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Beta Golf

Bob Zider, founder and managing partner of The Beta Group, placed his handmade golf club prototypes into the back of his Chevrolet Suburban and drove out of the parking lot of San Francisco International Airport. It was June 6, 1997, and he and his partner, John Krumme, had just returned from visiting Callaway Golf in San Diego, where they had introduced executives at the industry leading golf club maker to their proprietary HXL golf club technology. They were tired—they had arrived at Callaway's test facility at 6 a.m. to witness "Iron Byron," Callaway's mechanical golf swing simulator, test Beta's golf clubs. Later that morning, Zider and Krumme had watched as five of Callaway's in-house professionals tested their prototypes. As they prepared to leave for the airport, Callaway's chief engineer had indicated that the company was not interested in Beta's technology because "it did not offer a significant improvement over their existing technology." The engineer was unwilling to disclose "Iron Byron's" test results, but Zider and Krumme had learned that two of the five in-house professionals had rated Beta's club excellent, two had rated it average, and one had rated it below average. Zider considered the feedback:

> I have often been told that Beta's inventions have been insignificant. I have learned to listen carefully to the naysayers. We went to Callaway because we expected the industry leader to kill the technology through data or engineering logic, but they couldn't. Actually, if all the pros had said it was average or below average, I'd know that we didn't have anything. But, two of them really liked it. I don't consider 1 of 5 'below average' ratings to be a fatal strike. We're not done with HXL until someone presents a logical reason not to pursue it.

In 1983, Zider had founded The Beta Group (Beta) as an "incubator" for technology-based businesses. Over the past fourteen years, Beta had successfully built a portfolio of businesses in the medical, consumer products, and industrial technology sectors by systematically matching proprietary technologies to unmet market needs.

In January 1996, Krumme, Beta's chief engineer, had designed a golf club prototype using a new metal "pixel" club face which offered an enlarged "sweet spot." Initial test data sponsored by Beta indicated that the club face reduced shaft vibration and the dispersion of miss-hit balls. At first, Zider had been skeptical about Beta's ability to commercialize this technology. Eight years earlier, Beta had declined an investment in the golf club industry because the market was growing slowly, dominated by entrenched brands, and resistant to technological innovation. Since 1990, however, growth in the golf club market had increased significantly, sparked by enhancements in technology,

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Professors William A. Sahlman and Michael J. Roberts and Senior Researcher Laurence E. Katz prepared this case. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

improved marketing from new club makers such as Callaway, and the emergence of Tiger Woods as a leader on the Men's PGA Tour. Encouraged by the industry trends, Zider and Krumme had focused on refining the technology, developing alternate business models, and addressing key risks. After eighteen months, they were confident that the technology was sound and that they could manufacture a quality product within specified tolerances.

However, Zider and Krumme had not resolved one remaining question: how would they commercialize the technology? They had identified four options. First, they could license it to leading club makers, on either an exclusive or non-exclusive basis. This strategy could play off the intense competition in the golf equipment industry for the latest generation of technology. Second, they could manufacture and distribute club inserts which would be inserted into a machined cavity in the club face during assembly. Aldila and True Temper, both club shaft makers, had been successful with this OEM model, supplying shafts to multiple club makers. Several leading club makers recently had adopted inserts because they enabled club makers to market new materials while minimizing design and obsolescence costs. Third, they could buy a former leading club maker which had lost share and revive its brand by promoting HXL. One former industry leader was reportedly for sale, and Beta could leverage its existing brand and distribution infrastructure. Fourth, they could start a new club company from scratch and develop a new line of equipment around Beta's new technology. Cobra, Callaway and Odyssey each had successfully pursued this strategy and sold for a multiple of three times sales within 5 years.

As Zider and Krumme reviewed each of these options, they needed to consider the associated capital requirements, risk profiles, and exit options. At the same time, they needed to evaluate which, if any, of these options was feasible, given investor skepticism of the industry and the industry's reluctance to invest in outside technologies.

The Beta Group

The Beta Group[1] was founded by Zider in 1983 to develop and apply a systematic, multidisciplinary approach to innovation. Zider, a 35-year-old partner at the Boston Consulting Group (BCG), had been an engineer at Pratt & Whitney Aircraft prior to attending Harvard Business School. (See **Exhibit 1** for profiles of Beta's principals.) Through several of his engagements at BCG, Zider had determined that large corporations did not have the internal systems to successfully exploit most innovations from their research departments. He also observed that venture capitalists rarely funded research and development projects and avoided many industries which required significant investment in R&D. He reflected on what he termed "the innovation gap":

> I believe there are structural reasons that systematic innovation has not fully evolved in corporations or venture capital firms. Most successful corporations focus on managing vast numbers of people and resources efficiently, not innovation. To the extent that an explicit R&D process exists in these companies, it is often functionally oriented and usually narrowly tied to an existing strategic product area. The typical corporate compensation structure also makes it very difficult to reward innovation, which discourages ground-breaking R&D and drives the best talent out of companies.
>
> VCs do invest capital in others who innovate, but over 90% of their capital goes to fund working capital requirements and operating losses. In the early 1980s, VCs allocated about one fourth of their investment dollars to seed and startups; today it's less than 6%. In fact, many

[1] Beta was an acronym for Business Engineering and Technology Applications

companies themselves invest more in R&D than the entire VC community. Today, VCs focus on investments with low technology risk and high market growth potential. Typically, technology development occurs before the VCs enter the picture.

Zider founded Beta to foster a systematic approach to innovation through a process that he called Business Engineering.[2] Business Engineering referred to the development of a concept and business strategy through rigorous analysis of markets and technologies by a multi-disciplinary team. Through Business Engineering, Beta matched an identified market opportunity with a proprietary technology, such as a patented technology or innovative process. Zider compared Business Engineering to the aircraft engine development process he had participated in at Pratt & Whitney Aircraft: "Just as engineers 'flight test' new engine designs on paper before they build them, we want to 'flight test' new businesses through the Business Engineering process before we invest significant capital. Like jet engines which work the first time they fly, we believe our businesses should 'fly' the first time out." Zider believed that Business Engineering would increase the probability of an investment's success while limiting the cost of its failure. (See **Exhibit 2** for a description of Beta's mission.)

Zider reflected on his vision for Beta's strategy:

> I wanted to create an investment process that could not only develop ideas and concepts but also could test and implement them. My idea was not to start another venture capital fund, but to originate ideas, develop business plans around them, identify key operating officers, assemble financing, and actually bring small companies to the point of operation. To that end, I wanted to pull together the functional expertise of the corporation, the judgment of the venture capitalist, the creativity and fire of the entrepreneur, and the analytic rigor of the strategic consultant.

