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IDEO

“I should have had café latte,” thought Dennis Boyle as he was sipping his strong espresso at Peet’s coffeehouse, just around the corner from his office. Many designers and engineers from his company, IDEO, one of the world’s largest and arguably most successful product development firms, often gathered here and talked. It was late summer in Palo Alto, the heart of California’s Silicon Valley, and Boyle gathered his thoughts for a meeting with David Kelley, the head and founder of IDEO.

Boyle had just led his group through the development of 3Com’s Palm V hand-held computer, which designers and managers at both firms already considered a successful product with very large commercial potential. Now he was being asked to design the competing Visor product by the very same individuals he had worked with previously. The only twist was that these clients themselves now worked at Handspring, a new venture whose goal was to come out with a fully compatible, slightly smaller and less expensive palm-size computer that could easily add functionality. 3Com had even licensed out operating software to Handspring.

Although working on the Palm V challenged IDEO’s engineering skills, working with Handspring promised to challenge the very manner in which it operated. It operated on the principle of getting all team members to “fail often to succeed sooner” – a creative process that often looked to outsiders like “spinning wheels.” The process usually generated a fountain of absurd-appearing but innovative ideas before the final answer and product miraculously came through a process of discipline and fast decision-making.

The IDEO philosophy melded Californian iconoclasm with a genuine respect for new ideas and invention. For over two decades, the firm contributed to the design of thousands of new products ranging from the computer mouse to the stand-up toothpaste dispenser. Along the way, it had also become the largest award-winning design firm in the world (see **Exhibit 2**). IDEO came to national prominence when ABC’s Nightline illustrated its innovation process by showing its designers re-engineer a decades-old icon, the supermarket shopping cart, in just five days.

Now Boyle had to decide whether he should suggest to Handspring’s management to add more time to a development schedule that was less than half of what it took to design the stunningly beautiful and innovative Palm V. Boyle’s group feared that an overly aggressive development schedule would require them to bypass many of the early development stages that the firm was

Professors Stefan Thomke and Ashok Nimgade 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.

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particularly good at and, at the end, deliver a product that could be so much better if they just had more time.

History of IDEO

[David Kelley] and the company he heads, IDEO of Palo Alto, has designed more of the things at our fingertips than practically anyone else in the past 100 years, with the possible exception of Thomas Edison.

- *San Francisco Examiner*¹

It was desperation caused by recalcitrant furniture during a college move that drove David Kelley to enter the Carnegie-Mellon campus workshop in search of a saw. The sights and sounds of the strange new world captured the fancy of the electrical engineering major from Ohio. For a while, in fact, he considered switching majors to fine arts but stayed with engineering. The internal switch that flickered on, however, would lead Kelley to leave engineering jobs at Boeing and NCR to embark on the journey that, according to *Fortune Magazine*, would make him “one of the most powerful people in Silicon Valley.” But the first thing Kelley would ever actually design of consequence was a telephone that could only ring one number: his own. He presented this to his college girlfriend.

In 1975, Kelley joined the Stanford University program in product design. These were heady days with Kelley finding that “In Silicon Valley everything was new. . . there were no preconceived notions.”² Through part-time consulting experience, Kelley found to his surprise that most consulting firms consisted of specialists, with technological companies lacking clear access to a general product development firm. In 1978, amid the Silicon Valley boom, Kelley gave up writing his Ph.D. thesis. (Nonetheless, even without a formal Ph.D. he would become a professor at Stanford University.)

Kelley went on to form and run David Kelley Design for the next decade. IDEO started in 1991 when David Kelley Design merged with two companies: ID Two, led by renowned designer Bill Moggridge, and Matrix, started by Mike Nuttall. The name IDEO came to life when Bill Moggridge scanned his dictionary for suitable names and liked “ideo-” (a Greek word which meant “idea”) as it formed the foundation of many important combined words such as *ideology* and *ideogram*. Kelley, whose company was larger than the other two combined, took over as chief executive of the new firm.

The merger brought under one umbrella all services client companies needed to design, develop, and manufacture new products: mechanical and electrical engineering, industrial design, ergonomics, information technology, prototype machining, and even cognitive psychology. IDEO thus pioneered the design version of “concurrent engineering” – a fusion of art and engineering to produce aesthetically pleasing products that were also technically competent.³ As an example of the utility of concurrent engineering, consider how the decision to add air vents to a computer to prevent overheating might detract from the product’s streamlined aesthetics if the designers and engineers failed to work together closely.

¹ R. Garner, *San Francisco Examiner*, May 23, 1994, p. B-1.

² L. Watson, “Palo Alto Product Designer Finds Business Booming,” *The San Francisco Chronicle*, August 3, 1992, p. C3.

³ J. Lew, “Of mice and Miatas: “Design shops shape our lives,” *San Francisco Examiner*, August 12, 1992, p. 4.

The hardest places to practice concurrent engineering, quite understandably, were in devices involving compact and complex design such as automotive components, medical instruments, and small computing devices where small changes would have often unforeseeable ripple effects on components far removed. IDEO, with its equal emphasis on design and engineering, took up many of these challenges. In contrast, its leading competitors historically had stressed industrial design over engineering.

