion that year.

No longer was Belden an unwanted corporate division, mislaid between others selling hardware and drilling equipment. The company was a modern manufacturing enterprise poised to serve the global telecom and technology giants of the 21st century. Seemingly unlimited growth in the internet was underway, and Belden's future looked particularly luminous as a wave of speculative investment swept the tech industry, boosting the fortunes of new internet-only, "dot-com" start-ups whose growth-over-profits models seemed to defy the laws of gravity as well as of business fundamentals.

Recall that it was Joe Belden who had warned some 80 years earlier, "Trees never grow to the sky."

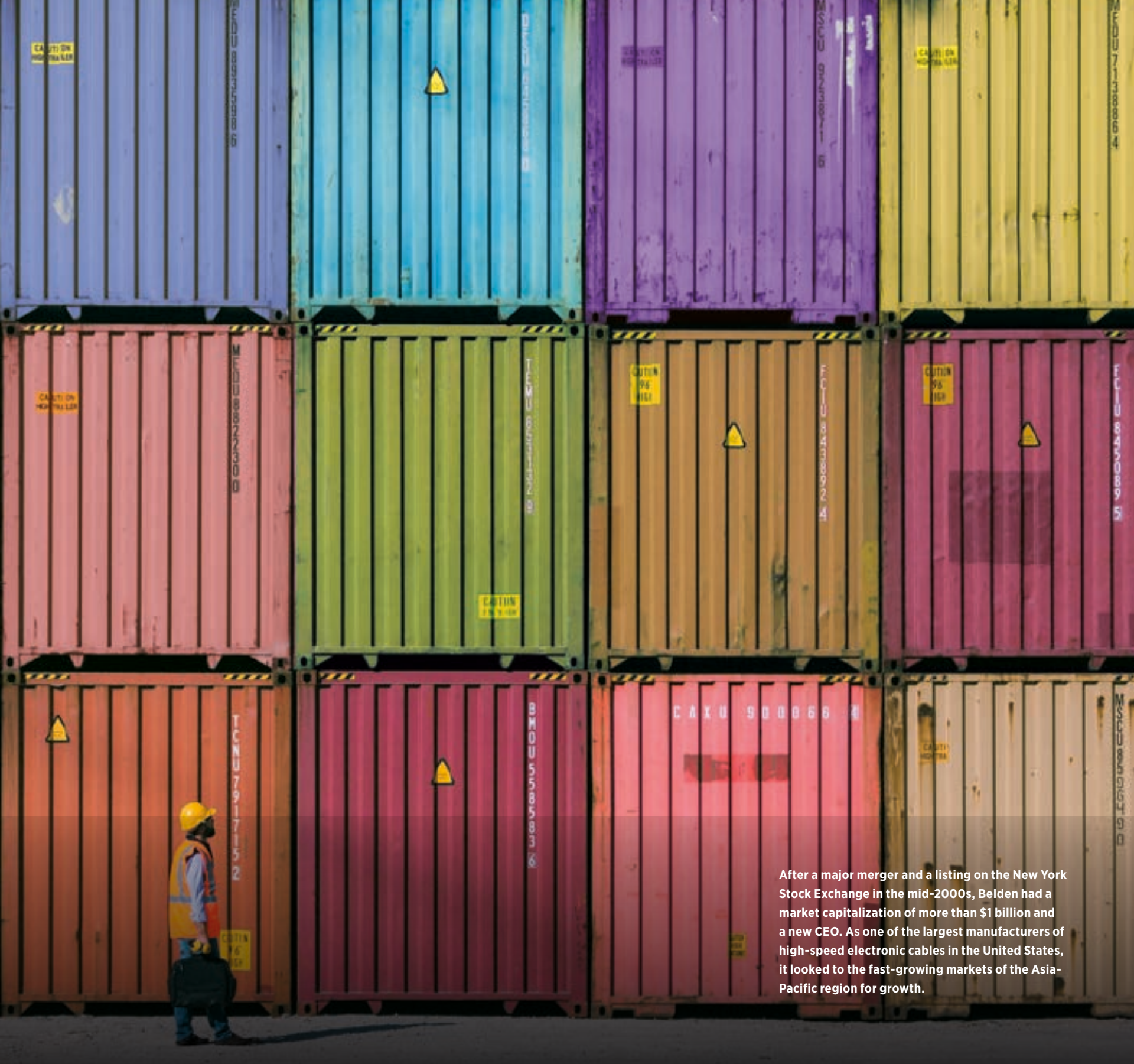
Belden's many contributions to the world include cables used to evaluate astronauts' vital body functions during space flight. Here astronaut Bonnie Dunbar collects medical data from payload specialist Lawrence DeLucas during a U.S. space shuttle flight in 1992. When Denver's Coors Field opened in 1995, its in-house cable TV, broadcast and sound systems were all wired with Belden cables.


KING
BLK HIGH ROTTWEILER CLUB

CHAPTER SIX

Cleaning Up the Basement

Belden's growth prospects soared as the new millennium opened. Independent again and recharged as a public company, Belden had capitalized on a series of shrewd acquisitions. It enjoyed steady cash flow and boasted a roster of prominent customers, from telecom giants SBC Communications and Verizon to major television networks, including NBC and CBS.



After a major merger and a listing on the New York Stock Exchange in the mid-2000s, Belden had a market capitalization of more than $1 billion and a new CEO. As one of the largest manufacturers of high-speed electronic cables in the United States, it looked to the fast-growing markets of the Asia-Pacific region for growth.

"We had become too successful for our own good"

Stock analysts touted Belden's "strong buy" rating. A *Wall Street Journal* headline on February 1, 2001, proclaimed, "Belden May Be a Name Investors Should Learn"— analyst Michael Schneider of Baird & Co. citing Belden as "an inexpensive infrastructure play … At 11 times earnings, it's also a good play against networking and telecom stocks."

Beneath the surface, however, the company faced significant challenges. Although Belden remained a respected brand, many of its cable and wire products were all but indistinguishable from those offered by competitors. Customers had caught on and were starting to view Belden as a manufacturer of commodity products. Furthermore, Belden's voluminous catalog of parts numbers confused many buyers.

"Although we were a manufacturing firm, they thought we were a standards body," says Ashish Chand, who joined the company in its 100th anniversary year, 2002, as country sales manager in India and is now executive vice president of the Belden Industrial Automation Solutions business.

For much of its first century, Belden had developed products in collaboration with its customers, coming up with new cable and wiring solutions to meet the rigorous performance requirements of an increasing number of fast-growing industries dependent on electronics. Belden's sales and marketing personnel were accustomed to having ready access to customers' decision makers. But once it began to be seen as a commodity provider, Belden found itself on the outside, dealing with purchasing agents instead of engineers and subject to downward pricing pressure from customers who didn't see the value-add in Belden's products. The company had lost its inside track to understanding its customers' needs and aspirations—it had become more tactical than strategic and it missed out on a number of opportunities.

"There were continuing advancements in our space in terms of audio and digital signal compression to increase

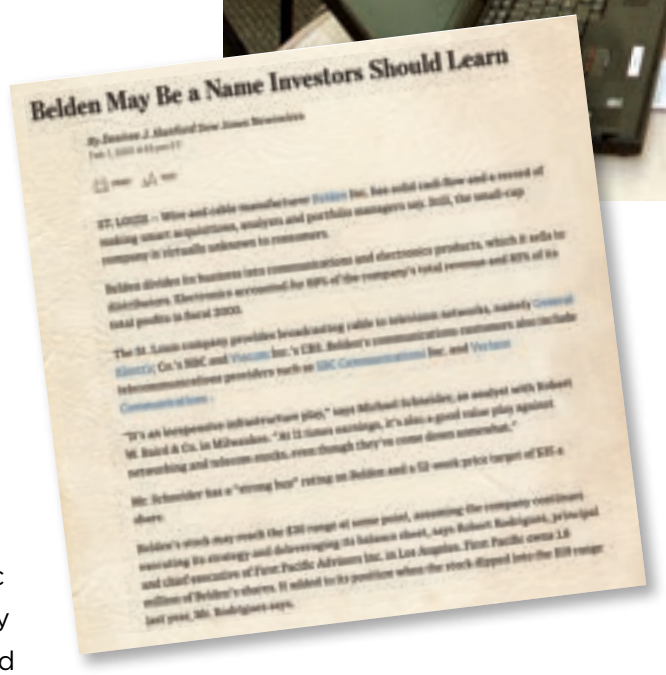
electrical bandwidth (measured in Hertz) or capacity, but we were behind the curve on electronic speeds (measured in bit rate),” Chand explained. “We had become too successful for our own good.”

External factors beyond Belden’s control made matters worse. Even as analysts touted Belden’s shares, the stock market—especially the tech-heavy NASDAQ—underwent a steady, then precipitous decline, the result of rising interest rates, a recession in Japan and a growing realization that profitability mattered in business valuation after all.

By October 2002, the flow of speculative investments in dot-coms that had fueled the growth of telecom and internet companies had all but stopped. Many of the darling dot-coms were out of business, and the NASDAQ had lost 78 percent of its valuation from its March 2000 high; stocks had lost $5 trillion in market capitalization.

While a flight to quality in stocks buoyed many traditional companies, telecoms were a wreck after investing more than $500 billion in the internet’s commercial opportunities. Moreover, they’d taken on large amounts of debt to finance the installation of fiber optic cables and to develop wireless networks. To compensate for the financial impact, they slashed the procurement of cables, copper as well as fiber optic. Belden’s outlook suddenly turned dark.

As CEO, Baker Cunningham stated in a 2002 industry roundtable, “The collapse of the dot-com bubble, the financial pressure of heavy debt loads, and the overbuild of fiber optic cable led all the telecom companies to drastically reduce their spending—what one analyst called ‘a capital spending hunger strike.’”



Belden May Be a Name Investors Should Learn

The dot-com bubble of the late 1990s burst in 2000, flooding the economy with bankruptcies in the telecom and computer sectors, two key markets for Belden. The auctioning off of failed companies’ assets, above, was a common activity from 2000 to 2002. Though wounded by the crisis, Belden was touted in *The Wall Street Journal*, left, for its solid cash flow and history of smart acquisitions. Opposite, the unseen force of wireless was poised to change the world.

PROFILE OF AN INNOVATOR

Rolf Reuschen and Bernhard Schmid, Industrial Automation Solutions

Hirschmann Automation has long been a leader in the standardization of redundancy protocols in the International Electrotechnical Commission (IEC) and the Institute of Electrical and Electronics Engineers (IEEE). Rolf Reuschen and Bernard Schmid were part of a Hirschmann team that in 2002 shared a patent for its design of a media redundancy protocol (MRP) for a ring network. The patent documented the combination of technologies required to identify and mitigate the disruption of service if one facet in a network ring was damaged.

Their invention revolved around a redundancy manager device that connects to the line ends of the network and continuously checks the network's status by transmitting and receiving test signals. If a network interruption is detected, the redundancy manager connects the line ends within milliseconds, keeping the network operational. After the error has been identified and bypassed, the network reconfigures itself almost instantly into a functioning structure—essential for ensuring the reliability of automated systems. This innovation also limited the need for mimicking the entire redundancy buffer system, achieving media redundancy more efficiently and at a significant savings.

In less than a year and a half, demand for Belden copper telecom cable had fallen 40 percent—fiber optic by 60 percent. A recession that followed the dot-com bust slowed sales of other Belden products like CATV coaxial cables, data cables, and cables for broadcasting and industrial automation, which collectively fell 25 percent. Belden reduced its product costs and slowed production to lessen the damage, but the benefits of those actions more than disappeared when the embattled telecoms demanded 20 percent price cuts on the products they continued to buy from the company.

"We would have to give more than 100 percent of the benefits of our recent cost reductions to the customer to retain the business," Cunningham said. "Even then, the overhead costs of operating at one-third of our capacity would wipe out any hope we had for making a profit."

Other cable manufacturers serving the telecom industry were in a better position to endure the market reversal. Whereas Belden operated a single plant in Phoenix with more than 1 million square feet of manufacturing space—the largest cable facility in the world at the time—competitors had multiple, smaller plants and more flexibility to reduce capacity to lower costs.

Stopping the bleeding

Nevertheless, Belden remained optimistic about the long-term future. It didn't retrench, and in a seemingly contrarian move that very October, it acquired the NORCOM telecom wire and cable division of Cable Design Technologies (CDT) of Pittsburgh for approximately $11.3 million.

The intent was to position Belden to benefit from the time when its communications customers resumed a more customary level of spending, but that time didn't come quicky enough. The continuing downturn in the telecom industry forced Belden to shut down the NORCOM business and close NORCOM's U.S. and Canadian cable plants the following year.

The financial impact of the dot-com bust was severe. Belden's revenues declined from $1.13 billion in 2000 to $827 million in 2003, resulting in a $60.7 million net loss for the

2003 fiscal year. Belden was forced to undergo a painful global downsizing that included the layoff of nearly 6,000 people; that left the company with about 4,000 employees worldwide.

With profits eroding further, Cunningham made the difficult decision in April 2004 to exit the telecom industry in the United States and sell the company's North American communications wire and cable business to competitor Superior Essex Inc. The $95 million deal included nearly all of the assets Belden had acquired in the $180 million purchase of CSI five years earlier, including the Phoenix plant. Though the telecom business generated $200 million in sales in 2003, Belden couldn't run it profitability in such a demanding market.

"We took a loss on the sale, but at least we stopped the bleeding," Cunningham said.

A visit to "cabling heaven"

None of the difficulties of 2002-2003 stemmed Belden's ambitions, however, and even as it was contemplating the closure of the NORCOM operation, the company had its eyes on becoming the world's largest U.S.-based supplier of high-speed electronic cables.