Zider recruited one of his BCG partners and incorporated the Beta Group, Inc. with a $300,000 investment from BCG and an in-kind donation of $1.5 million of consulting services. In return, BCG received an equity position in Beta's projects. BCG viewed its investment in Beta not only as an opportunity to achieve attractive returns on its partners' capital, but also as an opportunity to attract and retain talented consultants by promoting its affiliation with Beta.

Investment Strategy. From the beginning, Beta adopted several operating principles which distinguished its investment strategy. First, Beta funded investments on a deal-by-deal basis with corporate and financial partners:

> We believe that the discipline of having to ask for money lowers our probability of failure. We believe that by forcing ourselves to pass each idea through two external screens—the funding search and the management search—we help to validate the concept. If we fail to complete either, we don't start the business.

Second, Beta created and sponsored its own investment opportunities, usually in sectors such as metallurgy and optometrics in which it had little or no investment competition. (See **Exhibit 3** for description of Beta's investments.) Specifically, they targeted opportunities in which a "trailing edge" technology could be applied to a market need. They believed that this strategy allowed them to avoid overpaying for ideas in "hot" sectors, such as multimedia, genetic engineering, or Internet commerce, while also allowing them to maximize control of their investments.

[2] Business Engineering is unrelated to Business Re-engineering, which was popularized in the early 1990s.

Third, Beta only pursued opportunities for which it had a superior technology, process, or other significant competitive advantage. Zider commented on this strategy:

> Since we fund each deal on its own merits, we have learned that good ideas alone are not fundable. We can not convince investors that we have a competitive advantage in restaurants, for example. But we have found that if we can patent a technology to insulate ourselves from competition and build a business around that technology, we can fund it and attract a management team.

By 1997, Beta had registered over forty patents and had successfully defended against patent infringements in the United States and Europe.

Fourth, Beta customized its approach to developing a business to meet the needs of the specific market. Beta was prepared to build a business as a start-up, as a joint venture, under license, or via acquisitions. Zider discussed this approach: "We want to fund a business in a way that will give it the best chance of long term success. There isn't one cookie cutter way to commercialize a technology." Of Beta's 12 investments since 1983, 30% had been start-ups, 40% joint ventures, 20% licenses, and 10% acquisitions.

Fifth, Beta was rigorous in conducting a feasibility study of the concept and market opportunity prior to investing significant capital. Typically, Beta outlined the steps and timeline that needed to be met for commercial success and then prioritized key risks. Beta preferred situations in which the risks were highly focused, so that they could be analyzed and assessed with limited investment. Zider explained Beta's approach to capital allocation:

> We believe that capital efficiency can be accomplished by staging investments and minimizing investment during high risk phases. We avoid investing in infrastructure, overhead, and outside management until we feel the primary risks have been adequately addressed. We usually invest less than $250,000 of our own money over a 12-18 month period while we identify and explore key risks.

Finally, Beta adopted a hands-on management relationship with the company throughout its life. Typically, at least one of Beta's partners initially served as a key member of the company's management team. Later in the company's lifecycle, Beta would replace themselves with outside managers but would continue to work closely with the company to implement the strategic plan.

Sourcing New Technologies. Zider commented on Beta's approach to identifying new technologies:

> Lots of people believe that inventions happen only in a moment of brilliance. We don't believe that innovation is simply a spark of naïve creativity. We believe that idea generation is the convergence of several linked but independent events, which include rigorous analysis of market needs, an open mind, and awareness of technical feasibility. We live by Louis Pasteur's quote, "Chance favors only a prepared mind."[3]

At times, Beta identified a market need through analysis and then hunted for a technology to meet that need. For example, Beta uncovered a market need for continuous arterial blood gas monitoring for intensive care patients through a consulting engagement that BCG had completed at a medical device company. At that time, no medical device existed to immediately notify medical professionals when a patient's blood-oxygen, carbon dioxide, or ph level was dangerously low.

[3] Louis Pasteur, Inaugural Address, University of Lille, December 7, 1854.

Through a concentrated technology search, Beta identified and acquired a fiber-optic sensor technology which it believed could be applied to the blood gas market to provide a procedure that was lower cost and less invasive than other competitive technologies. Beta founded FOxS Labs (Fiber-optic Oxygen Sensors) in 1985 with a $50,000 investment and later found a joint venture partner who invested $2.2 million to test the device in human clinicals. Beta sold its interest to their joint venture partner at a $30 million valuation in 1989.

At other times, Beta identified a technology and then looked for an appropriate market need. For example, Krumme previously had worked with a titanium-based alloy called "nitinol" which could bend but then return to its original shape when heated. As nitinol had been refined, a version had been developed that would "spring" back to its original shape at room temperature. Based upon Zider's market analysis of the eyeglass and contact lens businesses while at BCG, Beta identified an opportunity to apply this memory alloy to eyeglass frames. Beta commercialized the technology in the U.S. through a joint venture with Marchon, a U.S. eyeglass frame distributor, and internationally through license agreements with Japanese and European eyeware manufacturers. When Beta sold its patents to Marchon in 1995, the frames, known domestically by the trade name Flexon, had retail sales worldwide of about $200 million.

Not all of Beta's innovations were ready to be commercialized when developed. At any given time, Beta was actively developing only two to three businesses. Beta kept a file, internally called the "Refrigerator," which contained nearly 50 ideas of lower priority. Each year at its annual retreat, Beta would review its "refrigerator" to identify ideas that might be ready to be commercialized:

> The "refrigerator" is distinct from the "dumpster," where we throw away bad ideas. The 'fridge preserves the ideas that we don't have time for, or that don't seem fundable at the time. There are lots of reasons a concept may go into the 'fridge—the market may not be big enough, the technology may not be ready, the industry may not be in favor, or there may not be an identifiable exit strategy. We have never rescued an idea from the dumpster, but several of our successful ideas have come from the refrigerator.

Over the past 13 years, Beta had achieved strong investment returns for its investors. See **Exhibit 4** for a analysis of investment returns.[4]

Beta's HXL Golf Technology

In the late 1980s, Beta identified golf equipment as a potential application of nitinol. The initial idea had been generated by one of Zider's BCG partners who had remarked that golf club shafts would be a good application of this alloy, "It would be great joke if I could bend a club over my knee or wrap it around a tree when I'm frustrated with my game, but then could heat it up at home to return it to its original shape." Zider dismissed this idea as only a gag, but did briefly consider making nitinol inserts which could be placed into a machined cavity in the club face during assembly. After making a prototype in 1989, Zider put the idea in the "refrigerator." Zider commented on the decision, "We couldn't make nitinol work in clubs because the price/value relationship was out of line. At that time, our prototype didn't show any discernible performance differences and a nitinol insert would have cost $100, raising the consumer price way beyond then-current price points."

[4] In 1989, Beta and BCG agreed to a buyout of BCG's equity position by the Beta principals. Between 1983-1989, Beta's realized returns were 55%, while the average venture capital returns of funds raised in 1983 was 11%.