Major IDEO clients included Apple Computer, AT&T, Samsung, Philips, Amtrak, Steelcase, Baxter International, and NEC Corp. IDEO's thirst for variety led it to complete thousands of projects, including 50 projects for Apple Computer (including its first mouse), ski goggles, the Avocet Vertech Skiers watch, and a large variety of medical instrumentation. The company also participated in Hollywood film projects, creating scale-model submarines for "The Abyss" and a 25-foot mechanical whale for "Free Willy". In the 1990s, IDEO won more industry awards than any other design firm worldwide (see **Exhibits 2 and 4**).

In the late 1990s, IDEO employed over 300 staff and maintained design centers in Boston, Chicago, San Francisco, London, Palo Alto, Grand Rapids, New York, Milan, Tel Aviv, and Tokyo. The sites were chosen for their stimulating locations. Although all centers operated independently, seeking business locally, they exchanged a high volume of e-mail and often shared talent as needed. Over the years, while his employees focused on designing client products, Kelley increasingly found himself designing and re-designing IDEO. "I'm more interested in the methodology of design . . .," according to Kelley. "I'm the person who builds the stage rather than performs on it."

Part of this stage-building involved studying the IDEO environment in new ways. Instead of merely relying on employee surveys, the company also studied workplace interactions through suspended video cameras in order to optimize office design.⁴ IDEO also sought to improve its own design processes by reviewing all completed projects. According to Kelley, "We pick the things each client does well, and assimilate them into our methodology. We're not good at innovating because of our flawless intellects, but because we've done thousands of products, and we've been mindful."⁵

With corporate downsizing, IDEO and other design firms flourished as companies outsourced more design projects. IDEO's fees generally ran from as little as \$40,000 to over \$1 million, depending on the scope of the project. Revenues came from about 30% each in medical, consumer, and telecommunications/computers with an additional 10% from industrial products.⁶

IDEO came to national prominence when it allowed ABC to televise a segment showing its designers meeting the challenge of re-engineering the commonplace shopping cart—a virtually unchanged icon for the past several decades, despite its creaky and obdurate wheels and often unwieldy basket—in just five days. The IDEO design replaced the traditional large basket with a system of baskets that allowed consumers to use the shopping cart as a "base camp" for shopping. Innovative new wheels allowed greater maneuverability in the store. Hooks on the frame would allow for bagged items to be transported out to the parking lot. The lack of a central basket removed much of the incentive for stealing the shopping carts.

⁴ P. Roberts, P, "Live! From your office! It's...," *Fast Company*, October 1999.

⁵ T.S. Perry, "Designing a Culture for Creativity," *Research Technology Management*, March 1995, v. 38(2), pp. 14-17.

⁶ R. Rosenberg, "By design, these firms take on other companies' products," *The Boston Globe*, May 11, 1997, p. C1.

Design Philosophy and Culture

If a picture is worth a thousand words, a prototype is worth ten thousand.

- IDEO innovation principle

Central to IDEO's design philosophy was the role of prototyping. According to Tom Kelley, general manager and David Kelley's brother, "we prototype more than our clients suspect, and probably more than our competitors." Frequent prototyping served as the most important way for his company to communicate with clients, marketers, experts, and end users. Prototypes ensured everyone was imagining the same design during discussions about a product. All IDEO offices had shops staffed by highly skilled machinists to rapidly produce both simple and sophisticated prototypes. Quite often, according to Whitney Mortimer, a Harvard MBA who joined the firm in the late '90s, "the real 'aha's' in product development occur here."

But in the early stages, perfecting a sophisticated model was considered a waste of time. "You learn just as much from a model that's wrong as you do from one that's right," according to engineer Steve Vassallo. Thus, designers and engineers themselves created early prototypes from readily available material such as cardboard, foamcore, Legos, and Erector sets.

Rapid prototyping at IDEO followed the three "R's": "Rough, Rapid, and Right!" The final R, "Right," referred to building several models focused on getting specific aspects of a product right. For example, to design a telephone, an IDEO team carved dozens of pieces of foam and cradled them between their heads and shoulders to find the best shape for a handset. "You're not trying to build a complete model of the product you're creating," per Vassallo. "You're just focusing on a small section of it."⁷

Quick and dirty prototyping allowed for a greater number of iterations. "By our method," David Kelley claimed, "you could never design a video recorder you couldn't program. [Researchers at larger companies] are afraid of looking bad to management, so they do an expensive, sleek prototype, but then they become committed to it before they really know any of the answers. You have to have the guts to create a straw man." At IDEO, these straw men were repeatedly knocked down, a process which left IDEO's staffers with thick skin. "Failure," Kelley felt, "is part of the culture. We call it enlightened trial and error."⁸

In an allied process, IDEO sought to generate as many ideas as possible early in the design process through almost daily brainstorming sessions. A much-used paraphrased quotation from Einstein epitomized the playfulness of the early stage: "If at first an idea does not sound absurd, then there is no hope for it." The entire process resembled a funnel, with several ideas at the top, three or four at the base, and only one making it all the way through. People were generally not upset if their idea did not become the definitive solution since the act of clipping off ideas brought the entire team closer to the solution—similar to legendary baseball batter Babe Ruth who outlined his strategy once as, "Every strike I make gets me closer to a home run." In addition, discarded ideas were archived and sometimes kept for possible future products.