To that end, Belden was again talking with Cable Design Technologies, from which it had acquired the NORCOM assets. By now, the companies' managements were familiar with one another and with their respective businesses, and they enjoyed a good relationship. In February 2004,

Belden celebrated its 100th anniversary in 2002 without much fanfare, though the company did take note, left, of some of its key milestones. Two years later, Belden's acquisition of Cable Design Technologies (CDT) marked a new juncture in its evolution, catapulting the company into the top tier in the manufacture of high-speed electronic cables.

The opening ceremony of the 2004 Olympics in Athens, Greece, was broadcast to the world via cameras using Belden cables, as every Olympics has been since.

A MERGER OF MANY

Belden's core competencies combined with those of CDT helped quicken the automation of the aviation industry. Above, robots inspect wing spars on a Boeing 777x at the aerospace giant's Everett, Washington, plant.

The merger of Cable Design Technologies (CDT) and Belden in December 2004 brought together two companies with an ambitious goal to become the leading provider of high-speed electronic cables in the United States. The transaction combined two businesses that had grown through multiple acquisitions over the years, making it a merger of many companies.

CDT was established as Intercole Automation Inc. in 1980 and incorporated under the CDT name in 1988. It became a public company five years later. Over its relatively short history, CDT acquired many businesses, chief among them Northern Telecom Ltd.'s communication cable and networking wiring products group, known as Nortel.

Other acquisitions included Barcel Wire, Dearborn Wire & Cable, Mohawk Wire & Cable, Anglo-American Companies, Manhattan Electric Cable and Montrose Products Companies. Most were makers of electronic data transmission cables.

"We would buy out similar-type companies," said Alison McCreath, a former Nortel marketing manager who spent eight years as a marketing specialist with CDT until its merger with Belden, where she presently serves as director of marketing communications.

The transactions rapidly lifted CDT into the top tier of manufacturers of advanced electronic data cables and transmission parts. CDT's high-bandwidth network connectivity products included fiber optic cable and connectors, assemblies, components, computer interconnect cables for communication switching applications, and communications cable products used in wireless, central office and local loop applications.

CDT also made electronic data and signal transmission products used in automation and process control for the aircraft, automotive, telecom and leisure industries, as well as fiber optic cables and products such as data center racks, patch panels and enclosures.

Aside from this extensive product portfolio, CDT had "customers that Belden lacked, particularly in Canada, a market where it had a small presence," McCreath said. "We also had realized earlier than Belden the value of the parts that connected to cables. If you sell the connectors along with the cable, you win the customer. … In the end, the merger was complementary, as CDT helped Belden build out its end-to-end connectivity solutions."

Before the merger, both companies were struggling with declining revenues and profits. Baker Cunningham, Belden's CEO, reached out to CDT's CEO, Fred Kuznik, to discuss the value of combining their strengths. The men hammered out the details, and the companies announced their merger plans in February 2004. Since Belden's shareholders received a larger portion of the voting rights in the combined entity, Belden was considered the acquirer for accounting purposes. But the transaction was really a merger of equals—hence its post-transaction name of Belden CDT (the CDT was later dropped).

With five operating divisions post-merger, Belden CDT stood on more solid ground than either company had for several years.

"Looking back," said McCreath, "much of what we're doing today like our Smart Buildings strategy would not have been possible had we not merged. It was a very good deal."

that relationship blossomed into an announcement that Belden and CDT were discussing a "merger of equals."

Incorporated in 1988, CDT was a leading designer and manufacturer of high-bandwidth network connectivity products used in computer interconnect, switching and wireless applications, electronic data and signal transmission, automation and process control, and specialty applications. Over its short life, the company had grown quickly through a series of acquisitions, including several companies that were more than 100 years old.

CDT brought a large portfolio in specialty wire and a strong position in military defense to its merger with Belden. The F/A 22 Raptor, the first supersonic stealth plane, revealed the future of military aviation at around the time of the merger.

"CDT had a strong specialty wire business and a strong market position in unique niches like military defense," Cunningham explained.

Other attractions for Belden included CDT's fiber optic business, inherited from Nortel; a well-regarded line of fiber and copper cables sold under the Mohawk name; a leadership position in data center racks, patch panels and enclosures via the NORDX subsidiary; and the direct sales model of its West Penn Wire unit, which focused on the audiovisual and security markets.

"CDT also had obvious skill sets in making acquisitions, as the company had concluded dozens of deals in such a short period of time," John Wojnicki said.

The complementary product lines and market strengths notwithstanding, Cunningham and his colleague acknowledged that the chief factor driving interest in the merger was its doubling of the combined companies' capital strength. Both Belden and CDT had reported net losses in 2003; their share prices had suffered, and they sought to make their stocks more attractive to institutional investors and mutual funds.

As former Belden Chief Financial Officer Richard Reece explained in a February 2004 conference call with investors, "Shareholders have been patient with us through two years of losses. We did what we could to bring more volume into our operation [but] there's not enough recovery soon enough to permit us to wait it out."

In July of that year, each share of Belden stock and two shares of CDT stock were exchanged for one share in Belden CDT (the "CDT" was later dropped from the company's name). Trading on New York Stock Exchange with a new ticker symbol (BDC), Belden emerged as a new company with more than $1 billion in market capitalization, and as one of the largest manufacturers of high-speed electronic cables in the United States. *Network Cabling* magazine extolled the deal as "a marriage made in cabling heaven."

"All the tools we were looking for"

Cunningham, who retained the titles of president and CEO, led the customary post-merger integration. He oversaw the closing of plants in England, Massachusetts and Vermont, for example, to save some $35 million in operating expenses. Then in May 2005, he retired at the age of 65, having piloted Belden through a tumultuous period that ended on an upbeat note: In 2005, sales catapulted 17 percent and net income increased to $15.2 million, bolstered in large part by the electronic cable division, which accounted for approximately 60 percent of sales.

For the first time in Belden's long history, the board retained an executive search firm to recruit a new president and CEO from outside the company. Sweeping shifts were underway in the manufacturing industry that were reshaping its future, with companies seeking ways to fine-tune processes for greater output and efficiency, higher quality and lower costs. Initiatives like Six Sigma, Just-In-Time Manufacturing, Lean Manufacturing and Industrial Automation swept the industry.

For the most part, Belden lagged in adopting these trends, and it didn't have anyone versed in those disciplines in-house, compelling the board to seek new leadership. Finding someone was a tall order.

"We were a cable company with disparate facilities," Ashish Chand said. "We needed someone who could strategically integrate our operations, make them more efficient, invest in adjacent technologies, and effectively create the next stage in our evolution."

In October 2005, the board selected John Stroup to succeed Cunningham as president and CEO. The 39-year-old Stroup had extensive experience in industrial automation, having served previously as group executive at Danaher Motion, a $1.1 billion company that made precision motor control solutions for the factory automation, aerospace, defense, medical and transportation markets. Stroup was surprised by the company's outdated manufacturing processes and facilities, but said, "I felt I could make a quick and substantial impact on the company through better operations alone."

Aside from his strategic and operational skills, Stroup's youthful vigor and eagerness made an impression on the board and company executives.

"He had all the tools we were looking for," former Belden CFO Henk Derksen said. "He was inquisitive, extremely smart and engaging, and able to zoom in on what we needed to do."

Stroup's preliminary plans for the long term focused on building up Belden's lower-volume, higher-margin electronics and data networking cable businesses, primarily through bolt-on acquisitions. He also sought to expand the company's focus on connectivity.

"John wanted Belden to provide the parts and pieces that connected to our cables—all the way to the closet where the active computing and networking devices sat in racks and cabinets—the products the CDT's NORDX unit sold,"

John Stroup, hired as president and CEO in 2005, turned Belden into a 21st-century enterprise. He laid out an ambitious reimagination of what the company could become and inspired the people of Belden to believe in and dedicate themselves to fulfilling his plans.

A BIG FOOTPRINT GETTING BIGGER

For more than a century, Belden has been a global company. Early on, founder Joseph Belden recognized the opportunity to sell cable and wire products abroad, meeting the great demand for Belden wire for aviation needs in Great Britain and Russia during World War I. Both countries were allied in war against Germany.

"Orders (from) the combatant countries began as a trickle and soon was a roaring torrent," Joe Belden wrote.

At the end of the war, Belden formed a Foreign Sales Department headed by Joe's brother C. P. Belden to export products throughout Western Europe. In succeeding decades, international sales became a growing source of revenue. In the late 1940s, overseas markets included makers of industrial power equipment, automobiles, airplanes and office equipment, among others. In the late 1960s, Belden's presence expanded throughout Canada following a series of acquisitions; in the mid-1980s, the company established its first distribution center in Neuss, Germany.

In the 1990s, several acquisitions widened Belden's international footprint, including Pope Cable and Wire in the Netherlands, Elektro-Isolierwerke in Germany, Dorfler Kabelwerk GmbH in Austria, Duna Kabel Kft in Hungary and Olex Communications Cable in Australia. Other foreign sales, distribution and manufacturing outlets came into the fold following the acquisitions of North American companies with a global presence.

Belden's plant in Pune, India, is equipped with state-of the-art equipment and proprietary technology to serve the industrial, enterprise and broadcast markets. The 24,000-square-foot facility was created as the first OneBelden factory, serving multiple markets and Belden product lines.

Since 2000, Belden has opened three plants in Mexico and acquired LTK Wiring, which had four manufacturing plants in China and subsidiaries in Chongqing, Dalian and Huizhou. Two major acquisitions have closed in Germany: industrial connectors supplier Hirschmann Automation and Control GmbH, which had two plants in Germany and three manufacturing joint ventures in China; and Lumberg Automation, with production facilities in Schalksmühle and Hoyerswerda, Germany, and Richmond, Virginia.

As of mid-2022, Belden's global footprint included 13 manufacturing and assembly operations in Europe, the Middle East and Africa; 10 in the United States, three in Mexico, two in Canada, two in China and two in India. Among them, they employed 7,700 associates.

Belden's embrace of Lean manufacturing and Kaizen practices in the mid-2000s enabled the company to improve product quality, shorten cycle times, trim inventory and reduce waste—transforming its business model in just a few years from one of make-to-stock to one of make-to-order. Opposite, Belden wire and cable was a mainstay in the recording industry.

John Wojnicki said. “We could make the panels the cables plugged into and incrementally build out our portfolio.”

Before these ambitions could be realized, Stroup and his team needed to fix Belden’s operations. He visited several facilities, walked the factory floor to greet employees, learned about their work, viewed the manufacturing equipment and observed how things were done. He was often dismayed by what he discovered.

“At one facility, there were stacks and stacks of inventory,” he recalled. “I pulled some tags to look at the prices, and they were nearly 10 years old in some cases. That’s a lot of working capital tied up that could be used in more productive ways.”

Another problem was the company’s disordered manufacturing footprint.

“We had too many manufacturing facilities in the wrong locations,” Stroup said. “Cable products are heavy and therefore expensive to transport. We needed to locate near the markets to be competitive. I used to joke that we must be the only company in the world trying to sell products in China that are manufactured in the United States.”

Other drawbacks included the absence of a strategic plan that was less than five years old; employee performance ratings that were below average industry standards; and the lack of key performance indicators (KPIs) that would enable the company to make more informed, data-based business decisions.

“The more I stripped away, the more I learned what needed to be fixed,” Stroup said.

Going Lean

Underlying all the other problems at Belden was a cultural one: post-merger, Belden had become two dissimilar companies. CDT, led by private equity, had been largely a deal maker; its singular expertise was in acquisitions, less so in manufacturing or process improvement. Belden, on the other hand, was more of an old-fashioned, stable but slow-moving company, though it had made opportunistic acquisitions of mostly distressed wire and cable businesses.

These differences echoed in the combined organization's workforce.

"CDT employees felt Belden employees were not edgy and aggressive, while Belden's employees felt CDT's employees lacked process discipline," Stroup said. "One of the key roles I eventually played was as a unifier."

John Stroup communicated his bold strategic priorities with an illustration dubbed "The Pyramid."

After three months of evaluation and analysis, Stroup decided to implement formal Lean Manufacturing practices, principles and tools at all company plants. Dick Kirschner, who managed the Richmond and Essex Junction plants at the time, recalled that Belden didn't have a formal Lean program and continued to make products using cellular manufacturing processes from the 1980s.

Kirschner, who had joined Belden in 1972, recalled picking Stroup up at the Cincinnati airport to drive the new CEO to the Richmond plant on his initial tour. It was the first time the two had met, and the trip was about an hour long.

"John sat next to me in the passenger seat and shot a fusillade of questions my way about our scrap rate, inventory turns, productivity rates, and so on," Kirschner said. "After we toured the plant and distribution center, he left me with the strong impression that formal Lean was in our future."