Beta's technological breakthrough occurred in 1996 when Krumme designed a club face with a thin cross section of a bundle of metal wires. While a traditional club face used a cast or forged slab of monolithic metal, Krumme's design used a series of small metal rods aligned together and attached to the back plate of the club like pixels on a television screen. (See **Exhibit 5** for a computer diagram of the club face with insert.) Krumme described how his previous inventions had led him to this design: "Several years earlier, I had invented and patented a connector for circuit boards which used a bunch of tiny nitinol threads, each the width of piece of human hair, to connect a microprocessor to a circuit board. While the application and performance needs are very different in circuit boards, this batch of threads provided the seed for the golf idea."

By decoupling the metal "pixels," Krumme's design altered the club's vibration response pattern so that the "sweet spot"—the ideal impact position—was enlarged and vibration feedback was reduced. This resulted in a better feel for the golfer, better ball speed after impact for off-center hits, and reduced dispersion of golf balls.[5] Beta expected that the characteristics would be more apparent to mid-to-low handicap golfers.[6]

Zider described Beta's new technology by analogy:

> The club face on a standard club is analogous to a metal trampoline: when the ball impacts the center of the club, energy is transferred from the club to the ball with little feedback. As in a trampoline, however, if the impact is off-center, the ball does not travel the same distance because the energy transfer is imperfect and the response is asymmetrical. Beta's technology makes the club face act more like a mattress, which uses a decoupled support system, so that motion on one part of the mattress is isolated from other parts.

Zider also compared HXL to recent innovations in tennis equipment:

> In the last ten years, golf has moved much the way tennis rackets did earlier: from wood to metal to composites and over-sized racquets. But, tennis has moved back to newly designed mid-sized rackets which provide bigger sweet spots on a smaller face while improving control and feel. Golf has not yet moved back to the middle. In golf, larger is not necessarily better. The continually increasing size of the club face means that the club will encounter more grass and dirt resistance, often catching the ground before the shot and completely ruining it. Therefore, a mid-sized club, like a mid-sized tennis racket, with the larger sweet spot might be very marketable. Our technology allows that to happen.

Beta commissioned Golf Laboratories, an independent testing center, to evaluate Beta's HXL prototypes. Initial test results showed that HXL designs produced slightly longer shots with less dispersion than the standard club. However, Beta believed that a finished prototype which had been balanced, sanded, and grooved might reduce the flight distance of a well-hit drive 2 to 3 yards. Beta had also conducted a computer simulation of the HXL technology which demonstrated the increased size of the sweet spot of the HXL insert over monolithic club faces. These test results and simulations confirmed Beta's engineering theory.

In addition to improved performance, HXL offered a distinctive new look to the club face. HXL looked like a honeycomb, which reinforced its unique technology and allowed design innovation unavailable with existing mono-faced clubs. Club makers could vary the pixel numbers, size, design,

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[5] Tests showed that ball speed lost 8% to 10% on miss-hits (i.e. toe or heel hits) with traditional clubs, but only 3% to 5% on similar miss-hits with HXL inserts.

[6] A golfer's handicap referred to the number of strokes above par that the golfer, on average, recorded in a round of 18 holes of golf. Lower handicaps indicated greater proficiency.

and material, all using their existing molds and designs which could extend product life cycles and reduce tooling, inventory and obsolescence costs. HXL allowed the face to be dimpled or grooved, like existing club faces, as well as processed for different surface friction characteristics within USGA rules.

The Golf Industry

In 1997, the wholesale golf club industry had $1.5 billion in sales, having grown 15% over the previous 10 years. There were 24.7 million golfers in the United States who spent, on average, $1,000 for a complete new set of clubs (8 iron clubs and 3 wood clubs). In 1996, nearly 2.0 million sets of woods and 1.3 million sets of irons were sold, an increase of 4% and 7%, respectively, over 1995. Wholesale prices had risen rapidly in recent years, as technological innovation allowed wood and iron prices to rise 16% and 6%, respectively, in 1996. Analysts forecasted that the market would grow 12% to 15% per annum over the next five years.

Radical market share changes had accompanied this rapid market growth. Historically, five companies—Wilson, Spalding, Hogan, Dunlop and MacGregor—had dominated the new golf club market. After decades of little innovation, however, the industry had been shaken by four waves of design and technology improvements. In the early 1970's, Karsten Manufacturing introduced perimeter weighted Ping irons which allowed more forgiveness for beginner and intermediate players. In the mid 1970's, Aldila, a shaft manufacturer, began marketing a graphite club shaft that had a higher strength to weight ratio, allowing the golfer to increase club speed through a swing without compromising strength. In the 1980s, Taylor Made introduced metal woods which were 70% stronger than traditional woods. In the 1990s, Callaway Golf introduced the Big Bertha clubs which dramatically increased the size of the club's "sweet spot." As a result of these innovations Hogan, Dunlop and MacGregor together captured less than 5% of the market in 1997.

In their place, new brands such as Callaway, Taylor Made, Cobra, and Odyssey emerged. With the introduction of its Big Bertha clubs, Callaway's sales had increased from $55 million in 1991 to $683 mil in 1996, resulting in a market value of over $2 billion. Similarly, Cobra, which had gained the endorsement of Australian-born Men's PGA leader Greg Norman, had achieved great success through the design innovation of its oversized irons. In 1995, Cobra had been acquired by American Brands for $700 million, or four times sales. In 1996, Taylor Made had introduced the Bubble Shaft, a graphite composite design in which the shaft swelled dramatically beneath the grip and tapered to a reinforced lip just above the club head. Lastly, Odyssey Sports had entered the putter business in the late 1980's by offering an unmistakable metal headed club with a "stronomic" black insert that was marketed to put "more feel into the putt." In 1997, Callaway acquired Odyssey for $130 million, or approximately 3x sales.

In 1996, no one company led all market segments. Callaway, for example, led the woods segment, while it captured virtually no share of specialty clubs (i.e. wedges and putters). Similarly, Ping, Cobra, and Tommy Armour led the irons market, but Ping had almost no share of the woods market and Cobra and Tommy Armour had only a small share of the putter market. **Exhibit 6** presents Beta's analysis of leaders by market segment.

Accompanying the rapid innovation, marketing budgets for golf clubs had skyrocketed. While technology appeared critical to success, Callaway, Taylor Made, and Odyssey had proven that adopting a strong consumer marketing focus was necessary as well. Industry analysts estimated that Callaway would spend over $100 million on sales and marketing in 1997.

The industry was known for rapid "knock offs" of popular club designs, as most patents in the golf industry were on "design" or "method" which offered very little protection from imitators. Nearly every club sold under a brand name was available through mail order catalogs and at discount retailers under a private label brand at less than half price.

Golf club makers generally performed research and development internally but outsourced production of components to both American and Asian companies. Club makers assembled the three sub-components—grip, shaft, and club head—and spent heavily to market both to retailers and consumers. Wholesale gross margins for club makers were attractive, approaching 60% for clubs made from standard materials and 50% for more specialized materials, such as titanium.