Sometimes in the course of a project, when progress appeared to come to a standstill, the leader could call for what has come to be known as a Deep Dive® approach. In this process, the team

⁷ T.S. Perry, "Designing a Culture for Creativity." *Research Technology Management*, March 1995, v. 38(2) pp. 14-17.

⁸ Ibid.

would focus intensively for an entire day to generate a large number of creative concepts, weed out weak ideas, and start prototyping based on the top handful of solutions.

To an outsider, however, the entire process could appear messy. “The nature of the organization is very much like David Kelley’s mind,” says Arnold Wasserman who was part of IDEO’s innovation strategy group. “Both are seriously playful and messy. And both are comfortable with confusion, incomplete information, paradox, irony, and fun for its own sake.”⁹

The inherent inability to precisely predict the innovation process’ outcome, time and cost made it extremely important to keep clients involved. At the beginning of a new project, IDEO would submit cost and time estimates to potential clients. As a project unfolded and designers came up with innovative ideas and concepts, project managers had to ensure that those concepts were within agreed upon budgets and timelines. However, designers often aimed for perfection which could potentially lead to cost and time overruns – also known as “creeping elegance” in design circles – and clients needed to be aware of those opportunities for further innovation and the cost and time involved. As a result, IDEO required very frequent client meetings where all those issues would be discussed.

After a visit to the company’s Palo Alto office, business writer Tom Peters likened IDEO to a veritable playground. In his words, “IDEO is a zoo. Experts of all flavours co-mingle in offices that look more like cacophonous kindergarten classrooms. . . . Walk into the offices of IDEO design in Palo Alto, California, immediately you’ll be caught up in the energy, buzz, creative disarray and sheer lunacy of it all. Breach the reception area at XYZ Corp . . . and you’ll think you’ve walked into the city morgue.”¹⁰

In keeping with its playroom atmosphere, on Mondays all company branches held “show-and-tells” where designers and engineers could showcase their latest insights and products. Also, of increasing importance to designers was IDEO’s “Tech Box,” the company’s giant “shoebox” for curiosities and interesting gadgets meant to inspire innovators. Designers could rummage through the contents and play with the switches, buttons, and odd materials in search of new uses. The Tech Box included some 300 objects ranging from an archery bow based on pulleys to heat pipes that would turn uncomfortably hot almost the moment they were placed in a cup of hot water.

The culture itself reflected the importance that management attached to creating a democracy of ideas. Most design firms had less than two dozen employees. Growing IDEO to 300 employees involved keeping each unit small. Thus, growth was achieved by budding out smaller design studios whenever one appeared to grow too large. Much quoted was David Kelley’s confident assertion that “This company will never be larger than 40 people.”¹¹ Following an amoeboid growth strategy, even in a small section of Palo Alto, found the company in possession of nine different buildings.

Employees were encouraged to design their own workspace to reflect their own personalities. Some strung up their bicycles on pulleys. Rolling doors could quickly seal offices for privacy. Staffers kept personal possessions in portable bookshelves and cabinets so that moves between projects could be accomplished rapidly. One studio suspended the wing of a DC-3 airplane with a blinking red winglight from the ceiling.

⁹ R. Garner, *San Francisco Examiner*, May 23, 1994, p. B-1.

¹⁰ T. Peters, “The Peters Principles,” *Forbes ASAP*, September 13, 1993, p. 180.

¹¹ B. Katz, “A leadership style,” *Perspective*, Fall 1999.

In keeping with Silicon Valley informality, the company discouraged formal titles and did not mandate a dress code. Management encouraged employees to leave their desk and walk around, especially during mental blocks. “It’s suspicious when employees are at their desk all day,” according to general manager Tom Kelley, “because it makes you wonder how they pretend to work.” IDEO paid high rent for its prime Silicon Valley location so as to encourage stimulating interactions between employees. Free, unlocked loaner bicycles at the Palo Alto lobbies also facilitated movement between each building. Designers were encouraged to talk to one another or even call a brainstorming session through email.

Management rarely fired employees. “We do a better job of managing good employees than of weeding out lower performing employees,” David Kelley admitted. “But with small studios, there’s literally nowhere to hide for noncontributors.” High-performing employees were rewarded by being given more challenging projects to lead. Each employee was assessed through peer review sessions, with peers chosen by the employee. Management also sought to reward high performers through more shares in its client venture capital base.

Through much of the 1990s, turnover, at less than 5% per year, was shockingly low by Silicon Valley standards. The company typically recruited young individuals out of its own internship programs. Recruiting was a long process, entailing meeting with 10 staff members, often over lunch. A disproportionate number of recruits came from Stanford University, where Kelley continued to serve as a professor.