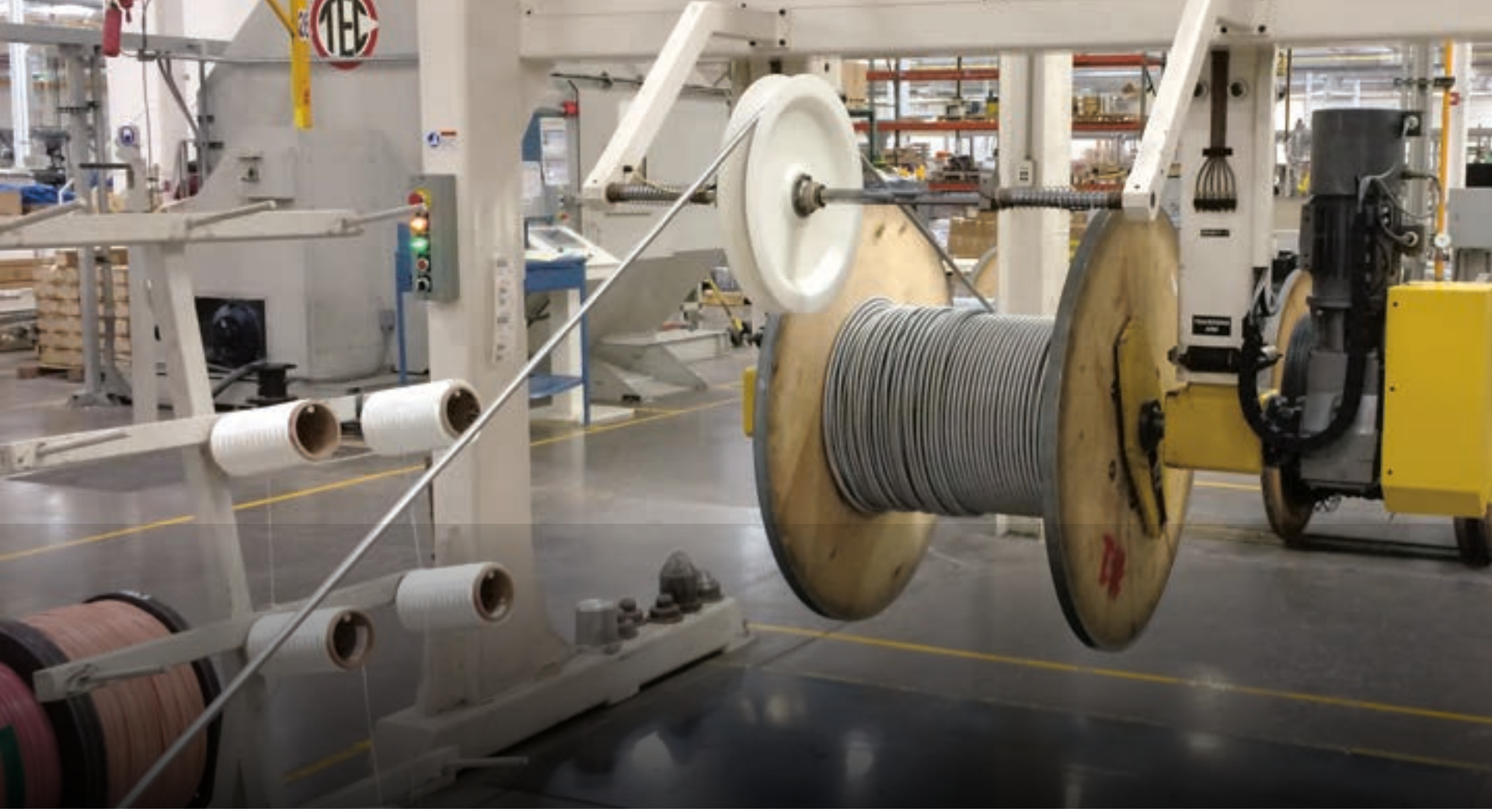
When Stroup announced the company's intention to implement Lean, he appointed Kirschner to lead the initiative.

"Dick knew more about manufacturing cable products than I could ever hope to learn, and we developed a close business relationship," Stroup said. "I made sure to fund him what he needed and gave him a mandate to hire whomever he needed."

Almost immediately, Kirschner engaged a consultant to facilitate the transition to Lean production methods; he then hired seven experts in Lean production and a rapid process-improvement practice called Kaizen. A key Lean building block, Kaizen focuses on eliminating waste, raising productivity and attaining sustained improvements. To foster a cohesive approach to Lean principles and to identify best practices, Kirschner formed a global Center of Excellence, tasking it with developing metrics, stretch goals and targets such as more frequent inventory turns and shorter manufacturing lead times.

To enhance buy-in across Belden's senior leadership ranks, Kirschner invited executives to an intensive, weeklong Kaizen session at the company's plant in Nogales, Mexico. Kirschner chose one specific manufacturing process for one particular product—a thick, steel disk called an extrusion die—and asked executives to see if they could shorten the process; it was currently taking the company about an hour to complete.

"Everyone including John [Stroup] rolled up their sleeves on the production floor to reduce the waste inherent in the



Belden invested $30 million in 2006 to build a new manufacturing facility in Nogales, Mexico, phasing out production at two U.S. plants. CEO John Stroup made the decision in order to lower manufacturing costs and use the capital for organic growth and expansion.

traditional setups," Kirschner said. "By the end of the week, we had the process down to seven to eight minutes. It went a long way towards changing the culture here into a Lean-thinking organization."

Belden held similar Kaizen events at other plants, and these resulted in accelerated manufacturing times and better on-time delivery of products from distribution centers to customers and channel partners. Stroup composed a monthly letter to the workforce about these events and other company matters, a practice he kept to in succeeding years.

Ascending the pyramid

With the Lean initiative paying dividends, Stroup fleshed out a new strategic plan, which he called The Pyramid and released in mid-2006. Represented by a pyramid with three horizontal bands, the plan stacked "urgent activities" at the bottom, continuous-improvement actions in the middle, and Stroup's most aspirational goals at the top.

Stroup's urgent activities included modernizing and streamlining the product portfolio, in part by eliminating unprofitable products; enhancing Belden's brand; and

Long-standing markets such as food and beverage, above, presented new opportunities as manufacturers automated factories and Belden augmented its traditional product line with fixed-wire and wireless switches, routers and connectors.

creating a culture of higher performance, with a stringent review and evaluation process. Regarding this last activity, Wojnicki said, "Employees were ranked between one and five [in productivity], and if you were a one or a two, you were put on a corrective plan. If there was no improvement, you could be dismissed. Productivity dramatically increased."

In the middle of the pyramid sat the need for continuous improvements in operational excellence, via such enterprise-wide initiatives as Lean and Kaizen, as well as a plan to reposition Belden's manufacturing facilities closer to markets.

At the pinnacle, in a pyramid within a pyramid, were written three words: Air. Light. Connectivity.

Stroup explained, "We had always been a copper cable company, but it was clear that copper was being eroded by both wireless transmission; that was air, and by fiber optics; that was light. Connectivity was our way of saying we needed to extend beyond the cable to the connectors and active components that were stickier from a customer standpoint. My goal was for us to sell complete solutions instead of discrete products to customers."

Many customers like those in the automotive, food and beverage, and transportation and logistics sectors were automating production. Belden had long supplied cable products to these customers, connecting to devices like switches, routers, actuators and sensors to operate machinery. Stroup challenged the organization to make and sell these other connected devices in addition to cables.

Using the pyramid, Stroup galvanized senior management and board members around the opportunities to generate profitable business by offering solutions incorporating a range of high-value connected products to customers in the United States, in fast-growing markets in the Asia-Pacific region and elsewhere. Strategic acquisitions of leading companies that made switches, routers and other connectors would abet these aims.

As Belden implemented Stroup's plan, it would finally be on its way to being no longer purely a maker of wire and cable products. For decades, the company had sought to de-emphasize the manufacture of commodity products in favor of solutions that would provide robust and lasting market differentiation, better margins and hard-wired relationships with customers. A young and admittedly brash CEO had figured out how, by focusing on the "pieces and parts" that Belden's traditional products connected.

"What John had in mind was transformative," Ashish Chand said.

Funded to a large extent by the cost savings from operational efficiencies and a planned divestiture of noncore assets, Belden plotted another series of major acquisitions.

"You build a pyramid from the bottom up," Stroup explained. "Nobody likes to clean up the basement, but once we could get the house in order, I told everyone we could work on some very exciting fiber optic and wireless initiatives. That was the prize at the end."

Now all Belden had to do was execute.

By the late 2000s, Belden was playing an ever-larger role in many of its customers' mission-critical connectivity applications. The company had divested underperforming product lines, completed nearly a half-dozen strategic acquisitions, opened a plant in China and taken a strong position in industrial automation and networking that helped offset the impact of the financial crisis of 2008-2011. The Belden eStruxture optical distribution frame shown here is a key component in the management of fiber optic connections. Opposite, Belden's 700 Series HDMI cable for digital video.

CHAPTER SEVEN

Connecting the

Connectors

CEO John Stroup's new strategic plan gave Belden's workforce a sense of clarity and purpose, unifying and invigorating employees, and inspiring them to stretch themselves and their view of what the company could do.

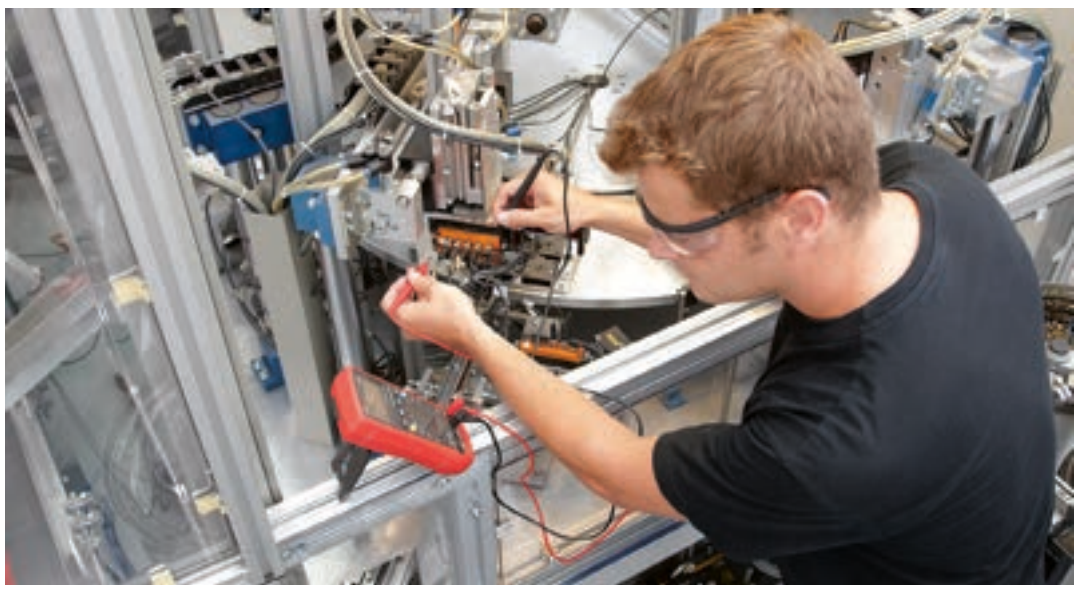
Even with the bar set high, Belden's people exceeded even Stroup's expectations—and within just months. They made dramatic improvements in operations; two plants were closed in the mid-South, and a new one opened in Mexico, moving manufacturing closer to customers in the Americas; and several product lines were divested or terminated without negative impact on relationships with distributors. With the foundational objectives of its pyramid strategy achieved, Belden had ample capital to begin acquisitions. It targeted companies that made the products that Belden's cables connected, and businesses that could expand Belden's presence in emerging markets.

"Now is not the time to be overconfident"

In 2007, Belden bolstered its business in China, one of the world's fastest-growing markets, with the acquisition of LTK Wiring in Hong Kong, a leading maker of PVC and thermoplastic elastomer (TPE)-jacketed cables for data transmission and automotive applications. LTK had four manufacturing plants in China and subsidiaries in the Chinese cities of Chongqing, Dalian and Huizhou.

Although LTK was not Stroup's top choice among three acquisitions Belden looked at—it was a traditional cable manufacturer whose products had more to do with the company's past than its future, he said—no longer would he jest that Belden was the only company in the world trying to sell U.S.-manufactured products in China.

Belden closed on two other important acquisitions in 2007, both in Germany; they supported Belden's efforts to



Belden made two key acquisitions in the late 2000s: Hirschmann Automation and Control, and Lumberg Automation. Lumberg's specialty is industrial connectors, high-performance cordsets and field bus communications components for factory automation; above left, several Lumberg LioN-X I/O devices. Hirschmann is a leading supplier of connectors for the Industrial Ethernet; right, a Hirschmann employee tests an automated rotary table used to produce power connectors. Opposite, traders react to a precipitous stock market drop during the financial crisis of 2008.

move beyond cabling in the desirable factory automation market. The first transaction, announced in January, involved Hirschmann Automation and Control GmbH, a supplier of industrial connectors with two factories in Germany and three manufacturing joint ventures in China. Hirschmann was a global leader in solutions for the Industrial Ethernet—the networking technology that transmitted production data in a factory environment.

The second acquisition, completed in April, was of Lumberg Automation, another leading supplier of industrial connectors, as well as of high-performance cord sets and field bus communications components. The Lumberg product line complemented Hirschmann's portfolio and Belden's expertise in signal transmission, enabling the company to provide an end-to-end Industrial Ethernet solution.

"Overnight our EMEA (Europe, Middle East and Africa) division went from low-margin cable business to high-tech, higher margin connectivity business," Henk Derksen said.

Meanwhile, Belden reinforced its leading market position in signal transmission in 2008 with the acquisition of Trapeze Networks, an infrastructure leader in the wireless LAN (local area network) market.

"At a time when mobile devices and enterprise mobility were just taking off, we could offer our enterprise customers connectivity solutions blending the strengths of copper, fiber and wireless technologies," Stroup said.

All three acquisitions were well-aimed and well-timed, at least given the circumstances that were obvious at the time. The global economy was vibrant entering 2007, and the United States had finished three straight years of healthy growth in the gross domestic product. But underneath the bullish conditions were largely unseen strains and fissures, many years in the making. It became clear by the summer of 2007 that something was very wrong.

A kick in the gut

To rejuvenate a slowing economy and counter the devastating financial impact of the 9/11 terrorist attacks, the Federal Reserve began lowering interest rates in the United States in 2001, and a series of further reductions over the next two years flooded the economy with liquidity.