Since 1894, the United States Golf Association (USGA) had served as the oversight body which had monitored and enforced equipment standards to protect the rules of the game. Rules for equipment, particularly clubs and balls, were strict and specific. The USGA received submissions for approval for nearly 400 club designs per year, about 40% of which were for putters. The USGA approved about half of these submissions each year. Rarely would a manufacturer try to commercially market a club not approved by the USGA. **Exhibit 7** presents excerpts from the USGA rules book on club faces.

Business Engineering HXL

In January 1996, Zider turned his attention to address the risks that Beta considered hurdles to HXL's success: USGA approval, patent approval, manufacturing economics, and pricing. While Beta had dedicated only minimal financial resources to explore HXL, Zider began spending nearly half his time evaluating HXL's potential.

Beta initially submitted the pixel design to the USGA for approval. The USGA replied within several weeks that their design, which used round pixels, did not meet specifications because the round pixels and epoxy filler constituted two materials on the impact surface, which was prohibited by their rules. At the same time, they commented that they had never seen a submission analogous to Beta's proposal. Beta resubmitted a revised proposal using hexagonal pixels which fit tightly together. This time, the USGA responded within several weeks that the prototypes "Conformed with USGA Rules." (See **Exhibit 8.**)

After finding no related patents, Beta applied for product patents for HXL covering several materials, including plastics, elastomers, traditional metals and shape memory alloys, and several pixel shapes, including hexagonal, rectangular, and triangular patterns. Product patents provided significantly more protection than the process or design patents typical to club manufacturers. Beta received a notice of allowance by the U.S. Patent and Trademarks Office within six months, which was significantly expedited over the usual twelve to eighteen month process. From prior experience, though, Beta was aware that patents were continually subject to review and reversal.

From the beginning, Krumme believed that the manufacturing process would not be a barrier to success, but that product costs needed to be determined. The manufacturing process for the pixel technology was different from the traditional monolithic casting or forging process, requiring precision tolerances (plus or minus one thousandth of an inch) and additional assembly operations. However, it employed standard electronics industry manufacturing techniques which did not pose major technical hurdles and allowed the use of existing club designs. Individual hexagonal wires first would be cut and machined, using standard screw machine technology, to create the pixels.

They would then be aligned in a close-packed pattern and inserted into the club head cavity[7] for bonding to the back plate. The number of pixels in each insert ranged from 120 to 180 pixels per club head. Finally, they would be machined for grooves as well as surface treatment. Beta estimated that HXL inserts would initially cost $5 to $40, depending on volumes, material selection, and pixel density.

Finally, Zider attacked the pricing model. Initially, he was concerned that there might not be enough room in the industry pricing structure for a technology which was higher cost. Through industry analysis and interviews, Beta pieced together the cost structure of club manufacturers. On average, assemblers spent $20 to make a club that sold at wholesale for $40. The same club would be sold at retail for $60. Based upon manufacturing cost analysis, Beta expected that a $10 to $20 price per insert would require a $20 to $40 premium at wholesale, and a $30 to $60 premium at retail. Zider's analysis of the retail market indicated that, at the higher end of the market which Beta would target, a $30 to $60 incremental price per club for eight irons was acceptable. Zider concluded, "When golfers spend $100,000 to join a country club, spending an extra $250 to $500 on clubs is not extraordinary, if they think the technology is worthwhile."

The Decision

After successfully addressing the key initial risks of patentability, performance, USGA approval, and market potential, Beta turned its attention to evaluate alternative business models for commercializing its HXL technology. Among its options, Beta evaluated licensing its technology to an existing company, supplying a component insert, acquiring an existing company, starting a new equipment company. Beta had employed each of these strategies in at least one previous investment.

License: Beta considered trying to license its patented technology, on either an exclusive or non-exclusive basis, to a leading club maker. An exclusive license might command an 8% to 10% royalty on wholesale sales and a $10 million marketing commitment, while a non-exclusive license might command a 6% to 8% royalty. Licensees would have control over all aspects of production and marketing, including pricing and quality standards. Beta would retain responsibility for research and development and patent defense. In the past, Beta had spent over $3 million defending patents against infringement. Beta expected that any licensee would be able to command a 20% to 50% price premium for the technology.

OEM Supplier: Beta also considered manufacturing pixel inserts and selling them to several leading club makers, who would insert them into the club heads during assembly. Club makers were accustomed to purchasing monolithic club inserts, made of different materials, and placing them into a pre-machined cavity in the club head during assembly. Aldila and True Temper, both leading club shaft manufacturers, had been successful with the OEM supplier model, building companies with a market value of approximately one times sales.

Based upon detailed costing studies, Beta believed that it would be able to manufacture club inserts for $5 to $40 per insert and sell them at a 30% to 60% gross margin. Beta could acquire machines with 1,200 to 2,000 pixels per hour capacity (depending upon materials) for $70,000 each. Beta expected that it would need to charge club makers an 80% to 100% markup on direct cost and a 8% to 10% "technology license" on the wholesale value of the club. But would club makers buy the product?

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[7] Club head makers had routinely made cavities in the club face for other monolithic inserts.

Beta referred to this strategy as the "Gore-Tex approach." Like Gore-Tex, the waterproof fabric sold to garment makers, Beta would sell branded inserts to several golf club makers who would compete on their own pixel designs and materials as well as on the features of their own clubs.

Acquisition: Beta considered bidding for a former leading golf club brand ("Acorn") which recorded a loss of $2 million in 1996 on sales of $20 million. At its peak in the 1970s and 1980s, Acorn had consistently recorded sales of $90 million and profits of $10 million. Since 1990, the company continually had been losing money on declining sales volumes.

Zider had identified a financial investor, The Parkside Group, who was prepared to join Beta in bidding for Acorn. Together, they would form a newly capitalized company ("Newco") which would hold the assets of both Acorn and Beta's HXL technology. Terms of the proposed agreement specified that Parkside would acquire Acorn's brand and tangible assets for 50% of 1997 projected sales, or $10 million, and contribute them to Newco along with $15 million to fund working capital requirements. Beta would contribute to Newco its technology, which would be valued at $5 million. The investor would assume operating responsibilities for the merged company while Beta would continue to manage research and development as well as defend against patent infringement.

Beta was interested in this opportunity because it would provide a "platform" to enter the business with an existing distribution organization and brand franchise. Together, Beta and Parkside planned to try to revitalize the brand by introducing a new product line which incorporated Beta's HXL technology. Re-launching the brand would require $35 million in marketing expenses over the next three years. **Exhibits 9** and **10** present the details of the proposed transaction and associated financial projections. Beta was aware that other strategic buyers also were considering bidding for the company.