An individual could work on one large project as a principal or on as many as three to four projects as a contributor. IDEO was a flat organization to an extreme. All work was done in project teams, which formed for the life of a project and then disbanded. As a result there were no permanent job assignments or job titles. There were no organization charts or titles to distract from the quality of the work. Project leaders often emerged on the basis of personal excitement about a project. Motivation from peer pressure also spurred employees to put in 50- to 60-hour weeks in creative endeavors.¹²

The lack of hierarchy also avoided the problem of promoting designers and engineers into administrative positions and out of their first love: creating products. But the “no-policy policy” could make for confusion among new recruits. Even proponents of the IDEO culture, including veteran Larry Shubert, admitted that “The culture is partly to be comfortable with ambiguity and confusion. . . We err on the side of autonomy. There’s some discomfort, yes.”¹³

But growth appeared to bring its own changes. According to Jeff Smith, president of the Palo Alto-based Lunar Design and an admirer of IDEO, “How well they’re able to remain creative and not become bureaucratic and politicized will be very interesting. There’s rumor of politics and agendas. . . .” Even David Kelley admitted some increase in bureaucratization. “People are talking about it like it’s a company. ‘Is it okay to invite my wife to this?’ Nobody ever asked me that before... Or, ‘Is it okay if I go home and mow the lawn this afternoon?’ Of course, it’s okay.”¹⁴

¹² T.S. Perry, “Designing a Culture for Creativity.” *Research Technology Management*, March 1995, v. 38(2) pp. 14–17.

¹³ S. Orenstein, “The doyen of design,” *Stanford*, May/June 1996, pp. 74–79.

¹⁴ *Ibid.*

By the late 1990s, however, the turnover had crept up to 10% as the promise of unparalleled high-tech wealth at Internet-based firms beckoned employees. To counter the trend of increasing attrition, IDEO sought to redo its compensation strategy, planning to do more equity deals and seek royalties.

IDEO's Innovation Process

It is inconceivable that the head guy in any organization will know all the answers.

- David Kelley, IDEO founder

If prototyping was central to IDEO's design process, brainstorming was central to its methodology. The two processes, actually, went hand in hand, with brainstorming sessions leading to rapid prototyping or vice versa. The goal was to quickly create a whirlwind of activity and ideas, with the most promising ideas developed into prototypes in just days. The firm followed several principles of brainstorming: stay focused on the topic; encourage wild ideas; defer judgment to avoid interrupting the flow of ideas; build on the ideas of others (since it was usually more productive than seeking glory for one's own insights); hold only one conversation at a time to ensure that introverts also got their say; go for quantity (very productive brainstorming could generate 150 ideas in 30 to 45 minutes); and be visual, since sketching ideas would help people understand them.

Throughout a single project, the project leader might hold brainstorming sessions, or "brainstormers." No more than eight invitees attended these sessions, which ran under the above rules. IDEO personnel viewed invitations to these sessions as a sign of worth and rarely turned them down. In an organization whose lobbies sported large bowls of M&M chocolates, David Kelley once said "brainstormers are the candy. . . You are in the middle of a project, handling endless details, and then you get invited to a brainstormer, where you get to have all sorts of good ideas and leave with no responsibility for them. It's cathartic, to dump your ideas."¹⁵

IDEO's product development process followed several phases (see **Exhibit 3** for details). In **Phase 0 ("Understand/Observe")**, the team sought to understand the client's business and immersed itself in finding out about the feasibility of a product. This involved inhaling everything ever written about the planned product and potential users. By the end of this process, team members tacked to the project center walls pictures and diagrams summarizing major discoveries about the marketplace and users. In the closely related **Phase I ("Visualize/Realize")**, the team ended up choosing a product direction based on ideas, technologies, and market perceptions. The team also gained an understanding of the product context through a gallery of envisioned characters using the product in their daily lives. By the end of Phase I, through close coordination with the client, the team would have rough three-dimensional models of a product and a general idea of the manufacturing strategy to be utilized.

In **Phase II ("Evaluating/Refining")**, the team enhanced design prototypes through testing functional prototypes. Emphasis shifted over the course of this stage from human factors and ergonomics to engineering. Phase II culminated with a functional model as well as a "looks like" design model. Then in **Phase III ("Implement/Detailed Engineering")**, the team completed product design and verified that the final product worked and could be manufactured. Although engineering efforts predominated, continuous low-level involvement with design team members occurred. By the end of this phase, the team delivered a fully functional design model, tooling databases, and technical documentation. Finally, in **Phase IV ("Implement/Manufacturing Liaison")**, the team

¹⁵ T.S. Perry, "Designing a Culture for Creativity," *Research Technology Management*, March 1995, v. 38(2) pp. 14-17.

ensured smooth product release to manufacturing as the product moved from the shop floor to the client's factory lines.

But despite the phases delineated above, IDEO had mixed feelings about formalizing any aspect of the innovative process. According to European director Tim Brown, "It's a delicate balance between process and innovation. . . It's no good if you crank the handle and you know exactly what is going to come out the other end. You also have to be prepared to fail a lot. The great thing about a prototype culture like ours is that we have lots of spectacular failures. We celebrate that."¹⁶

Nonetheless, armed with the tools of rapid prototyping, brainstorming, and a well-honed product development process, the company viewed itself as being able to provide value to virtually any client. The very diversity and experience of its personnel ensured that it would rarely encounter entirely new problems. Occasionally, however, the company found itself swimming in unfamiliar water. Once, for instance, the governor of Hawaii asked IDEO about how the state should proceed with its economic reforms.

The Palm V Project

Never go to a client meeting without a prototype.