Backed by credit, banks began pushing mortgages, often to home buyers with marginal credit, and as they usually do, funded further lending by pooling the mortgages and selling them on a secondary market. This time, however, the investment firms, hedge funds and others that bought the pooled

THE EX-CONNECTOR

Following Belden's acquisition of PPC in 2012, the company inherited the External-Compression Connector, an invention that changed the cable installation industry. Used to crimp cables of many different sizes while preserving the integrity of the insulation, the Ex-Connector made work vastly simpler for cable installers.

The acquisitions of CDT in 2004 and PPC in 2012 positioned Belden to become one of the world's major cable developers and manufacturers, and a leading provider of connectivity products and solutions.

The CDT deal brought with it data center racks, patch panels and enclosures, via the company's NORDX subsidiary, and early IBDN cable management products that enable today's integrated cable-management solutions. The PPC transaction, given that company's large portfolio of advanced connectivity solutions, built on these strengths. With PPC, Belden also acquired a portfolio of patented cable connectors, including an invention in 1998 that vastly simplified the work of television cable installers.

Until that time, installers used a crimp connector to attach one cable to another. While each of the two cables had a center conductor wire and an external layer of foil or braid, there were minute differences in the cables' diameters.

"These differences made it difficult to fasten the cables properly with a crimp connector to keep water out," said engineer Noah Montena, who joined PPC in 1997 and today is director of product innovation at Belden. The hundreds of differently sized connectors, each designed to fasten cables of a particular diameter, presented another drawback to crimping.

"The installer would be outside in the rain or in a crawl space in poor lighting with all these connectors to replace the previous connectors that were corroded from the rain getting inside them," Montena said. "In a rush, they'd grab whatever would fit, even if it was a little larger than it should be. Once the connector loosened, water entered the cable and corroded the conductor." That all but guaranteed that the installer would be back the following year to replace it.

Montena, most of whose work to that time had involved designing pneumatic fittings for PPC's machinery, was determined to solve the problem.

"I thought, what if I could push a round die with a conical taper inside it over the cable, it would be large enough to accept the cable and then could be compressed down to the precise diameter of the cable."

Montena resisted the traditional use of brass for the crushable fill.

"I looked for a plastic material that achieved the right performance but at less force," he said. "I also wanted for us to be able to make the part using our own injection molding machines, so we could control the precise configurations in very high manufacturing volumes."

Montena called his invention the Ex-Connector, for External-Compression Connector. For cable installers, the Ex-Connector replaced hundreds of differently sized connectors with one connector that fit perfectly and did not easily degrade; it has since been refined continually to reduce the risk of environmental damage. For PPC (and Belden today), sales of the Ex-Connector are robust, with close to 1 billion sold each year.

"In the grand scheme of things, it was not a huge deal, but it quickly ramped up to become the industry standard," said Montena. "Whenever I'm at a friend's house and happen to peer at their cable connection and see the connector, I think to myself, 'I did that.'"

mortgages—many of them subprime—packaged them into derivative instruments called collateralized debt obligations (CDOs), which they sold to other investors; the buyers then protected their investments from default with products called credit default swaps, which they could buy from insurers such as AIG (American International Group).

Everything was fine as long as housing prices continued their long upward trend. But the stage was set for catastrophe if the housing market reversed course—which it did after the Fed started raising interest rates in 2004. Homeowners, many unable to afford more expensive loans, began selling their houses into a saturated market. Construction slowed and home prices plummeted, along with the value of the securities on which their mortgages had been based. More than 25 subprime lenders filed for bankruptcy, as did the investment house Bear Stearns, one of the largest investors in CDOs. AIG collapsed and required a federal bailout.

From October 2007 through March 2009, the value of the U.S. equity markets fell more than 50 percent, and a major recession ensued, sweeping Belden up in the economic wreckage.

"It was a kick in the gut," said Stroup, whose monthly letters to "Dear Belden Associates" explained what happened and its impact on Belden.

"The era of easy credit has ended, putting the U.S. economy in tough shape," Stroup wrote in October 2008. "Because the U.S. economy is so tightly integrated with the world's other important economies, the slowdown has spread to Europe and Asia. Businesses no longer have the need to expand their production and increase capacity. This means investments in new factories, non-residential construction and information technology will slow down. Since our products are applied in such areas, we should expect our business to slow, as well."

The following month, Stroup wrote that "now is not the time to be overconfident," but he reassured employees that Belden's solid credit rating, strong capital reserves and continuing ability to generate cash gave it sufficient liquidity to endure well into the future. If the company needed to assume additional debt, Belden's balance sheet had the strength to accommodate it, he wrote. Nevertheless, he announced the "undesirable, but necessary, step" to downsize the workforce "in a humane manner."

Gaining strength in a storm

Stroup felt it essential that, even against the headwinds, Belden press ahead with its growth strategy—convinced that the company could offset revenue and margin losses through organic growth: selling more to existing customers while continuing to seek new customers. He also believed that by delivering a unique value proposition and achieving lasting competitive differentiation, Belden would eventually be able to raise prices.

"This is unquestionably the best countermeasure in a declining market," Stroup wrote. "None of us welcomes these challenges, but I know we have the people, processes and plans to not only weather the storm, but to emerge stronger than our competitors."

Stroup looked domestically and internationally for growth, as well as for the capacity to meet an expected increase in demand as soon as it came. The Asia-Pacific region had been hammered by the recession along with the rest of the world, though the Chinese economy was showing more resilience than others. To serve the region, Belden opened a plant in Suzhou, China, in the first quarter of 2009. It was Belden's largest manufacturing facility outside North America.

At the end of that year, eyeing the opportunity to develop a copper-to-fiber architecture for broadcast television,

Stroup engineered the acquisition of Telecast Fiber Systems, a U.S.-based manufacturer of fiber optic technology for live entertainment production and broadcasting. Belden quickly began integrating its cable and wireless signal transmission connectivity platforms with Telecast's fiber optic systems.

In the meantime, however, the recession hammered Belden's legacy cable and wire business, including the LTK cable subsidiary in China. To mitigate the impact, Belden sold parts of the original acquisition to Shenzhen Woer, a Hong Kong manufacturer of heat shrinkable materials. Belden held on to a few of LTK's products and technologies that were aligned with its connectivity strategy, but the company took a loss on the divested assets. Trapeze also came up short and was sold to Juniper Networks in 2010.

Other Belden acquisitions fared exceptionally well during the downturn, chief among them Hirschmann and Lumberg. Both grew revenues and market share, affirming the viability of Stroup's strategy. Building upon Hirschmann's and Lumberg's success, the company acquired California-based GarrettCom, a global supplier of industrial grade switches, routers, converters and security software, in 2010. GarrettCom's networking products complemented the Hirschmann networking products for mission-critical applications in the transportation, power utility, telecommunications, surveillance and security, and other industries, strengthening Belden's market position in industrial networking.

In 2011, the U.S. economy recovered its pre-recession vitality. Liquidity returned in the financial markets and stock indices rose. Belden finished the year strongly, recording a 159 percent increase in earnings and a 23 percent increase in revenue. In his letter to employees, Stroup took pride in their efforts, writing, "Never in our history has our financial position been stronger."

The expansion of the Suzhou, China, Belden plant in 2014 in the eastern Jiangsu Province put the company in a strong position to capitalize on growth opportunities in key markets across the entire Asia-Pacific region, offering global customers shorter lead times for Belden's differentiated products, technology and services.

Fiber bounces back

Buoyed by the uptick in performance, Stroup engineered one of the largest and most pivotal acquisitions in Belden's history when the company purchased connector manufacturer PPC for $515.7 million in 2012. PPC was a leading developer and manufacturer of connectivity technologies for the broadband market. Its broad portfolio was comprised of advanced connectivity solutions, coaxial cable, fiber optic cables and ducts, amplifier technology, construction hardware, cable molding and raceways, and traps and filters for telecommunications. PPC retained its name as a Belden brand called PPC Broadband.

Apparently, great ideas in cabling and connectivity are born in bars, as PPC, like Belden, had its origins in one: the cellar of the Heidelberg Restaurant and Bar in Manlius, a suburb of Syracuse, New York. Founder John Mezzalingua had launched PPC in 1939 as a manufacturer of custom screws for the automobile and home appliance markets. During World War II, screws became a valuable commodity, and the company prospered.

The reputation of PPC Broadband and its products, such as this versatile house amplifier splitter, guided the decision to retain the PPC name as a Belden product division.

In the 1960s, Mezzalingua's son Dan jumped on an opportunity to make cable television fittings for the nascent CATV industry, back when TV set tops sported rabbit-ear antennas to capture broadcast signals over the airwaves.

"Getting in on the ground floor of CATV intrigued him," author R. Harrison Huston wrote in the book *Mezzalingua*, a memoir of the family. "Dan saw it as a potential giant."

His instincts were prescient. CATV boomed, and PPC rapidly grew into a leading manufacturer of connectors and cable for the industry. It then pioneered and patented advancements in connector technology that revolutionized broadband, setting industry standards for quality, performance and function. In 2008, *The Wall Street Journal* ranked PPC No. 2 among the 35 most innovative companies in the United States.

These many attributes appealed to Stroup.

"It was a wonderful acquisition, giving us a highly respected brand, talented people and tremendous intellectual property," he said. "Together, we'd be able to provide unique end-to-end solutions delivering higher bandwidth and advanced services with fewer service calls, and that would help our global broadband customers profitably grow their businesses."

This plan set PPC Broadband on its own acquisition spree. It picked up several companies to widen its offerings of integrated broadband fiber products to telecommunications providers, cable multiple system operators (MSOs) and other customers. The transactions included two optical fiber solutions providers, NT2 and OPTERNA FutureLink; integrated fiber enclosures manufacturer SPC; and UK-based fiber optic cable maker M2FX. M2FX's chief attraction was its use of a proprietary process called Mini-Flex to extrude and make hardened fiber optic cable jackets that were very flexible.

"Fiber optic was again the future," PPC Broadband's senior director of operations, Brian Hayes, said. "It initially died with the dot-com bust but had come back."

Fiber optic cables enjoyed a mini-boom starting in the mid-2010s, as cloud computing vendors built fiber optic networks with speeds as high as 100 billion bits per second

FROM SCREWS TO BROADBAND SOLUTIONS

Having been at the forefront in the development of products for the cable TV industry, the combined Belden PPC benefited as broadband-delivered streaming media became feasible. With 5G cellular and broadband networks in place across much of the world by the early 2020s, Belden's wide-ranging solutions for the sector are poised to grow.

Of Belden's many acquisitions over the past 120 years, one of the most important was PPC in 2012 for $515.7 million. The sum would have flabbergasted PPC's founder, John Mezzalingua.

Genaro Mezzalingua's parents were immigrants from Italy, and they changed his name to John on the advice of his kindergarten teacher, according to a memoir of the family by author R. Harrison Huston. As a teenager in the early 1920s in Manlius, New York, Mezzalingua worked multiple jobs at a greenhouse, a foundry and in his father's trucking business.

He often drove one of the family's trucks to deliver parcels to an Italian grocery store owned by the Minozzi family. The Minozzis also owned the Heidelberg Restaurant and Beer Garden next door to the store. On these trips, Mezzalingua met and fell in love with Carmella Minozzi, who became his wife in 1931.

At the time, the Great Depression gripped the country. The family's trucking business foundered, and the Mezzalinguas barely scraped together enough money to pay the bills. At the Heidelberg Restaurant one afternoon, John Mezzalingua began thinking about all the screws that went into making home appliances and automobiles. He figured the foundry could supply steel for the screws; all he would need was to buy a machine that made them.

Fortunately, the family enjoyed solid relations with a local bank in Manlius, and Mezzalingua was able to borrow the money to buy a single drill press that made several thousand screws each hour. In 1939, he founded Production Products Company (PPC) to make custom screws to specifications for multiple markets. During World War II, the need for screws in military equipment kept the one-room factory humming.

After the war, PPC branched into making screw machine components as well as screws. Then, in the 1960s, Mezzalingua's son Dan started working for PPC as its second salesman—John being the other.

"Dan was busy knocking on doors when he called on a company that would dramatically … alter the direction of the company," Huston wrote in his 1997 book *Mezzalingua: memoirs of an Italian-American family*. The customer, Oneonta Video, manufactured antenna components for television sets and roofs, and Dan struck a deal to make cable television fittings for the company.

As Oneonta's business grew, it began to sell a range of cable equipment under a subsidiary called Craftsman Electronic Products. The company's expansion got Dan thinking: "He hashed and rehashed the pluses and the minuses of cable television and could find few minuses and a multitude of pluses," Huston wrote.

After a conference between father and son, PPC bought Craftsman from Oneonta. John Mezzalingua was "100 percent sold," Huston wrote, when Dan projected that in 25 years, "the entire nation will be wired for cable television."

What was then a father-and-son business in a one-room plant was poised to take off like a rocket. PPC exploded with business and became a leading manufacturer of connectors and cables serving the cable TV and telecommunications industry. Then Belden came calling with an offer to combine the two companies into one with critical mass that could provide high-bandwidth solutions to broadband customers worldwide.

(BPS). Future speeds of 400 billion BPS were envisioned to serve the data transmission needs of the Internet of Things, artificial intelligence and 5G (fifth-generation) mobile networks. PPC Broadband was well positioned as a leading provider of broadband fiber solutions as these other technologies took root.

Broadcast automation, cybersecurity and smart buildings

Belden's other acquisitions of the 2010s were aimed at gaining a foothold in the growing broadcast automation market. At the time, television studios, radio stations and broadcast networks were deploying technology to reduce or eliminate manual operations in program switching. Since the earliest days of radio and television, program content and ads had been delivered live from a studio, from tape recordings or relayed from a network feed. Someone at a console slid or toggled switches by hand to change what a listener heard or a viewer saw.