Start-up: Following the model of Callaway, Cobra, and Odyssey, all of which had introduced new golf brands within the past 10 years, Beta explored starting a new club company. Beta considered Odyssey to be a model of a successful start-up golf equipment business. Odyssey, which had started in 1990 with $5 million of capital from financial partners, had grown to $35 million in sales in 1996 when it was bought by Callaway for $130 million.

To launch a start-up, Beta would need to find a financial partner willing to commit $10 million in start-up capital and would need to recruit a management team with significant experience in the golf industry. The new company would outsource manufacturing but would manage R&D and marketing internally. Beta needed to address several strategic questions which would impact the start-up's economics, including how they would market their brand. Would they try to market clubs through professionals, who had expensive golf contracts, or through infomercials, which cost nearly $1 million each to run? How would they secure distribution through the retail channel? How would they price their clubs?

Conclusion

As Zider pulled out of San Francisco International Airport's parking lot and headed toward Beta's offices in Menlo Park, he considered which launch strategy he would recommend to his partners:

> We hate businesses like golf. Investing in sporting goods goes against every principle we have at Beta. It's a hobby industry which attracts many people with deep pockets who are in it to stroke their ego—just like boats and wineries. It's a trendy consumer business based on image and perception, and many smart people have lost a lot of money in it. We also are

violating the single most basic tenet of business—know something about the industry. We don't know a damn thing about golf.

However, we've seen the combination of technology and good marketing lead to significant market share changes very rapidly at the expense of old line brands. Our technology is new. As Callaway and Cobra have proven, there seems to be little loyalty in the retail channel or at the consumer level, and people seem to be willing to pay for the "next thing". The price points and margins are high, and the few companies who have been successful have been extremely well rewarded. To date, we've taken some of the risk out and limited our downside. But we're outsiders to the industry so we're unlikely to find friendly investors. The VCs are into the Internet and medical devices. Even if we do have a preferred model, who can we find to invest?

Exhibit 1 Profiles of Beta Group Principals

John Krumme

John Krumme initially joined The Beta Group in 1986. John served as President and later Chairman of Beta Phase from 1986 to 1993. In 1993, John formally returned to The Beta Group to participate in the firm's new investment activities. Prior to joining The Beta Group, John was a founding general partner of two start-up companies: Metcal (1981-1986), a self-regulating heating technology company; and Alchemia (1981-1986), a shape memory alloy product development company which became Beta Phase in 1986. Prior to his start-up of Metcal and Alchemia, John was a development engineer at Raychem (1973-1979), Hewlett-Packard (1969-1973), and General Electric Medical (1967-1969). John graduated from Stanford in 1967 with a MS/MSE degree in mechanical engineering. John holds more than 20 issued patents.

Bob Newell

Bob Newell joined The Beta Group in 1997. From 1992 to 1997, Bob was CFO of Cardiometrics, a medical device company. In 1985, Bob assisted Bob Zider and John Krumme in the formation of Beta Phase and was CFO of Beta Phase from 1985 to 1992. Bob has held financial management positions with WordStar International Corporation, Donaldson, Lufkin, & Jenrette and Bank of America. He has helped start several medical companies. Bob was also an Air Force pilot. He received a Bachelor of Arts degree in mathematics from the College of William and Mary in 1970 and a Master in Business Administration from Harvard Business School in 1976.

Dave Plough

Dave Plough joined The Beta Group in 1986. Dave has led the firm's investments in CollOptics and Altair Eyewear. He served as initial President of two portfolio companies, CollOptics and Reflex Sunglasses, and as General Manager of another portfolio company, FOxS Labs. From 1982 to 1984, Dave was an associate with The Boston Consulting Group where, among other activities, he had The Beta Group as a client. Dave received a Bachelor of Arts degree in 1981 from Dartmouth College where he graduated cum laude and a Master of Business Administration degree in 1986 from the Stanford Graduate School of Business.

Bob Zider

Bob Zider founded The Beta Group in 1983 with backing from The Boston Consulting Group. Bob initiated and led the firm's investments in Beta Phase, FOxS Labs, CVI/Beta Ventures, Beta Optical, Marchon, Eschenbach, CVIBeta Japan, Nitinol Devices and Components, and Reflex Sunglasses. Bob served as initial President of CVI/Beta Ventures and initial Chairman of Nitinol Development, Reflex Sunglasses, and the Business Engineering, Inc. consulting firm. Bob spent seven years from 1976 to 1983 at The Boston Consulting Group, where he developed the Business Engineering investment approach. Bob began his career from 1969 to 1971 as an analytical engineer with Pratt & Whitney in the Advanced Engines Group. From 1971 to 1973, and on a part-time basis from 1974 to 1976 while attending school, Bob was a Lieutenant with the National Oceanic and Atmospheric Administration. Bob received a Bachelor of Science degree in civil engineering in 1969 from the University of Virginia and a Master of Business Administration degree with Distinction in 1976 from the Harvard Business School, where he was class president.

Source: The Beta Group

Exhibit 2 Beta Group Mission

The Beta Group

The Beta Mission

Exploring for gold was exciting 140 years ago. Upon learning of a random discovery, thousands of men with little or no experience would pick up and "rush" to the gold fields in the hopes of finding gold. A few became fabulously rich. The majority ended up flat broke.

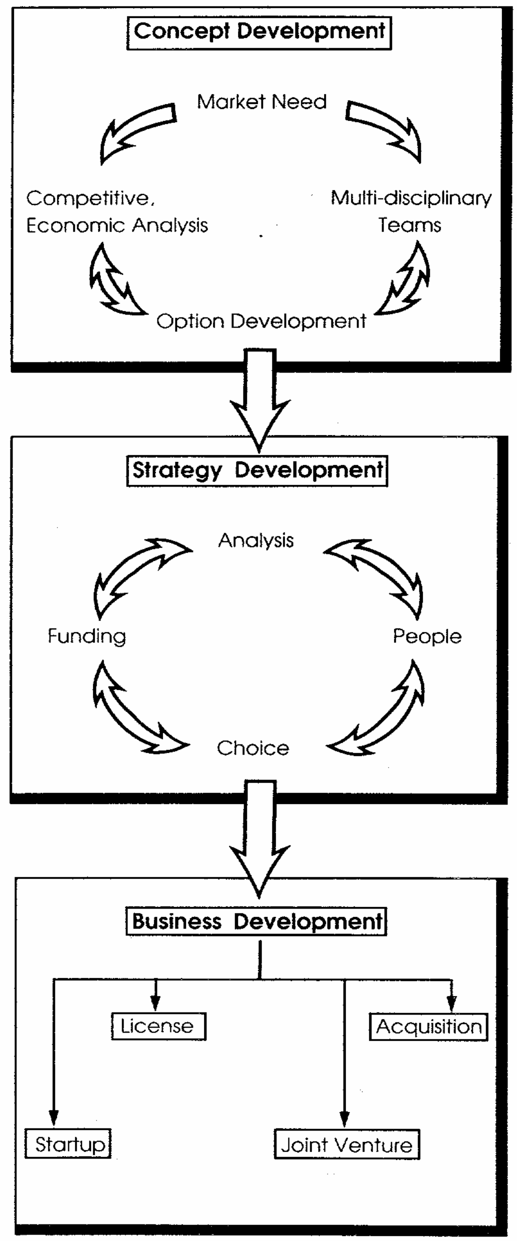
Mineral exploration today is far less exciting. Pattern recognition, pathfinders, air and satellite reconnaissance have replaced the mule and pick. Information and analysis have replaced random exploration. The simple task of mining has evolved into a systematic, highly engineered process designed to increase the odds of success and reduce the probability of failure.