- "Boyle's Law" (per Dennis Boyle of IDEO; not to be confused with the law of pressure and volume named after 17th century physicist Robert Boyle)

In the early 1990s, with the advent of Apple Computer's Newton pad, handheld computing got its start and met its near-demise. This revolutionary feature-laden product proved ahead of its time, with consumers frustrated by the sometimes slow and inaccurate handwriting recognition system that was meant to replace the tyranny of the cumbersome keyboard. Users also found the system large and inconvenient. It took until March 1996 before anyone could successfully introduce another general-purpose handheld computing device. This honor belonged to California-based engineer-visionary Jeff Hawkins, whose "Palm Pilot" found almost immediate consumer acceptance. Key to Hawkins' success was the development of critical technologies, including the so-called Graffiti program for handwriting recognition and "syncing," the capability to synchronize data between a handheld computer and a home computer.

Hawkins possessed a maniacal focus on product simplicity. This led him to hone his vision by carrying a crude wood prototype the size of a deck of cards in his pocket while envisioning how typical customers might use the product through the course of a day. Sometimes he would sit through staff meetings scrawling imaginary notes onto the inert wood screen of the prototype. The end result proved a product meant to compete with paper rather than with larger computers. Although it could just store addresses, telephone numbers, a calendar, and a to-do list, it did so rapidly and conveniently.

For all its apparent simplicity, the Palm Pilot became the fastest-selling computer product ever.¹⁷ Hawkins and his staff achieved their feat of design and engineering while working during a period of corporate upheaval that saw their parent company change from Palm Company to U.S. Robotics to 3Com. Understandably, the Palm Pilot success story attracted other start-ups and entrants to the new field, leading to handheld devices touting features such as vibrating alarms, voice recording,

¹⁶ D. Dearlove, "Innovation from the chaos," *The Times* (U.K.), August 13, 1998.

¹⁷ P.E. Teague, "Special Achievement Award: Jeff Hawkins," *Design News*, March 6, 2000, p. 108.

increased memory, and so on. One advertisement for the competing Everex Freestyle palm-sized computer, after listing several new features, warned: "Palm Pilot beware!"¹⁸ Microsoft itself was expected to enter the field with a new product that would leapfrog current products by offering eight megabytes of memory.

At the Palm division, while many engineers pondered new ways to retain market share, Hawkins recalled thinking, "Who cares. I don't need eight megabytes; I can't even fill up two. Let's show the world that this isn't about speeds and feeds. . . . It's about simplicity."¹⁹ To avoid being caught up in the battle over new features and minutiae, the Palm division under Hawkins' leadership sought an entirely new approach, one that would also hopefully draw in more female users into a market of predominantly male businessmen.

Palm eventually turned to IDEO to fulfill Hawkins' vision. Within IDEO, the choice of project leader fell naturally to Dennis Boyle, a senior project leader and studio manager who had left his mark on the company with a stream of successful products and the institution of the Tech Box, a natural outgrowth of his tendencies since childhood (to the chagrin of this mother) to collect artifacts of all sorts in shoeboxes. For Boyle, the fit was natural: the very moment he first saw the Palm Pilot he knew "this will make a big difference" and proceeded to use it, add it to his collection, and discuss it at staff meetings. Palm was to remain Boyle's main client for the duration of the project, with a majority of his billable time dedicated there.

For Hawkins' and Boyle's teams, inspiration came from the sleek Motorola StarTac mobile phone that was introduced in 1996 at the price of \$1,000— at a time when many mobile phone makers started giving away their products in return for user subscription fees. Hawkins recalled that, "The StarTac was a radical departure. It looked different, beautiful. It also commanded outrageous prices. We wanted to do the same thing."²⁰ Other products that inspired the IDEO team, and which Boyle kept in his briefcase, included a metal Canon minicamera, Pentax opera glasses, and a telescoping pair of eyeglasses in a thin metal case used as emergency back-up eyewear.

Each of these small and elegant products made the existing line of Palm Pilots appear stodgy in comparison. This was not surprising given that the computer world had generally ignored design in favor of technical bells and whistles that catered to men. Men, after all, comprised the majority of computational gadget users at the time. This mindset was successfully challenged by Apple Computer, which true to its "Think Different" advertisement campaigns, came up with its translucent turquoise iMac computers. Apple President Steve Jobs declared, "for most consumers, color is more important than megahertz."

With similar thoughts in mind, Boyle's team outlined plans for a slimmer, sleeker version of the existing Palm Pilot. This called for reducing the thickness from the current 19mm to 11mm and the weight by one-third. According to Janice Robert, the 3Com vice president in charge of the Palm division at the time of the Palm V release: "We want to appeal to people not just on the rational level but the emotional level."²¹

¹⁸ D. Roth, "Putting fluff over function," *Fortune*, March 15, 1999.

¹⁹ *Ibid.*

²⁰ *Ibid.*

²¹ *Ibid.*

The team started work on what would become the Palm V project late in 1996.²² At the outset of the “Understand Phase” (**Phase 0**), which lasted 10–12 weeks, the IDEO team realized that despite the popularity of the Palm III, little data existed on user preferences. Boyle therefore started creating his own observational database by purchasing dozens of the Palm Pilots and giving them to colleagues, business friends, spouses, physicians, and representatives from other walks of life.