"For decades, a person sat in a control room with a channel guide that listed scheduled TV or radio shows, and he pushed buttons at just the right time to broadcast *60 Minutes* or *M*A*S*H* to the public," Stroup said. As content began to be produced, stored and distributed digitally, and as communication infrastructure got more robust, sophisticated and reliable, the switching could be done by computers.

Making the decision to offer broadcast automation systems, Belden undertook two acquisitions. The first, in 2012, involved Miranda Technologies of Canada, a leading supplier of hardware and software for the television broadcast, cable and satellite industry. The $357 million acquisition increased the percentage of Belden's revenue from networking and connectivity products from 30 percent to 36 percent. Two years later, Belden purchased Grass Valley,

one of the world's largest manufacturers of broadcast equipment like cameras, studio production switchers, sports replay and highlights devices, and media storage. After the deal closed, Belden merged Miranda into Grass Valley. Belden acquired another broadcast technology company, Snell Advanced Media (SAM), in 2018 and merged it with Grass Valley.

In just a few years, Belden had gained a sizable market presence selling suites of connected products to customers in industries in the thick of using technology to transform traditional processes and production methods. Among them was manufacturing, where Belden was supporting a digital transformation of the factory floor through wireless, mobile and other technologies that comprised the Industrial Internet of Things.

Factory automation, supporting processes such as this robotic welding operation at a General Motors truck assembly plant in Canada, became a major market for Belden in the 2010s. So, too, did broadcast automation, and Belden provided hardware, software and switches to radio and TV stations, opposite, and broadcast networks.

"Hirschmann grew rapidly during and after the downturn because its intellectual property was adopted on the factory floor by Procter & Gamble, General Motors, Clorox and other end users automating their production," Stroup said. "Meanwhile, we had great relationships with the world's largest automation companies like Emerson, ABB, Schneider Electric and others. We were in a unique position."

Stroup believed Belden could leverage that position, particularly in cybersecurity.

The extraordinary reliance on digital data and automated processes that tie manufacturers, suppliers, service providers, distributors, retailers and end users together through interconnected systems put every stop in the supply chain at risk—from data and identity theft to business disruption, political and social attacks, and ransomware. The risk was so high that 70 percent of IT security executives told the Ponemon Institute in a 2014 survey that their companies had experienced a significant disruption to operations from a cyberattack. They attributed successful attacks to "immature cybersecurity programs, with loosely defined threat protections at critical infrastructure."

Many of Belden's customers in the power system transmission, cable infrastructure, broadcast and other sectors fit this profile. Stroup contemplated the value of adding cybersecurity products to Belden's portfolio, to help customers enhance the robustness and security of IT networks. He took his idea to members of Belden's board, senior management, major investors and employees.

"Some people thought it made perfect sense, while others saw it as a significant leap," he said. "I struggled initially to describe the fit and value. Ultimately, I explained that cybersecurity was just another product extension, no different in many ways than the switches and routers that connected to Belden's cables. Since the cybersecurity software resided within a network switch or router, it could be bundled into a solution for a customer's mission-critical applications."

With the board's assent, Stroup transformed Belden into the world's largest provider of solutions for industrial cybersecurity. In 2015, the company acquired Portland, Oregon-based Tripwire for $710 million. The company had been founded by Gene Kim, a computer science undergraduate at Purdue University whose independent study project in the early 1990s involved network cyber intrusion. He released Tripwire in 1992 as an open-source intrusion detection tool that could tell when either accidental or malicious changes occurred to a UNIX operating system; with the changes

PROFILE OF AN INNOVATOR

Eric Purdy, Broadband & 5G

Eric Purdy, the second most prolific inventor in PPC, holds numerous U.S. and foreign patents on devices that forever changed the connector landscape. His design for Signal Tight, a coaxial cable connector, revolutionized the coaxial cable market and changed the standard operating procedure of major U.S. network operators, which no longer had to require that their connectors be fully tightened to preserve signal integrity; Signal Tight was the first design of a connector that establishes and maintains a reliable ground path to a port even when an installer doesn't fully tighten the connector on the port.

Purdy's designs are used in residential and business applications for communication services such as television and internet access. Such installations typically have dozens of these connectors, which loosen over time. Signal Tight prevents signal degradation and lowers the risk of interference with service.

Purdy also devised a method for ensuring continuous shielding, which is vital to maintaining signal speed and strength, and vastly improves overall streaming quality. Connectors invented by Purdy can be blended, mixed and matched to meet customer needs, significantly increasing signal quality and reliability.

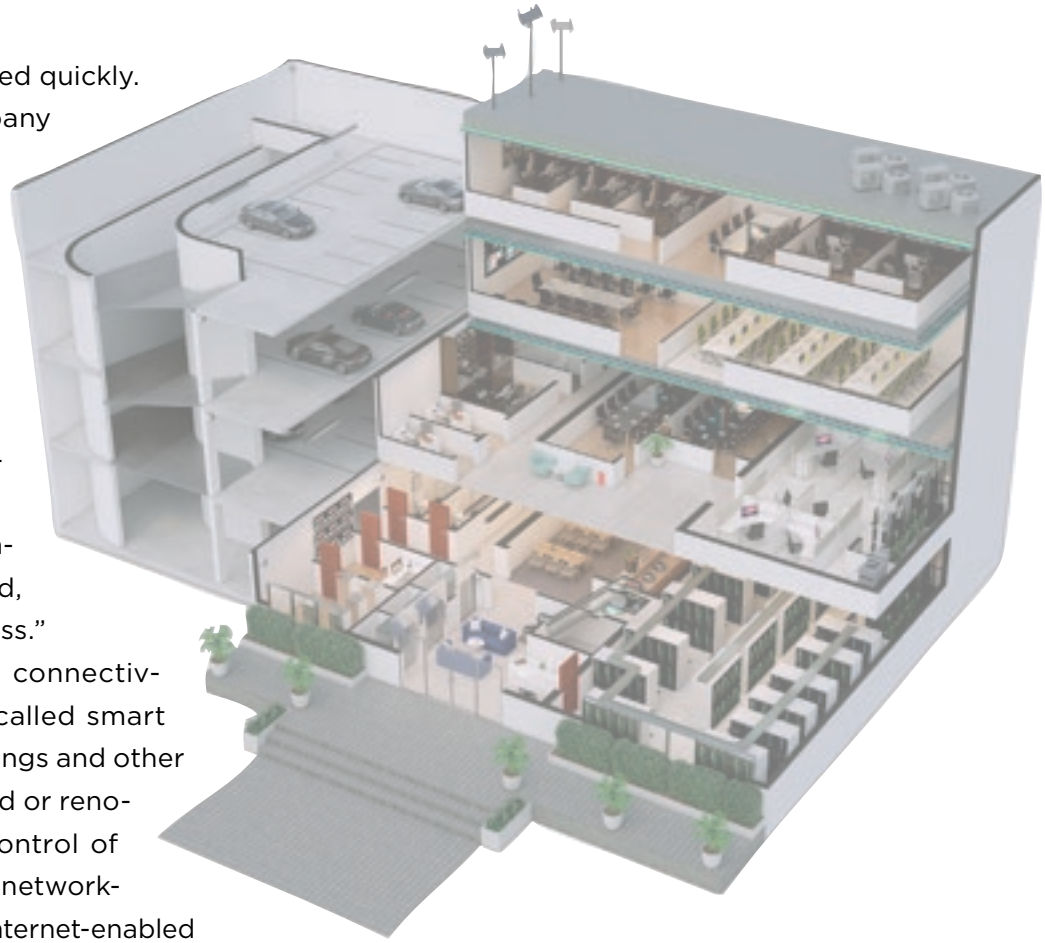
More than 2 billion Signal Tight connectors have been sold, generating more than $500 million in revenue for PPC to date; additionally, litigation over Purdy's patents have produced substantial licensing royalties.

detected early, the system could be recovered quickly.

Six years later, Kim co-founded a company with the name Tripwire Inc. He served as chief technology officer and hired W. Wyatt Starnes as CEO. The company became a leader in cybersecurity with a twofold value position: identifying industrial network configuration weaknesses, and providing the appropriate cybersecurity software to strengthen cable, connectivity and networking products.

"Unquestionably, it was a seemingly unconventional acquisition," Stroup acknowledged, "but it was a natural extension of our business."

Another natural extension of Belden's connectivity expertise was the development of so-called smart buildings. Manufacturing plants, office buildings and other commercial structures were being developed or renovated with systems that automated the control of power, heating, ventilation, air conditioning, networking, lighting, security and other subsystems. Internet-enabled wireless sensors, switches, routers and other products were able to accumulate and analyze enormous amounts of data and make adjustments in each system for optimum performance. Wholly integrated smart buildings increased energy efficiency; reduced water usage; enhanced air quality; improved workforce or residents' safety, security and comfort; and lowered operating costs.



Solutions for smart buildings is one of Belden's areas of expertise and, particularly following the 2018 acquisition of JMA Wireless, the company now offers a powerful set of solutions to connect and control power, HVAC, networking, lighting and security systems in commercial buildings. Through its own capabilities and a partnership with Tripwire, cybersecurity, opposite, is among the services Belden can provide to all of its customers.

To meet the growing demand for intelligent building systems, Belden inked a strategic alliance with wireless infrastructure provider JMA Wireless in 2018. It combined Belden's fiber solutions; power cabling; patching solutions; and NORDX custom cabinets, racks and enclosures (renamed Belden Networking) with JMA Wireless' antennas and distributed antenna systems, along with JMA's digital electricity, radio frequency conditioning and mounting systems. The partnership enabled Belden to deliver what Julie Furber, who joined Belden as executive vice president of Smart Buildings in 2020, called "the most powerful solution set in the industry to deploy a fully converged wireless technology infrastructure in a smart building."

The hardest decision

After more than 110 years in business, Belden was still a wire and cable company, but it was also much more. Its legacy product lines represented an ever smaller contribution to revenue, and more often than not, cable and wire products were sold as part of a larger solution.

Geographically, the United States accounted for slightly more than 50 percent of sales. About 8 percent of revenues came from Canada, 5 percent from Germany and China, and no more than 2 percent from other parts of the world. This modest geographic diversity was a considerable strength, as it broadened Belden's sources of revenue, leveraged growth in emerging markets and enabled the company to place manufacturing close to where the products were sold. It also provided currency hedges and limited the financial impact of a geopolitical or economic crisis in a single country.

To capitalize on growth in the Asia-Pacific region, Belden began producing Lumberg Automation industrial connectors and products targeted specifically to the Chinese market at the Suzhou plant in the summer of 2014. At the time, Belden's Industrial Connector division had four production bases in Europe and the Americas. Ashish Chand said this fifth, Asian base was "a very important step in our localization strategy, as our customers in China benefit from shorter lead times and local technical services."

Meanwhile, the acquisitions continued at home and abroad. They included, in 2014, ProSoft Technology of Bakersfield, California, and, three years later, Connecticut-based Thinklogical. ProSoft's expertise was in solutions that enabled dissimilar automation control equipment to exchange data via wired and wireless connection; it had a presence in many industries worldwide but an especially strong position in Asia-Pacific manufacturing. Thinklogical's strength was in developing and manufacturing high-performance, fiber optic-based video and switching equipment for military and broadcast applications.

Alison McCreath, Belden's director of marketing communications, said Belden was drawn to Thinklogical because of its position in building command and control centers for the U.S. military. Its secure keyboard-video-mouse (KVM) switches allow a user to control multiple computers through a single keyboard, monitor and mouse—and, said McCreath, "The switches can't be hacked. We see it as a compelling opportunity for profitable growth."

As a new decade neared, John Stroup had successfully executed the three stages of his strategy. Having reached the "air, light and connectivity" pinnacle of the pyramid, Belden was providing leading connectivity, communication and cybersecurity solutions to customers in many industries around the world. In 2018, revenues reached a record $2.59 billion, and earnings per share and cash flow both catapulted by 13 percent from the previous year.

Then one of its key markets, broadcast solutions, abruptly faltered.

For nearly a century, broadcast and cable television had dominated the delivery of entertainment to people's homes. But in 2007, Netflix began offering streamed movies and television

In 2017, Belden acquired Thinklogical, a manufacturer of keyboard-video-mouse (KVM) signal extension and switching systems that enable organizations to easily access and distribute video-rich data. Its solutions are used by government, media, entertainment and critical-infrastructure organizations for high performance, security and fast decision-making in mission-critical situations.

People have always been the secret to Belden's success. Doing work that has purpose and meaning increases employees' engagement, satisfaction and happiness. Here Justyna Mikolajczyk packs connectivity products at Belden's plant in Neckartenzlingen, Germany, readying them for last-mile delivery.

shows to subscribers over the internet; broadcast and cable networks' dominance weakened. Streaming services by Netflix, Apple, Hulu, Amazon and others—plus many of the networks themselves, which bypassed the intermediaries and went straight to consumers via the internet—quickly displaced broadcast and cable.

"Netflix took the industry by surprise, turning it upside-down," Stroup said. "Very few people expected that Netflix would become what it has become."

Disruption of the television and cable industry by streaming services had been on no one's radar just a few years earlier, but by the early 2010s, it was inevitable. For a while, Grass Valley seemed to be protected from the impact, as streamed programs still had to be produced and recorded somehow; Grass Valley's switches, high-definition cameras and other devices were essential pieces of studio equipment—particularly in producing live sports and news.

"But that market was imploding," Stroup said. Rather than buy new cameras and consoles, networks hoarded their capital for bids on the rights to televise sporting events like football, golf and major international competitions, he explained. The repercussions would reach Grass Valley if streaming providers began outbidding the networks for, say, professional football games or other highly popular events—which Stroup predicted they eventually would.