Business innovation today is exciting. Billions of dollars are standing by to be invested in engineers, scientists, and marketers who have an innovative new idea. Most of these "business explorers" lack a comprehensive knowledge of the market, finances, the competition and the multitude of other key factors required to build a business and grow it to long term success. A few will become fabulously rich. The majority will not.

Just like yesterday's gold miners, today's "business explorers" face long odds in the attempt to create wealth as they strive to find a new product, provide a new service, or restructure an obsolete means of doing business. Despite seemingly endless enthusiasm, many fail to achieve their objectives. Successful businesses, like yesterday's gold fields, are not easy to find.

The Beta Mission is to develop and apply a systematic, multi-disciplinary approach to innovation which we refer to as Business Engineering. The Business Engineering process utilizes analytic systems to assist business development. It relies less heavily on chance. As in exploration, it relies on the art of pathfinders and pattern recognition to provide clues. As in engineering, it relies on data and analysis of competitors, market and product characteristics to develop options and simulate their success or failure on paper or in a highly focused test before committing major resources. Business Engineering is the natural extension of disciplined approaches applied elsewhere. Business Engineering coupled with creativity and drive is a powerful approach to innovation.

Business Engineering



Robert B. Zider

Source: The Beta Group

Exhibit 3 Description of Beta Group Investments

Medical Sector

The Beta Group believes that the ongoing structural changes that are taking place in the health care industry will create significant investment opportunities. In particular, the historical focus on *quality of care*, irrespective of cost, has been replaced by a focus on the *cost of care*, as long as the care provided is consistent with or superior to the existing quality of care. The Beta Group believes this new *cost of care* focus will be the dominant theme in medical care throughout this decade. The Beta Group believes that technologies, proprietary processes or other competitive advantages that lower the total cost of care, while maintaining or increasing the quality of care, will create attractive investment opportunities. Examples of medical sector investments that The Beta Group has made include:

Medical sensors The Beta Group successfully developed a fiber optic blood gas sensor technology, achieving a 132% internal rate of return on a staged investment of $3.8 million in a startup company it founded called *FOxS Labs*. The *FOxS Labs* investment was the result of a methodological exploration of medical sensors opportunities. The Beta Group, working in conjunction with The Boston Consulting Group, conducted an in-depth assessment of the opportunities within blood gas continuous sensing. Interviews and field research were conducted in cardiology, intensive care medicine, surgery and other specialties. The work team assessed the four most promising technology options and evaluated a fiber optic technology as the superior option. After an in-depth patent review and a rigorous assessment of the technology by outside technical consultants, The Beta Group acquired a fiber optic technology patent from Richard G. Buckles. After successful development to the point of human clinical trials, *FOxS Labs* was sold to Puritan-Bennett Corporation, a corporate strategic partner that The Beta Group had brought in to aid in the development and marketing of the Buckles fiber optic sensor technology.

Medical devices The Beta Group has made several investments in shape memory metal alloy applications, including an intravenous flow controller, surgical tools, and incontinence devices.

The Beta Group extended its experience and expertise in shape memory alloys with its 1991 start-up of Nitinol Devices and Components ("NDC"). NDC is a manufacturing company dedicated to the engineering, design, and fabrication of shape memory alloy components. Products include guidewires, catheters, and coronary stents. Beta's $2.0 million investment in NDC achieved a 125% compound annual return with its sale to Johnson and Johnson's Cordis division in 1997.

In January 1992, Beta started up *CollOptics, Inc*. *CollOptics*, which is jointly owned by The Beta Group, Collagen Corporation, and GE Medical, acquired the GE Medical Systems Laser Adjustable Synthetic Epikeratoplasty (LASE) technology in January 1992. *CollOptics*' mission is to provide a semi-permanent contact lens to the consumer on a minimally invasive, reversible, and adjustable basis. The semi-permanent contact lens would be placed under the epithelium of the eye in a simple, outpatient procedure. Unlike other refractive surgery approaches, the LASE approach is only minimally invasive and is reversible. It is too early to tell whether The Beta Group's $800,000 investment in the company will prove successful.

Consumer Products Sector

The Beta Group believes the diverse and constantly evolving consumer marketplace offers significant investment opportunities. The principals of The Beta Group believe that the development of new consumer product concepts which address underlying consumer cultural, demographic, and behavioral trends will create attractive investment opportunities. The Beta Group believes this is particularly true where a proprietary technology or process or other competitive advantage is brought to the consumer marketplace. Examples of consumer sector investments that The Beta Group has made follow:

Eyewear The Beta Group has acquired significant experience and expertise in the development of shape memory alloy applications. Beta applied this expertise to the consumer products arena by developing and commercializing shape memory eyeglass frames in the *CVI/Beta Ventures* start-up company. Beta Group developed and patented the use of nitinol metals in ophthalmic frames. The shape memory properties of nitinol eyeglass frames (primarily known by the "Flexon" trade name) allow the frames to maintain a consistent, comfortable fit despite wear and handling. Beta Group achieved a *134%* compound annual return on a staged investment of $500,000 in *CVI/Beta Ventures*.

Electronic music distribution The Beta Group funded the start-up of *Personics* in 1984. *Personics* permits the music retail consumer to make in-store custom mixes of artists and songs. The consumer samples songs at a listening booth located in the music retail store and has hundreds of songs and artists to choose from. Once the consumer has made his selections, he or she submits the choices to a sales clerk. In approximately 10 minutes the consumer receives an audio cassette tape with the mix of songs he or she selected. The Beta Group achieved a 73% compound annual return on *Personics*, on a staged investment of $3.3 million.

Industrial Technology Sector

The Beta Group believes that the industrial technology sector presents significant investment opportunities, particularly where a new technology, proprietary process or other competitive advantage is transplanted from an existing application into either a new application or an entirely new market. Examples of industrial technology sector investments that The Beta Group has made follow:

Electronic connectors One of Beta's first start-ups, Beta Phase (1984) developed a high density (up to 500 lines per inch) zero insertion force connector system using a flex print and shape memory actuator combination. Though technically successful (it is still used in Cray's supercomputers), Beta suffered two dilutive financings prior to the sale of the company to Molex.