The rapidly developing obsession of Boyle’s team with Palm Pilots spread throughout the company: over 200 IDEO staff members throughout the company eventually started them. Feedback through e-mail or through casual hallway conversations quickly started reaching Boyle’s team. The team became aware of problems concerning the product’s susceptibility to breaking after being dropped, rigidity of the case, battery placement and memory doors, and location of the stylus holder.

In March 1997, **Phase I** (visualize and realize) started. At the outset, only three to four IDEO designers and engineers were involved. At the project’s height of activity, as many as a dozen staffers would become involved. The diverse team included nationalities ranging from as far afield as Taiwan, the Netherlands, and Israel. Boyle deliberately tapped the talent of two female design engineers including senior designer, Amy Han, in hopes of achieving insights that would attract more female users into a marketplace where 95% of the existing Palm users were men.

Han and her colleague Trae Niest, in turn, obtained feedback from 15 other female colleagues. As a group, they challenged the conventional wisdom that handheld devices, in general, had to be square with block edges and colored a mundane gray. Even the advertisements promoted a corporate monolithic blandness, with, for instance, depictions of businessmen slipping Palms into gray suit pockets. The findings and insights of Han and her group led the industrial designers to make the new product more curvy, with tapering edges. The new project bore the code name “Razor,” which indicated the goal of Hawkins’ team at Palm to create a “razor thin” product.

The IDEO team met weekly with the Palm division to ensure a constant stream of feedback. Boyle made sure the team never went to a client meeting without a prototype of some type or another. The prototypes varied from being as simple as a keypad button to mockups of subtly different-sized LCD panels to styluses of varying thicknesses, lengths, and contours (see **Exhibits 5** and **6**). This process helped ensure that even the smallest of details would be considered. As a result, for instance, the team designed both sides of the device to accommodate a wide variety of potential add-on covers and styluses. Even left-handed individuals would find the dual rail system accommodating.

To ensure a very thin product, the design teams realized early in the process that traditional batteries would have to give way to thinner rechargeable lithium ion batteries. However, it was not clear, considering recharging times and use patterns, that lithium ion would work in this design. The Palm team under Frank Canova, director of hardware engineering, and IDEO spent much of the first half of 1997 corralling reluctant battery makers to cooperate in this venture. Another sticky issue confronting the entire team concerned the use of anodized aluminum for creating the thin casing—a choice of material based on the limitations of plastics—given that US manufacturers had little experience working with this material. As a result, the Palm V team faced the dual challenge of communicating with Asian manufacturers while simultaneously using anodized aluminum to create the technically difficult thin complex surfaces.²³

²² Many viewed the parallels in nomenclature between the Palm III, V, and VII and the BMW 3, 5, and 7 series as 3Com’s tribute to BMW’s internationally heralded automotive product line.

²³ D. Roth, “Putting fluff over function,” *Fortune*, March 15, 1999.

By May 1997, conceptualization and realization of the Palm V project gave way to **Phase II** (evaluation and refinement). This stage involved computer-aided design (CAD) engineering to help create accurate industrial models resembling the proposed end product. In this phase, designers and engineers incorporated observed usage patterns to allow users to recharge the Palm for only brief periods of time without shortening battery lives. The team moved toward a final model, choosing solutions, vendors, and sources. Every part of the mechanical model was machined out as close as possible to the final mass-produced parts. By the end of Phase II, some 20-25 prototypes had been created (see **Exhibit 6**).

In the fall of 1997, **Phase III**, implementation (detailed engineering), started. Every component was engineered to be functional in terms of the electronics and software. Some three to five production prototypes were created. A number of each of these prototypes were built for drop testing to develop the sturdiest possible electronics. Testing was also undertaken to meet government regulations. By the end of Phase III, prototype models could exceed \$30,000 each. The team kept refining those models until just one or two final contestants remained. At the same time, the Palm team grew by leaps and bounds, particularly in the realm of production as well as product promotion. Through regular meetings of increasing sizes, and through a flurry of e-mail exchanges, responsibilities gradually shifted away from IDEO.

One of the most bothersome problems confronting the team involved binding the complex 11 mm-wide unit together without a single screw (screws being considered aesthetically and mechanically undesirable by the IDEO designers). The team ultimately committed to using a binding device never before used for handheld computers: industrial glue. At a most inopportune time, however, 3Com's modem card gluers—the only available personnel with experience in using industrial glue—left the company. The remaining team ended up experimenting through trial and error with several different adhesives and bonding parameters before arriving at a satisfactory solution (see **Exhibit 6**).

By end of **Phase IV**, implementation (manufacturing liaison), "Razor" would be released to production. The Palm division planned to retain some IDEO personnel for another six months—the amount of time projected for gearing up for market release in February 1999. During this period, pilot production would work on smoothing processes at the production line to ultimately allow for manufacturing up to 5,000 units a day. This was crucial: each day's loss of a production line's output would cost the company a few hundred thousand dollars. Many problems still remained for the Palm manufacturers to address including cracks in the display, electrostatic charge, docking problems, cover imperfections, supplies procurement, and component switching. An aggressive schedule would compound problems that would otherwise be considered routine for products of this complexity. Hundreds of personnel were expected to become involved at the manufacturing sites in Utah, Japan, and Singapore as well as at dozens of vendor sites in Hong Kong, Taiwan, California, Texas, and Singapore.