Thus, in July 2020, Belden sold Grass Valley along with the Miranda broadcast technology assets to private equity firm Black Dragon. The sale removed a drag on Belden's organic growth and free cash flow, saving $100 million in costs in 2020 and 2021. The deal made economic sense for Belden, but it wasn't easy.

"It was my hardest decision," Stroup said.

Nevertheless, the CEO had achieved almost everything else he had planned in leading a company whose once-sharp competitive edge had dulled considerably just before he arrived in 2005. Stroup had succeeded in transforming Belden from a commodity business into a modern enterprise that provides wide-ranging connectivity solutions and cabling products for industrial applications around the world.

But a company is more than its products. While Stroup's vision of what was possible laid the template for Belden's turnaround, it was Belden's people who delivered it. An emphasis from the top on talent acquisition, skill and career development, and teamwork sent a jolt of "can do" optimism into the workforce; employees' performance and productivity spiked, and the resulting culture of trust and support endures to this day.

"John got a lot of credit for developing a culture of process management, which was all about metrics, root cause analyses, KPIs and stretch goals—all of it extremely important in taking a company with little process orientation and getting it to think about and focus on process," said Dean McKenna, Belden's former senior vice president of Human Resources. "He does not get enough credit for the importance of galvanizing and guiding people on a path to potentially greater customer penetration."

Through an initiative that Stroup called "OneBelden," the company began an effort to forge a unique culture focused on performance in a motivational climate, driven by more than just sales metrics.

In May 2020, Stroup stepped aside as Belden's day-to-day leader and was appointed executive chairman, and a new CEO stepped forward—just in time to lead the company through yet another crisis: this one a pandemic that was killing millions and putting the global economy on life support.

CHAPTER EIGHT

The Digital Transformation Company

As a teenager in Venlo, the Netherlands, Roel Vestjens often passed by the large cable manufacturing facility in the southeast of Holland where he was born and raised. It never occurred to him that he would someday lead the company that operated it.

"Everybody in town knew the Belden factory," said Vestjens, who became Belden's president and CEO in May 2020 when he succeeded John Stroup.

Belden's striking Customer Innovation Centers (CICs) are places where partners and customers collaborate with Belden consultants to develop innovative solutions in industrial automation. Belden's first of five planned CICs, seen here, opened in July 2021. Each features "the cube," a digital window into Belden's transformative capabilities.

Fifteen years earlier, Vestjens had been a business manager in Amsterdam at Phillips N.V., the Dutch conglomerate, and stuck in a career rut. Having studied to become an electrical engineer, he received an MBA from Nyenrode Business University and left the Netherlands to launch his career in the United States, becoming a senior consultant at Capgemini in Seattle. He joined Phillips in 2002.

"I noticed that I was taking longer and longer vacation time; I was getting bored with the Dutch multinational way of business," Vestjens said. "Then, a friend who had just joined Belden mentioned they were hiring."

An engineer, marketing executive and business leader, Roel Vestjens became Belden's president and CEO in May 2020, in the midst of the Covid-19 global pandemic. He nonetheless seized the moment with a new growth strategy predicated on harnessing the rapid digitization and automation of operations to transform customers' businesses.

At the time, working for a company that made cable and wire didn't appeal to Vestjens, and he passed on the opportunity. Several months sailed by.

"I met my friend again for a beer, and he insisted that Belden was going places," Vestjens said. "I read up on the company and learned they'd just hired this young executive named John Stroup as CEO. The board had given him a mandate to strategically grow the business, which told me they weren't afraid to take risks. It was the American way of doing business, and I missed it."

Making a compelling case

Vestjens handed in his resignation in February 2006 and hired on as the marketing manager for Belden Wire & Cable Systems in Europe, the Middle East and Africa (EMEA). Four years later, he was dispatched to Hong Kong to lead the company's OEM Business Group in the Asia-Pacific (APAC) region, and later was named president of Belden APAC. In 2013, he relocated to Belden's St. Louis headquarters as an executive vice president in charge of several divisions. July 2019 saw him elevated to chief operating officer. In St. Louis, Vestjens worked closely with Stroup, who ceded more responsibilities to him over time.

"John taught me everything I know here, and then the time came for the mentor to let the protégé loose," Vestjens recalled. "It was up to me to run the show now, he said."

Stroup had set the stage for the succession—and put in place the pieces for the kind of American-style business transformation that Vestjens had sought to be part of during his restlessness at Phillips. During Stroup's tenure, Belden had moved beyond cable and wire manufacturing into connectors, switches, routers, actuators, sensors and cybersecurity—all part of Stroup's plan for the company to

become a provider of solutions for companies undergoing their own digital transformations. The aim had yet to reach fruition, however.

"John didn't get a chance to pull everything together to create customer solutions," said Ashish Chand, executive vice president of Industrial Automation Solutions. "He had the vision for what these solutions would be, but [we were] still figuring out how our products would come together in a solution that produced a positive customer outcome."

Vestjens' task was to unravel this conundrum.

"We needed to deliver a compelling operational and financial outcome to a customer," Vestjens said. "I felt the way to do that was to create solutions to specific customer problems based on one or more use cases. The use case was crucial, as it would drive different combinations of our products to solve the problem."

Vestjens capitalized on his multifaceted experience as an engineer, marketing executive and business leader to craft a model for identifying markets and working with customers to build and deliver use-case-based solutions. His broad skill set would become valuable in another way: leading the company through a global pandemic caused by a novel coronavirus, which disrupted business and all but shut down the world for more than a year starting in March 2020.

"Now we simply had to"

The new CEO reached out to management consultant McKinsey & Co. for guidance in further refining Belden's solutions strategy—especially in such a tumultuous, constantly shifting health, economic and social environment.

"We needed a neutral party to sit in and help us understand how the sectors we served would be impacted by these crises," said Chand, who led the team that worked with McKinsey.

Platforms for a new strategy

As the Covid-19 pandemic spread across the world, causing the deaths of nearly 5 million people by late 2021, Belden monitored changes in consumer behaviors, government spending and the evolving ways that people were working. To Chand's surprise, the team found that people collaborating via mobile devices and virtual meetings were highly productive.

"We identified megatrends and played them out across our key industry sectors to discern the implications—what assets they're likely to invest in once the crisis passed," Chand explained.

The megatrends suggested that factories would become ever more interconnected on a much faster timetable than had already taken place. The reason lay in the vast amount of information that was available now that virtually everything incorporated digital technology of some kind.

A Fourth Industrial Revolution, also known as Industry 4.0, was underway, relying upon the use of sensors, data networking and other technologies to automate traditional manufacturing and industrial processes. In factories, for example, sensors embedded in various equipment collect and share volumes of data that can be analyzed with machine-learning algorithms to improve machine performance, speed, accuracy, overall operational efficiency and asset management. People can connect virtually to these smart machines whether they're on site, at their homes or in another remote location. Most of the requisite products were already in Belden's portfolio.

"The upshot was for us to help our customers build the factory of the future," Chand said. "We had long planned to do so, but now we simply *had* to—and we had a competitive advantage."

To seize this opportunity, Vestjens conceived an updated strategy and an organization to deliver it, prioritizing two platforms: Industrial Solutions and Enterprise Solutions, the latter housing Broadband & 5G and Smart Buildings business segments. This vertical-market-based orientation, as opposed to one based on product, was designed to enable Belden to craft solutions to the needs and problems of customers in each sector.

"So much of what is going on today with regard to interconnected factories, enterprises, buildings and people is virgin territory," Vestjens said. "If you don't understand how each market plays, you can't help solve the problems of customers in that market."

The integration of information technology and operations technology enables manufacturers to control, monitor and measure the performance of factory automation systems. With industrial automation one of its key areas of focus, Belden helps customers build world-class, integrated digital and data infrastructures. Opposite, Belden's Broadband & 5G business builds upon a history of service to the telecom industry.

Platform 1: Industrial Solutions

Belden's Industrial Solutions platform focuses exclusively on industrial solutions, where customers are typically looking to invest in advanced networking solutions that converge information technology (IT) assets with operating technology (OT) assets. Belden serves customers in, among others, mass transit; oil and gas; and energy generation, transmission and distribution—providing comprehensive data integration solutions to help them capture the value of the new interconnected environment.

"These customers' operations are critical to business and society, and cannot be interrupted—like a nuclear power plant," said Chand. "Such operations are difficult to change, monitor or repair once they're turned on, however. Our goal is to provide mission-critical networks from the sensor to the cloud, ensuring no operational disruptions."

In developing end-to-end solutions for these and other manufacturing and industrial customers, Belden combines and customizes a variety of software and hardware products into a proposed use case; this allows Belden to explain a solution's use and how it solves a customer problem or need, and to calculate or estimate the projected benefits. Products include active equipment such as switches, routers, access points, and gateways; passive equipment such as cable products and connectors; and network management and security software.

Platform 2: Enterprise Solutions

The two business segments in Belden's Enterprise Solutions platform, Broadband & 5G and Smart Buildings, focus, respectively, on telecommunications and indoor wireless connectivity.

The telecommunications and MSO (multiple system operators) sector, served by Belden's Broadband & 5G unit, continues its long transition from copper wire to fiber optic

broadband technology delivering content over 5G transmission networks. Belden enjoys a leading market share in the sector, thanks to PPC Broadband's early-mover status in serving the fiber optic product needs of MSOs—cable companies that provide services beyond television broadcast. PPC's market appeal was bolstered by the acquisitions of FutureLink, OPTERNA, M2FX, SPC and NT2 between 2016 and 2020.

"Our product portfolio covers every imaginable product category in the sector," said Olivier Bojarski, former president and general manager of Belden's Broadband & 5G business. "We have a strong market presence in fiber optic solutions for at-home and in-building wireless capabilities. We're also well positioned to support 5G broadband network architecture, using optical fiber from the edge of the carrier network to homes and businesses."

The ability to handle this so-called "last mile" of telecommunications positions Belden as a primary provider of outside-the-home copper and fiber solutions; that augments the company's solid market position in inside-the-home copper and fiber solutions.

"There are substantial growth opportunities in the emerging 5G end-to-end solutions market, both domestically and abroad in the APAC region," Bojarski said. "We're excited to integrate the recent bolt-on acquisitions and to patent new products."

Belden's Smart Buildings segment is also predicated on seizing momentum, via the opportunities presented by a rapid growth in wireless connectivity in indoor spaces. The Smart Buildings segment targets "any operation that is not a factory," according to former Belden Executive Vice President Julie Furber, who led the initiative.

Belden's Smart Buildings installations include professional hockey and entertainment arenas, university buildings, hospitals, hotels and data centers. Opposite, Lean Manager Dávid Mészáros at the plant in Budapest, Hungary, has helped make continuous improvement a way of life at Belden.

"We're focused on hospitals, universities, stadiums, hotels, supermarkets, warehouses, casinos and other commercial buildings," she said. "We provide these customers with all the cabling, connectors and patch panels needed to bundle multiple network ports together."

In 2021, the Smart Buildings organization wired the largest new data center in Canada—a $3 million project won over the incumbent. Other Smart Buildings wins, in spite of the pandemic's impact on entertainment events, included a professional hockey arena in eastern New York and a multipurpose sports and concert venue in Austin, Texas.

"During the slowdown, we narrowed our focus on sectors like data centers, healthcare and government that had to keep operating, positioning us for continued growth ahead in these markets," Furber said.

Vestjens coupled Belden's updated strategy with a new organizational structure, a new set of business-unit and enterprise-wide goals, and a reallocation of resources prioritized to each market segment's customer-outcome and financial objectives. The company created three new employee positions in the Industrial Solutions platform: digital automation consultant, solution architect and solution consultant. As of early 2022, a recruitment and training program facilitated by McKinsey was underway to identify and develop the competencies needed in these new positions.

"Depending on the role, there is a need to understand the flow of a factory to identify bottlenecks and opportunities and how our different products can come together as a solution," said Leah Tate, Belden's senior vice president of Human Resources, who leads the talent acquisition and development effort.

For a company that had amassed so many different product lines and skill sets through a procession of acquisitions, the new structure aligns the workforce on a clear and shared path to increase market share in the three segments organically, leveraging Belden's existing product portfolio and R&D.

For the time being, Belden doesn't expect to make large, transformative acquisitions. However, Vestjens said, "We're looking for small, tuck-in acquisitions—companies with adjacent products to broaden our end-to-end solutions."

A case in point is the 2021 acquisition of OTN Systems, a Belgium-based manufacturer of critical telecommunication equipment, for $71 million. Offsetting part of the cost was the divestiture of Poliron, a copper cable subsidiary serving the oil and gas market in Brazil. Belden no longer viewed that business as a strategic priority.

As he was leading Belden in pursuit of a new, solutions-based business strategy, Vestjens was also pushing the company to expand its environmental, social and governance initiatives. With an eye on 2025, he and his team set the company's first-ever goals for reduction of emissions and climate-change impact, use of recycled and recyclable materials, energy use and diversion of waste from landfills; workforce diversity, equity and inclusion; employee well-being and engagement, growth and development; ethics in business practices; and data privacy and security.

Steppingstones in an evolution

By late 2021, as businesses across the world reopened and the United States experienced an economic rebound, Belden was making considerable headway in its evolution into a digital transformation company. In both of its platforms, Belden had implemented innovative ways to develop use cases for solving its customers' problems.

In Industrial Automation Solutions, Belden opened its first Customer Innovation Center (CIC) in July 2021 in Stuttgart, Germany, the nucleus of the European process automation industry. Belden earmarked capital for five CICs to reach and serve customers in the automotive, mass transit, materials handling and intelligent traffic systems industries. The company opened two CICs in 2022, in Santa Clara, California, and Shanghai, China, and planned to open two more—in Chicago and Bangalore, India—in 2023.