Other industrial products As part of its continuing development efforts, Beta has obtained rights to FOxS' fiber optic sensor technology for use in industrial applications such as hazardous waste and hydrocarbon monitoring. Beta also developed under contract a PC based communications test system for Motorola, launched commercially in 1997. Beta continues development of shape memory applications including pipe couplings, electrical cable connectors, sporting goods and resettable fuses.

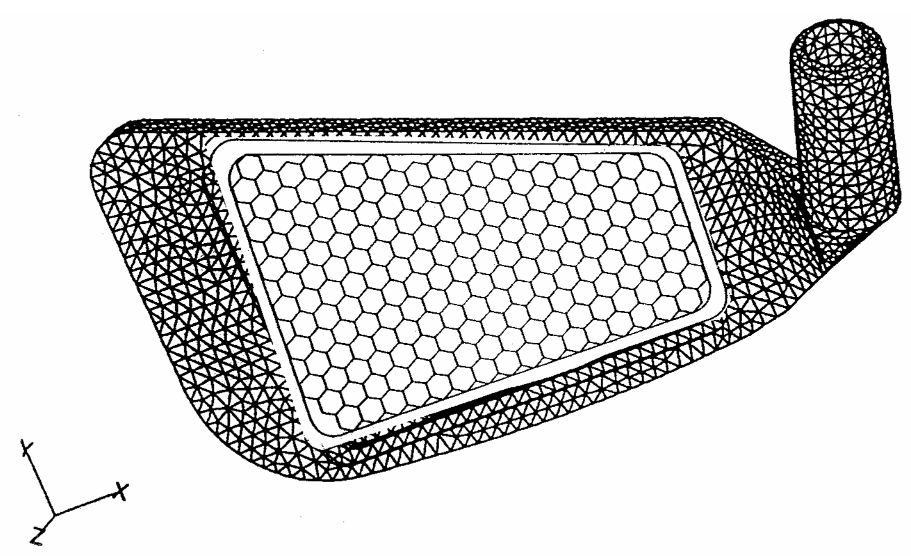
Source: The Beta Group

Exhibit 4 Beta Group Financial Performance Summary (only investments exceeding $250,000)

Investment	Description	Investment Date	Internal Rate of Return
Beta Phase	Electronic connectors	1984-89	Loss
FOxS	Blood gas sensors	1985-89	132%
Personics	In-store custom music	1984-89	73%
Beta Optical	U.S. eyeglass frame manufacturing LBO	1986-88	Loss
Total (1983-1989)			55%
CVI/Beta[a]	Shape memory eyeglass frames	1990-97	86%
Nitinol Devices and Components	Coronary stents	1992-97	125%
Reflex Sunglasses	Shape memory sunglasses	1992-94	Loss
CollOptics	Reversible refractive eye surgery	1992-97	Loss
Altair Eyewear	Ophthalmic products marketing	1992-97	34%
Total (1990-1997)			86%

Source: The Beta Group

Exhibit 5 Computer Diagram of HXL Club Insert



Source: The Beta Group

[a] Includes the Marchon Joint Venture, Eschenbach Joint Venture, and Japanese Manufacturing Consortium

Exhibit 6 Market Segmentation

	Woods	Irons	Wedges	Putters
Super Premium	>$400 Callaway Lynx Taylor Made	>$1,000 Armour Titanium Callaway Daiwa Ping	>$120 Armour Titanium Callaway Ping Taylor Made	>$120 Snake Eyes Taylor Made
High	$300 Cleveland Cobra Nicklaus	$800 Armour Hogan Cobra Mizuno Nicklaus Taylor Made	$100 Cleveland Hogan Cobra Ram Wilson	$100 Callaway Cobra Ping Odyssey Alien
Medium	$200 Golfsmith Ping Wilson	$600 MacGregor Powerbilt Ram Wilson	$80 Golfsmith Dunlop Ram	$50 Dunlop Powerbilt Golfsmith
Low	$80-$120 Dunlop Golfsmith Mitsushiba	<$500 Dunlop Golfsmith Rawlings	$40 Golfworks Magique	$30 Golfworks Magique

Source: The Beta Group

Exhibit 7 The Rule of Golf 1997-1998

App. II

b) transparent material added for other than decorative or structural purposes,

c) appendages to the main body of the head such as knobs, plates, rods or fins, for the purpose of meeting dimensional specifications, for aiming or for any other purpose. Exceptions may be made for putters.

Any furrows in or runners on the sole shall not extend into the face.

4-1e. Club Face

GENERAL

The material and construction of the face shall not have the effect at impact of a spring, or impart significantly more spin to the ball than a standard steel face, or have any other effect which would unduly influence the movement of the ball.

IMPACT AREA ROUGHNESS AND MATERIAL

Except for markings specified in the following paragraphs, the surface roughness within the area where impact is intended (the "impact area") must not exceed that of decorative sandblasting, or of fine milling.

The impact area must be of a single material. Exceptions may be made for wooden clubs (see Fig. VIII, illustrative impact area).

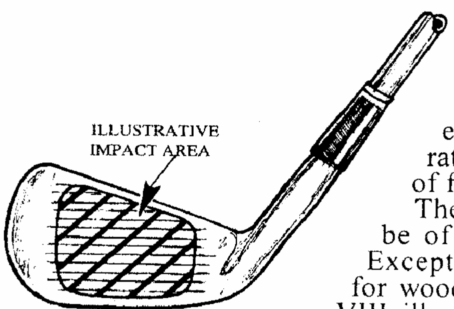


Figure VIII

IMPACT AREA MARKINGS

Markings in the impact area must not have sharp edges or raised lips, as determined by a finger test. Grooves or punch marks in the impact area must meet the following specifications:

App. II

(i) Grooves. A series of straight grooves with diverging sides and a symmetrical cross-section may be used (see Fig. IX). The width and cross-section must be consistent across the face of the club and along the length of the grooves. Any rounding of groove edges shall be in the form of a radius which does not exceed 0.020 inches (0.5 mm). The width of the grooves shall not exceed 0.035 inches (0.9 mm), using the 30 de-

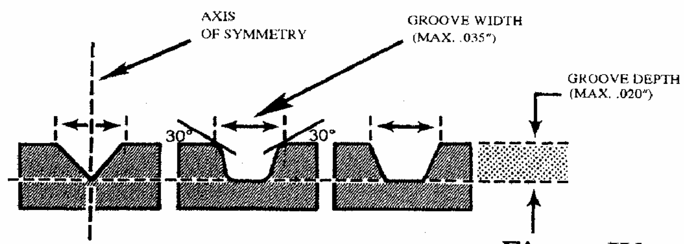


Figure IX

EXAMPLES OF PERMISSIBLE GROOVE CROSS-SECTIONS

gree method of measurement on file with the United States Golf Association. The distance between edges of adjacent grooves must not be less than three times the width of a groove, and not less than 0.075 inches (1.9 mm). The depth of a groove must not exceed 0.020 inches (0.5 mm).