The Handspring Project

In July 1998, both Hawkins and his business partner Donna Dubinsky, a Harvard MBA who had run the business side of Palm, resigned from 3Com on amicable terms to set up shop in Palo Alto. Part of the reason for the move was the desire for greater autonomy. Despite the success of the Palm line, 3Com as a whole was not doing well enough to reward personnel with stock. The goal of the new company was to come out with a fully compatible, slightly smaller, and less expensive clone of the palm-size computers. A technical motivation behind the new company was to address the Palm's inability to easily add functionality.

Hawkins had already scaled back to part-time work at Palm Computing to turn his attention to a long-time interest of his: writing a book on how the brain works. The temptation to interrupt the academic project to take another pass at building the perfect palm-size device was irresistible for someone universally hailed as the “father of a new industry.” In quick order, Hawkins and Dubinsky were joined by the original Palm team of a dozen engineers. People enjoyed working with Hawkins, who, in Boyle’s words was “by and large an even-keeled, predictable, normal person despite being a brilliant innovator.”

Just a few weeks after starting up, Dubinsky and Hawkins, now chief product officer at Handspring, signed a licensing agreement with 3Com for the right to use the Palm operating system. This agreement would provide any product they developed compatibility with the myriad applications already available for Palm devices. Once again, Hawkins would turn to IDEO for designing a new product.

Hawkins felt that the proposed device should be able to easily link-up through so-called “ROM cards” for games, pagers, cell phones, Global Positioning System receivers, voice recorders (the product would have a tiny built-in microphone), wireless modems, MP3 music players, graphing calculators, digital cameras, and even cardiac monitors. A solution for how to do this came to Hawkins when he spotted his child’s Nintendo Game Boy, which allowed for changing games simply by inserting interchangeable game cartridges. This led to the so-called “Springboard” slot on the back of the product, which would allow the user to plug in a variety of matchbook-size modules. Hawkins’ ten-year-old daughter actually proposed the product name “Visor” – short for “advisor.”

The IDEO-Handspring team wanted the modules to be simple to use, with the device operating the moment a module was inserted. Some two dozen third-party developers expressed interest in developing add-on devices for the proposed Visor. Even without a concrete plan, funding flowed easily from venture capitalists eager to duplicate Palm’s success with a device that could set a new trend in handheld computing. Publicity, too, would come easily, even in a field replete with new handheld devices. For the meantime, however, the media was kept guessing.

Apart from product features such as price, memory and colors, the Visor team saw little need for market research. According to Dubinsky, “We felt we understood the marketplace pretty well. After all, we invented the product and the category... You can’t test the concept of a slot; it’s too major.”²⁴ The new project, however, was launched at a time when skeptics noted that people used hand-held devices primarily for mundane tasks such as storing addresses and personal calendars, rather than for complex tasks such as accessing e-mail. “People don’t want a combination device,” according to Ken Dulaney, mobile computing market research specialist at the Gartner Group. “Every time you try to get a computer to do many things, it ends up doing none of them well.”²⁵

Hawkins and Dubinsky insisted that the Visor’s cost be kept to \$150 – a price far below the \$300 commanded by the original Palm Pilot in 1996 and the \$450 commanded by the Palm V at its market launch. This price was intended to attract a wider following and consistent with Handspring’s strategy of getting a product with the new standard into many hands as quickly as possible. As a result, Hawkins and Dubinsky pushed for a product launch deadline of late 1999, just in time for the holiday gift-giving season and several months less than their already ambitious prior deadline of spring 2000. This would entail a product development cycle of about 10 months before handing off the product to production in March-April 1999.

²⁴ K. Hafner, “One More Ultimate Gadget,” *The New York Times*, September 16, 1999, Late Edition, p. G1.

²⁵ Ibid.

Boyle was not worried about the challenging schedule because IDEO could meet difficult deadlines, even if at the eleventh hour and fifty-ninth minute. Furthermore, the team under Boyle had already encountered and worked smoothly with most of the Handspring team through dozens of prior meetings and other encounters during the Palm V project. IDEO and Handspring shared in common a belief in quick prototyping and a consumer-centered mentality. In Hawkins' words, after all, "I'm not down on engineering, but I'm really down on technology for technology's sake. . . I don't say 'Put the biggest, meanest CPU in here.' I say, 'Make this work well for the consumer.'"²⁶

The Handspring project would also require Boyle's team to keep the rest of IDEO, not to mention the rest of Silicon Valley, in the dark about the project. This would make for uncomfortable moments, especially during informal hallway conversations with colleagues, some of who were still working on the Palm V project.

What concerned Boyle much more, however, was sacrificing IDEO's emphasis on innovation and design in order to meet the client's goals. Because of the time and price pressures, Hawkins' proposal would imply running with only "tried-and-true" technology; IDEO would not be able to indulge in the early phases of its legendary innovation process that differentiated it from other product development firms. Visor would have to sacrifice style and settle on an inexpensive plastic housing, and on AAA batteries instead of the rechargeable lithium-ion battery found in the Palm V.