At each 10,000-square-foot center, some 50 Belden employees with diverse skill sets engage customers to identify and overcome impediments that may be thwarting their organizations' digital transformations.

Solutions architects at Belden's Customer Innovation Centers use the validation laboratory, this one in Stuttgart, Germany, to test solutions before implementing them at customer sites. Opposite, the CICs' services include live, on-demand and customized training.

"Many customers see us today as a signal transmission products company," Chand said. "The CICs are a major steppingstone in our evolution towards becoming a digital transformation solutions company."

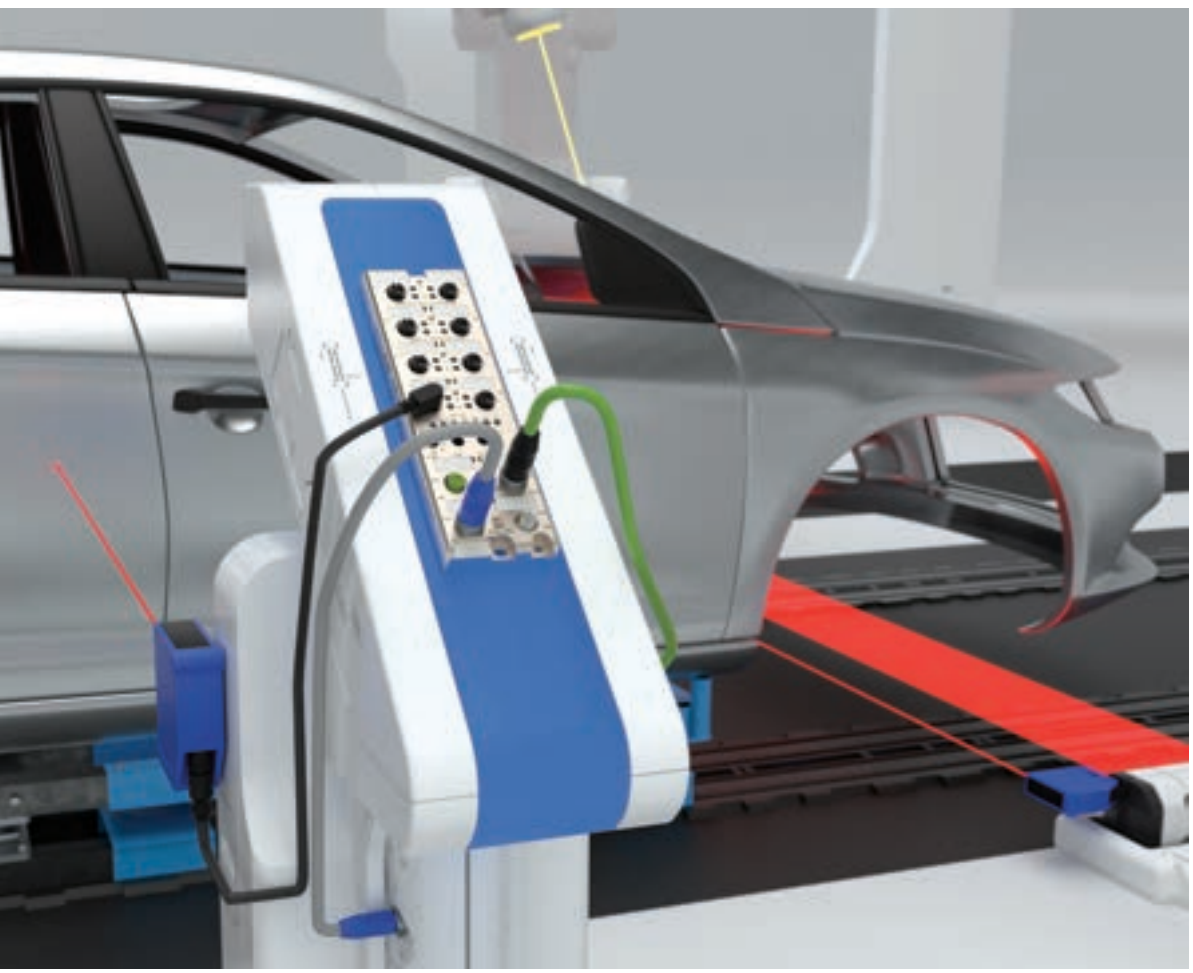
Vinod Rana, vice president of global technical solutions in the Industrial Automation Solutions business, offered the theoretical example of a large automotive company that has long been a customer for Hirschmann switches and connectors. The customer would be invited to the CIC in Stuttgart to review Belden's full product portfolio. If the customer is interested, Belden would arrange for a digital automation consultant to visit the customer's plant to assess the current state of digitization in the operation's workflow.

"By walking the plant floor, the consultant can uncover the use case—the problems we can solve to help the customer increase productivity and efficiency," Rana explained.

The digital automation consultant may, for example, deduce that the customer wants to enable its plant personnel to make real-time decisions based on short-term data analytics.

"The problem is that the data is stored in the cloud, slowing down access to the data for analytical purposes," said Rana. "Realizing this impediment, the consultant can advise the implementation of an edge computing platform with a mobile data visualization software application that will provide the analytics before the data migrates to the cloud. That's a compelling use case."

Once that use case (or another) is discerned, Belden would schedule a meeting at the CIC with the customer's representatives and Belden's solution architects. Driven by the use case, Belden's team of hardware and



Belden's Industrial Automation Solutions segment features products like the LioN-X portfolio, left, which comprises a range of IT and OT integration options from the Lumberg Automation division. Opposite, Belden's management team rang the New York Stock Exchange's opening bell on June 15, 2022, in celebration of the company's 120th anniversary.

software engineers would build an end-to-end, "pre-ingestion" solution—a proof of concept showing what could be accomplished by implementing a tailored combination of Belden's cables, connectors, sensors, switches, routers, network management software, input/output links, security systems and so on—"all of it plug-and-play in one box, which is where we're headed," Rana said.

Assuming the automotive company is intrigued by the offering, a solution consultant would work with Belden's field sales organization and the customer to modify the solution as needed. Once a contract is signed, the solution would be deployed at the factory, and a Belden solution support team would provide post-sale services such as project management, training and ongoing optimization to ensure the solution's effectiveness—nurturing and deepening the relationship with the customer.

To bring its solutions-oriented strategy to life required transforming Belden's sales organization. In January 2021, the company reached outside to recruit and hire Anshu Mehrotra as senior vice president of Sales and Marketing. Mehrotra had performed a similar role at several other industrial companies.

"My remit was to help the commercial organization adapt, orient and imbed a culture around solutions, which is a very different culture for a sales organization steeped in engaging with customers a certain way for nearly 120 years," said Mehrotra, who in 2022 became executive vice president of Belden's Broadband & 5G business segment.

Mehrotra oversaw the implementation of a change management initiative in which Belden's salespeople—previously experts in the specifications and use of the company's products—were trained to go beyond product thinking and to intimately understand their customers'

ON THE ROAD WITH BELDEN

Belden's Mobile Collaboration Center brings the company straight to its customers. They can see and test Belden products, and discuss with in-house experts how Belden can support their mission-critical infrastructure and operations.

On August 16, 2021, 800 people at Data Center World got a chance to see something no one had ever seen before: Belden's Mobile Collaboration Center (MCC), a data center on wheels.

Developed in collaboration with and built by special-events trailer designer Spevco, Belden's MCC is a 43-foot-long semi-truck trailer with a 6-foot slide-out that makes it bigger on the inside than it looks from the outside—and it's inside where the fun begins.

The rig showcases Belden fiber optic cables, connectivity solutions, and racks and enclosures made for use in a data center. "We've also got patch panels, cross connect systems and optical distribution frames that provide cable interconnections between communications facilities inside in the trailer," said Vinoo Thomas, Belden's Smart Buildings vice president, Data Centers and Broadcast. "The MCC enables us to demonstrate the breadth and efficacy of our end-to-end data center solutions."

The MCC went on the road in 2021, making eight stops across the country that year and many more in 2022.

"Once we pull up the trailer and get it ready, our local field manufacturing reps are on hand with a team from Belden to engage with existing and prospective customers," Thomas said. "We can comfortably fit eight customers and three of our people in it at one time, although we've had 13 people in there at once several times."

The Belden team is composed of a mix of strategic account management people and application engineers. The manufacturing representatives include distributors and system integrators such as PEAK Technology Solutions.

"Everyone is apprised well in advance that the MCC will roll into a particular city or town on a specific date, giving them enough time to go through their customer lists to invite them to the event and otherwise spread the word," Thomas said.

Once inside the trailer, visitors' jaws often drop at what looks like a mini-NASA launch operations center. The first station customers encounter has a 70-inch television screen that displays Belden's capabilities in fiber optic cable and connectivity products. Other stations show the cable products pegged to a board, a smaller screen showing videos of field termination products such as fiber fusion splicers, and fiber assemblies "in a myriad of combinations," Thomas said.

There's an OptiTuff cable display in another station, featuring Belden's newest fiber cable product that's "lighter, tougher and more flexible than competing cables," according to Thomas. "We've also got a variety of small wall-mount enclosures and optical distribution frames that connect multiple servers and/or switches. There's also a small kitchen to house beverages and snacks, and a storage area."

Aside from asking Belden representatives questions about the company's solutions, visitors also can communicate via video conference with engineers at Belden's prototype F1 Center of Excellence laboratory in Montreal—a hotbed for fiber optic assemblies where Belden and its customers collaborate on custom cable designs.

"The engineers are ready to discuss the visitors' custom fiber optic and connectivity assembly challenges and opportunities," Thomas said. "Afterwards, we party—outside the trailer."

markets, business issues, pain points and operational challenges. “Armed with use cases in these segments,” Mehrotra said, “they are equipped to proactively reach out to a customer with a set of solutions.”

He provided the example of a consumer products company struggling with a particular plant’s efficiency and lower-than-optimal productivity: “By understanding the reasons for the inefficiencies, the salesperson can propose a solution to the plant manager composed of our products. In this example, it might be a full-on network infrastructure comprised of Belden network switches, cables, sensors and I/O modules, all layered with Belden cybersecurity,” he explained.

In proposing the solution, the salesperson shows the customer the economic benefit. In a highly structured way, the salesperson can demonstrate that the solution will increase the plant’s productivity, equipment efficiency and uptime by specific percentage points, respectively, over a specified period.

Belden opened its second Customer Innovation Center, in Santa Clara, California, in July 2022.

Belden prices its solutions according to the economic benefits the customer is expected to achieve, based on the proposed use case. “This is important,” Mehrotra said, “since the plant manager can now point to this data to articulate the value of our solution to the company’s CFO holding the purse strings.”

In February 2022, Belden agreed to sell its Tripwire cybersecurity business, formerly part of the Industrial Automation Solutions platform, to HelpSystems, a Minneapolis-based provider of security and automation software, for $350 million in cash. Under terms of the deal, Belden would be an exclusive reseller of Tripwire’s cybersecurity products in the industrial space.

Vestjens explained that the sale would enable Belden and Tripwire to carry out their respective growth strategies more effectively. He said Belden was pleased “to monetize the business” while maintaining a preferred commercial relationship with Tripwire for the industrial market.

Collaboration on the road

Belden’s Smart Buildings unit showcased Belden’s broad capabilities to data center customers in an eye-opening way in 2021. The organization created what amounts to a data center on wheels: a “voodoo blue”-painted semi-truck emblazoned with the words “Belden Data Center Solutions from the Rack Space to the Parking Space.”

This Mobile Collaboration Center (MCC), as it’s called, was conceived to whip up awareness of Belden’s fiber optic cables, connectivity solutions, and racks and enclosures for data center use. It made its debut on August 16, 2021, in Orlando, Florida, at Data Center World, an annual industry gathering. More than 800 conference attendees visited the

MCC; according to Vinoo Thomas, vice president of Data Centers and Broadcast in the Smart Buildings business, it was the "most eye-catching exhibit" on display.

At the conclusion of the event, the MCC traveled up the Eastern seaboard to a professional baseball stadium in Atlanta before motoring to the so-called "Data Center Capital of the World" in Ashburn, Virginia, where more than 70 percent of the planet's internet traffic flows each day. The MCC subsequently traveled to Montreal and then headed west to visit another half-dozen sites, including a football stadium in Los Angeles and a multipurpose arena in Seattle.

"The emphasis in the roadshow is on collaboration—hence the MCC's name," said Alison McCreath. "We're bringing the MCC directly to data centers and co-location data centers to make sure our existing and prospective customers are fully aware of what we can do for them."

Belden put its Mobile Collaboration Center on the road in August 2021, providing a showcase for its products and a place for customers to collaborate with Belden on data management and digital transformation solutions.

In 15 minutes, visitors can get a tour of Belden's products and capabilities, led by the company's field sales team and data center experts.

"Lunch or a happy hour is on us," McCreath said. "Ultimately, we hope the interactions lead to more collaborative discussions, although we're prepared to do business right then and there. We can schedule a next-day fiber assembly with a 24-hour turnaround delivery."

A future grounded in the founding

One hundred twenty years is a very long time for a business to survive, much less prosper; according to the U.S. Census Bureau, only one-half of 1 percent of American companies live to last a century. Belden has done that, plus two decades. As the company celebrates its 120th anniversary, it's poised to attain what has eluded it over the past half-century in spite of its success—an enduring value proposition.

Joe Belden spotted an opportunity and provided an urgently needed product during the Second Industrial Revolution, as a breakthrough technology called electric power enabled mass production. Through a Third Industrial Revolution, one fueled by the digitization of information and machinery, Belden innovated ceaselessly to expand its product set and become an industry leader in helping customers leverage the automation of production and a sea change in data management and communications.