Note: Exception - see US Decision 4-1/100.

(ii) *Punch Marks.* Punch marks may be used. The area of any such mark must not exceed 0.0044 square inches (2.8 sq. mm). A mark must not be closer to an adjacent mark than 0.168 inches (4.3 mm) measured from center to center. The depth of a punch mark must not exceed 0.040 inches (1.0 mm). If punch marks are used in combination with grooves, a punch mark must not be closer to a groove than 0.168 inches (4.3 mm), measured from center to center.

Source: United States Golf Association (USGA)

Exhibit 8 USGA Letter to Beta Group

United States Golf Association
Golf House PO Box 708 Far Hills, NJ 07931-0708
908 234-2300 Fax 908 234-9687
http://www.usga.org
Technical Department Fax: 908 234-0138

September 25, 1997

Mr. John Krumme
President
Beta Development
2454 Embarcadero Way
Palo Alto, CA 94303

Dear Mr. Krumme: Decision: 97-291 & 97-306

This is in reference to your letter dated July 24, 1997 and the iron (97-291) and putter (97-306) which you submitted for an official ruling. The cavity back iron has an insert in the face made of a copper alloy material, that is formed from hexagonal steel columns which join together creating a smooth surface. The toe-heel weighted putter has a similar face insert made of stainless steel.

I am pleased to advise you that the clubs, as submitted, have been inspected and it has been determined that they conform with the Rules of Golf.

In advertisements of this iron (97-291) and putter (97-306), you are authorized to make the statement: "Conforms with USGA Rules." Use of such statements as "USGA Approved" or "USGA Tested" are prohibited. Use of the USGA seal or logo, without specific permission, is prohibited.

We are retaining the samples as a record of this decision.

The USGA reserves the right to change the Rules and interpretations regulating equipment at any time.

Yours sincerely,

Frank Thomas

Frank W. Thomas
Technical Director

FWT: wp
cc: Reed K. Mackenzie, Chairman, I&B Committee
O. Gordon Brewer, Jr.
David B. Fay
Michael Butz
John Matheny

Exhibit 9 Proposed Acquisition Structure and Financials

THE PARKSIDE GROUP
Strategic Equity Investors

September 1, 1997

Barry L. Schneider

Managing Partner

Mr. Bob Zider
Beta Group

Via Fax

Dear Bob:

I was not able to fax you the financials tonight because Cory and I finished them after midnight. The plan is for Cory to get you this letter and our latest pro forma financials so that you and I can talk at some point Monday.

Our understanding has always been that we would create a Newco by merging a newly capitalized "Acorn" with HXL. You can refer to the handwritten schematic that I faxed to you several months ago, indicating such a structure. We specifically asked you the value you placed on HXL, so we would be able to value it as a "contributed asset" in the business combination. Your response was clear; you wanted somewhere near a $5 million valuation.

Attached are our sources and uses, and forecasted financial statements. Please feel free to call Cory to inquire about any part of the financials, and I will try and call you either from the plane or from the hotel Monday night.

The bottom line is that Beta is getting its $5 million valuation, both in terms of a preferred return of $5 million, and in a 16.6% carried ownership interest ($5M/$30M post $). It is likely that the Seller will also want a carried interest, and coincidentally, he will swap $5 million in assets that would otherwise have been purchased for cash. If he does so, we will require $5 million less cash to close, but the seller will maintain a 16.67% carried interest (no dilution; the IRRs would essentially stay the same).

It is contemplated that The Parkside Group (TPG) will be the managing general partner, and in exchange for our work, we will receive a $300,000/year management fee and 20% of the distributions in excess of the preferred distributions (invested capital). Thus, Beta would receive $5 million before the general partner received any of the 20%. Finally, TPG will receive all of the tax loss allocations.

The ironic part of this structure is that we are planning to fund 100% of the LP share as well. However, given the interest in this industry, it would not surprise me if ultimately, there were LPs other than just TPG. Hopefully, after reviewing this financial structuring information, you will agree it is responsive to the issues we have been discussing. Obviously, this information is extremely confidential.

We expect that the operating responsibilities will reside with TPG, and that The Beta Group would continue with research, development and commercialization of the technology, and use their experience to help protect any patent infringements. Certainly, in addition to equity in Newco, we could discuss a technology consulting agreement. I guess it depends a bit on how many generations of technology you have, and ultimately, how well the market accepts HXL.

One point of interest, you will note that we are planning on spending $15 million to support brand in '98 (leading to a pro forma $40 million in sales for the year). In 1996, for the year, Callaway spent $37 million in marketing on its way to $650 million in sales for the year.

Talk to you soon.

Barry Schneider

Barry L. Schneider

Exhibit 10 Proposed Acorn Financial Projections and Acquisition Structure

Income Statement ($000)

	Post-Closing	1997 (4 mos)	1998	1999	2000
Revenues	-	$4,000	$25,000	$40,000	$60,000
Cost of goods sold	-	2,400	14,000	20,500	30,000
Gross profit	-	$1,600	$11,000	$19,500	$30,000
Gross Profit %		40.0%	44.40%	48.8%	50.0%
Operating Expenses					
Management fees		$ 75	$ 300	$ 300	$ 300
Selling, general and administrative	-	750	5,000	8,500	14,000
Marketing	-	2,200	15,000	10,000	10,000
R&D/innovation	-	150	500	500	500
Depreciation	-	17	21	88	186
Amortization of goodwill	-	-	-	-	-
Total operating expenses		$3,192	$20,821	$19,388	$24,986
EBIT	-	$(1,592)	$(9,821)	$113	$5,014
EBIT %		(39.8%)	(39.3%)	0.2%	8.4%
Nonrecurring asset liquidation	$2,000	-	-	-	-
Interest income	-	$820	$97	-	-
Interest expense	-	-	-	349	859
Pretax income	$(2,000)	$(772)	$(9,724)	$(237)	$4,155
Income taxes	-	-	-	-	1,620
Net income	$(2,000)	$(772)	$(9,724)	$(237)	$2,534
Net income %		(19.3%)	(38.9%)	(4.6%)	4.2%
Preferred dividends	-	-	-	-	-
Convertible preferred dividends	-	-	-	-	-
Net income to common	$(2,000)	$(772)	$(9,724)	$(237)	$2,534

Sources and Uses of Funds

Sources	
Contributed cash	$20,000
Seller contributed assets	5,000
Contributed HXL	5,000
Total Sources	$30,000

Uses	
Cash reserves	$ 2,950
Accounts receivable	6,000
Inventory	10,200
Other assets	5,500
Intangible assets	5,000
Net PP&E	150
Long-term assets	200
Total Uses	$30,000