With a Fourth Industrial Revolution upon us, and the lines between physical, digital and biological spheres increasingly blurred, Belden is evolving to become an indispensable partner to its customers. It still offers a wide range of essential products, but now wrapped together into use case solutions targeting measurable benefits in speed, productivity and effectiveness, asset management, quality and profitability.

Belden's focus on Industry 4.0 solutions is a strategy in

More Than Just a Job

Belden nourishes a culture that encourages people to be their best selves, to learn, to connect, to collaborate, to continuously improve and to give back. People are the drumbeat of Belden, their ideas generating ceaseless product and technology innovations, their teamwork and esprit de corps ensuring that customers' needs are never overlooked.

Clockwise, from top left: employees honor the retirement of Budapest plant manager Laszlo Felfoldi; India's 73rd independence day prompts a team from Gurgaon to do charitable work; Andre Naus jackets a cable at the Venlo plant; sales specialist Danijela Radanovic is in Belden's Early Career Leadership Program, a professional development plan for college students; and Aurelien Fabre, Ernesto Bernal and German Fernandez stop on a jog during a break from a meeting in Costa Brava, Spain.

In our increasingly interconnected world, Belden plays a vital role helping customers digitally transform their businesses and operations, while providing consequential work to approximately 7,700 people worldwide.

support of its customers' digital transformations, but it's also a strategy for Belden's own long-term viability. The company wouldn't be in such a strong competitive position were it not for these attributes: competent leadership that has navigated Belden through a sea of tempests; the ability to evolve with changes in technology and customer needs; remarkable customer loyalty; incessant innovation that has generated hundreds of patents, products and product enhancements; and, perhaps most important, its culture.

Like many long-lived enterprises, Belden and its customers have benefited from the aspirations, values, beliefs, personality and behaviors of the company's founder. Joe Belden's commitment to innovating and to his customers, along with his kindliness, integrity, honesty and consideration for others, has reverberated across the decades. It can be seen in how Belden's managers and employees interact with one another, in the close collaboration between Belden people and their customers, and even in a new initiative to foster a more diverse and inclusive workplace: the Authentic Voices for Inclusion & Diversity (AVID) Council, formed in 2021.

"We are committed to building a workplace at Belden that helps everyone thrive and bring their whole selves to work," said Elle Marc-Charles, Belden's director of Inclusive Culture, whose effort was taking shape in early 2022. "I am excited about the steps we will continue to take in making positive change."

As CEO, Roel Vestjens has deepened the emphasis on culture that took form with the launch of the OneBelden initiative under Stroup in the mid-2000s. While staying true to the values that have long defined Belden—doing right by customers, continuously improving, reaching for greatness, playing to win, investing in talent and emphasizing teamwork—he's also modernized them, providing a compelling, stable workplace animated by a vibrant and inclusive culture in which employees can find meaning and pride in their work.

Dean McKenna, Belden's former senior vice president of Human Resources, said, "Roel has kept alive John's legacy of process details, innovation and inspiration, but he's put his own stamp on helping our people realize that the role we play as a company and in society is more than generating value for shareholders. We can have a positive impact on the communities where we live and work, in ways that can be life-changing for the people in these communities. We can be that company—one that people want to be a part of."

As 2021 drew to a close, Belden introduced a new workplace vision to inspire people to recognize and value the importance and impact of their work, along with their personal contributions to the company's success: "Belong. Believe. Be You."

Work has always been meaningful, challenging, interesting, inspiring and fulfilling at Belden. There's an esprit de corps that writer Jessie Cleveland captured eloquently in her columns for *Beldenews* during the company's first half-century, and that Vestjens echoes in his quarterly letters to employees. It's the energy, innovation, focus and determination of that spirit—seen in a workforce of engaged, happy people—that is likely to carry Belden forward for another 120 years.

Acknowledgments

Every company's history is full of tales of strategic and business challenges, economic headwinds and tailwinds, risks and opportunities. The decades sail by, leaving in their wake extraordinary corporate transformations, fashioned by visionary leaders skilled at sizing up customer needs before the competition catches wind.

Having had the good fortune to write the histories of several iconic American companies whose industry-shaping achievements nearly everyone knows, it was a pleasant surprise to learn about Belden. Few outside its industries know how Belden has repeatedly reinvented itself to quietly transform one industry after another: telephone and telecommunications, home appliances and automobiles, broadcast and cable television, computer networking and digital connectivity.

Joseph Belden may not be a household name, but he exemplified a similar inventiveness and fortitude to the likes of Henry Ford, William Boeing and Adolph Coors. Belden and those who followed him have had led with creativity, grit and humanity—creating and preserving a culture in which, for 120 years, people have worked hard, treated one another with respect, listened to customers, intuited the markets, invented new things, and taken multiple industries into the future. It's been a honor to tell their story.

The intelligent, written musings of Joe Belden as he planned and built his company laid the foundation of what Belden would become, and for me they provided an extraordinary frame for understanding Belden's essence and its trajectory. I couldn't have written the book without his observations, without the far-ranging conversations I had with Belden's three most recent CEOs, and without the recollections of the dozens of other Beldenites with whom I had the pleasure to speak. Their fondness for the company and the people they met along the way, their roller-coaster tales of ups and downs, and their obvious pride in the contributions they and their teams have made are inspiring.

Belden's history is the 30th book I've now written, a nice round number impelling me to thank my staff of researchers, especially Jennifer Sue Johnson and Luc Alper-Leroux; my tireless editor Peter Hawes; my longtime business manager Paula Goldberg; and Essex Publishing, for presenting me this opportunity to capture Belden's remarkable story. Well done, all.

Russ Banham
August 2022

Russ Banham is one of the world's foremost corporate historians. His 30 books include the histories of iconic companies and institutions including Airstream, Boeing, Bosch, Coors, Ford and the Harvard Business School. Nominated for a Pulitzer Prize, he has written more than 6,000 feature articles for *CFO*, *Chief Executive*, *The Economist*, *Financial Times*, *Forbes*, *Fortune*, *Inc*. and *The Wall Street Journal*.

Timeline

1902
Belden Manufacturing Company is incorporated, with Joe Belden as president and Albert Beutler as plant superintendent. It rents the top floor of a five-story building at 116-118 Michigan Street in Chicago.

1904
The company moves to a rented, six-story building at 190-194 Michigan Street in Chicago. Products include switchboard wire, telephone cords, rosin core solder, annunciator wire and telephone attachments.

1909
Belden introduces Beldenamel, a varnish-based insulation that enables the electric coils, transformers and motors in automobiles and home appliances to be made smaller than ever.

Belden's sales reach $350,000, and the company moves to a larger six-story building at 2300 South Western Avenue in Chicago.

1914–1917
Belden's magnet wire is used extensively in air-to-ground radio communication during World War I. The company also produces wire and cords, plus webbing for harnesses and belts, for U.S. military applications.

1918
Belden purchases land at 4647 West Van Buren Street in Chicago for construction of a new office and manufacturing plant.

1920
Belden's sales exceed $1 million, and the West Van Buren Street complex has grown to eight buildings.

The growth of radio broadcasting creates demand for Belden's low-tension cable, aerial wire and magnet wire.

1926
Commander Richard Byrd uses Belden aircraft cable on his history-making flight toward the North Pole.

1927
Construction of a new plant begins on a 27-acre parcel of land in Richmond, Indiana. Production begins the following year.

1929
Belden enters the automotive aftermarket business with ignition wire sets, battery cables and spark plug wires.

1930
Belden moves most manufacturing from Chicago to an expanded Richmond facility.

Belden builds a new headquarters at the corner of West Van Buren and Kilpatrick streets in Chicago.

1932
Belden patents the world's first automotive lead battery terminal.

Belden's Silkenamel wire is used for an experimental but never commercialized TV technology developed by American Television Laboratories.

1934
Belden introduces the first automotive wires insulated with neoprene for use in severe weather.

1935
The company opens a branch plant in Philadelphia. It will operate through the end of World War II.

1939
Belden becomes a publicly traded company, with shares listed on the Midwest Stock Exchange.

Joe Belden dies in his sleep on February 17, at the age of 62. Whipple Jacobs succeeds him as president.

1941
Belden enlarges the Richmond plant to meet demand for wire, cords and cable for U.S. tanks, trucks, Jeeps, battleships, submarines and warplanes in World War II.

1949
Whipple Jacobs resigns as president and is succeeded by Charles "Craig" Craigmile.

1952
Belden celebrates its 50th anniversary.

1957
Belden patents the broadcasting industry's first low-loss, twin-lead cable for radio frequency signals, enabling greatly improved picture quality on televisions.

1962
Belden patents Beldfoil, a shielding tape made of aluminum foil and polyester film for use in data communications, audio speakers and fire alarms.

1965
Craig Craigmile retires and is succeeded by Robert Hawkinson as president and chief executive officer. Hawkinson oversees an expansion in which nine new plants are built or acquired in the eastern United States.

1966
The company changes its name from Belden Manufacturing Company to Belden Corporation.

1967
Belden acquires Complete-Reading Company.

Belden constructs a Technical Research Center in Geneva, Illinois.

1968
Belden acquires Southern Electric Sales Company, and Insulation & Copper Sales.

1969
Belden acquires General Wire & Cable Company, and Electrical Specialty Company.

1970
Belden acquires Manufacturers Specialties Company and D.A. James Company.

Belden's sales exceed $100 million, and the company's shares are listed on the New York Stock Exchange.

1973
Belden relocates its headquarters from Chicago to Geneva.

Belden acquires an 80 percent interest in Phoenix-Hecht Inc. and a 50 percent interest in Geneva-Pacific Corporation.

1976
Belden closes its Chicago plant.

1977
Belden celebrates its 75th anniversary.

1978
Belden acquires Cable Concepts Corporation.

1979
Belden acquires Magnum Electrics, Western Controls and EDCON.

1980
Belden acquires Millibride.

Following back-to-back mergers involving Crouse-Hinds and Cooper Industries, Belden becomes the Belden Electrical & Electronics Products division of Cooper. Several operations are closed or sold, and headquarters is moved to Richmond.

1982
Bob Hawkinson leaves Belden and is succeeded by Roger Cornett as head of the Belden division.

1980s
Belden is the first in the industry to market Ethernet cables for computer networking, as well as the first company to market fiber optic cables for industrial use.

1986
Belden opens new plants in Ontario, Canada; and Essex Junction, Vermont.

1989
Nishan Teshosian succeeds Roger Cornett as president of the Belden division.

All R&D activities are consolidated at a new Belden Engineering Center in Richmond. The Geneva Technical Research Center is fully shut down.

1993
Belden regains its independence in a $400 million initial public offering and begins trading on the New York Stock Exchange that October. C. Baker Cunningham becomes Belden's chairman, president and CEO.

1994
Belden moves its headquarters from Richmond to St. Louis.

1995
Belden acquires American Electric Cordsets, and Pope Cable and Wire.

1997
Belden acquires Cowen Cable, Intech Cable and a division of Alpha Wire.

1998

Belden acquires Olex Communications Cable and Elektro-Isolierwerke.

1999

Belden acquires Cable Systems International, Dorfler Kabelwerk GmbH and Duna Kabel Kft.

2000

Belden acquires the metallic cable telecommunications business of Corning Glass Works.

2002

Belden celebrates its 100th anniversary.

Belden acquires the NORCOM telecom wire and cable division of Cable Design Technologies (CDT).

2004

Belden exits the telecom industry, selling its North American communications wire and cable business.

Belden merges with CDT, creating a $1 billion, NYSE-traded company—Belden CDT—that is one of the largest U.S. manufacturers of high-speed electronic cables.

2005

Baker Cunningham retires as president and CEO and is succeeded by John Stroup. With a plan to turn Belden into a provider of solutions to help customers digitally transform their businesses, Stroup will move Belden beyond cable and wire, and into connectors, switches, routers, actuators, sensors and cybersecurity.

2007

Belden acquires LTK Wiring, Hirschmann Automation and Control GmbH, and Lumberg Automation.

2008

Belden acquires Trapeze Networks.

2009

Belden opens a plant in Suzhou, China.

Belden acquires Telecast Fiber Systems and sells parts of LTK Wiring.

2010

Belden sells Trapeze Networks and acquires GarrettCom.

2012

Belden acquires PPC and Miranda Technologies.

2014

Belden acquires Grass Valley and merges Miranda into it, and acquires ProSoft Technology.

2015

Belden acquires Tripwire Inc.

2017

Belden acquires Thinklogical.

2018

Belden acquires Snell Advanced Media and merges it with Grass Valley, and inks a strategic alliance with JMA Wireless.

2020

Belden sells Grass Valley and Miranda's broadcast technology assets.

John Stroup retires as president and CEO and is succeeded by Roel Vestjens. Building on Stroup's work, Vestjens will transform Belden into a vertically integrated company prioritizing three business segments: industrial automation solutions, broadband and 5G networks, and smart buildings.

2021

Belden acquires OTN Systems. Belden opens the first of several Customer Innovation Centers, in Stuttgart, Germany. Others will later open in Santa Clara, California; Shanghai, China; Chicago; and Bangalore, India.

Belden creates a Mobile Collaboration Center to showcase its capabilities to data center customers.

Belden forms an Authentic Voices for Inclusion & Diversity Council.

2022

Belden sells its Tripwire business and becomes an exclusive retailer of Tripwire's cybersecurity products in the industrial space.

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OUR VALUES

- CUSTOMERS define our success
- We play to WIN
- Continuous IMPROVEMENT is our way of life
- We reach for GREATNESS
- We invest in TALENT
- We succeed together through TEAMWORK