If they had twice the time, Boyle was confident that his team could help create a killer product that would match the Palm V in design excellence and capability. Should he and Kelley try to persuade Handspring to postpone the Visor launch, which would allow the team to follow all the steps of IDEO's innovation process? Or should they just accept the client's request for a very aggressive schedule that was shorter than half the time they had for the Palm V? Or perhaps it would be better to decline Handspring's request and help new clients on IDEO's waitlist. He wrestled with these thoughts as he finished his espresso and walked back to the studio to meet David Kelley.

²⁶ R. Merritt, "Palm Pilot designer steers fresh course in handhelds." *Electronic Engineering Times*, October 25, 1999.

Exhibit 1 IDEO Timeline

| | | |
|---------------------|----------|--|
| ca. 500 B.C. | | Documentation of Egyptian papyrus prototypes for paper, which millennia later remains medium of choice for personal data storage. |
| 1978 | | David Kelley receives master's degree from Stanford's product design program. Eventually starts up his own company, David Kelley Design. |
| Mid-1980's | | With the advent of Apple Computer's Newton, handheld computing gets its start and meets its near-demise. |
| 1991 | | IDEO started through a merger between David Kelley Design, ID Two, and Matrix. |
| 1996 | | Annual IDEO revenues reach \$40-50 million. |
| | March | Engineer-visionary Jeff Hawkins' handheld "Palm Pilot," meant to replace papyrus derivatives rather than computers, finds immediate consumer acceptance. |
| | Fall | IDEO starts work on the Palm V project, which bears the code name "Razor." |
| 1997 | March | Phase I ("Understand") starts on the Palm V project; by May Phase II ("Evaluation and refinement") starts; by fall, Phase III ("Implementation") starts. |
| 1998 | Summer | Handspring project starts at IDEO when Jeff Hawkins asks Dennis Boyle for a proposal for proposed handheld computing device with revolutionary "Springboard" slot. |
| | Fall | Phase IV ends; "Razor" will be released to production. Gearing up for market release starts. |
| 1999 | February | First Palm V shipments expected. |
| | October | Shipment of Handspring Visor planned by Hawkins and Dubinsky, in time for Christmas shopping season. |

Exhibit 2 Leading Design Firms and Corporations with Industrial Design Excellence Awards

| Design Firms | 1995-1998 Awards |
|----------------------------|-------------------------|
| IDEO | 32 |
| ZIBA Design | 20 |
| Fitch | 18 |
| Frogdesign | 12 |
| Altitude | 11 |
| Pentagram | 10 |
| Design Continuum | 10 |
| Lunar Design | 9 |
| Herbst Lazar Bell | 7 |
| Hauser | 6 |
| Ralph Applebaum Associates | 6 |

| Corporations | 1995-1998 Awards |
|------------------------------|-------------------------|
| Apple | 9 |
| Black & Decker | 13 |
| Compaq | 9 |
| Samsung Electronics | 7 |
| Hewlett Packard | 5 |
| NCR | 9 |
| IBM | 5 |
| Microsoft | 7 |
| Philips Electronics | 6 |
| Thomson Consumer Electronics | 7 |

Source: *Business Week's* 1999 Design Awards, Industrial Designers Society of America.

Exhibit 3 IDEO's Innovation Process**PHASE 0: Understand/Observe**

This phase helps the team determine feasibility of designing a product. It involves understanding everything about a new client and its business. Thus, to design a new home entertainment remote control, for instance, the team might study the history of remote controls and the companies involved in designing them. It would research everything from the cost structure of remote controls to the associated panic incidence of “where is the remote control?” syndrome. The team would buy every different kind of remote controls on the market to take apart in a fashion more gentle and controlled than exhibited by frustrated owners.

In addition to meeting with representatives from marketing and manufacturing, the team might also observe people at home on their couches attempting to use remotes. On the topic of consumer observations, IDEO head David Kelley once noted: “That's where most of the good ideas for a new project come.”²⁷ Although this phase was typically the least expensive part of an entire project, product developers at most companies spent little time here for fear of duplicating efforts of marketing or R&D. By the end of Phase 0, the team created a feasibility record along with major discoveries about the marketplace and users.

PHASE I: Visualize/Realize

In the “Visualize/Realize” phase, the product development team visualized potential solutions through tangible prototypes to the point where a product direction was chosen. Although it involved similar activities as Phase 0 (in fact, Phases 0 and I were often combined), it was more product-focused. This intensive stage required close coordination of efforts with the client to ensure constant feedback. By the end of Phase I, the team aimed for having rough three-dimensional models of a product, an understanding of the context in which the product would be used, and an outline of a manufacturing strategy.

The team combined ideas, technologies, and market perceptions with observations of real world users to investigate potential needs that the product could fill. To do this, IDEO eschewed the traditional reliance on statistical data collected by the marketing team in favor of storyboard depictions of lives of several potential users. Use of these fictional characters concretized the product development process. For instance, while designing a better remote system, the IDEO team might conjure up characters like “Jughead the constantly eating couch potato” or “Archie the swinging bachelor” or “Moose the klutz,” or “Veronica the princess.” Observations of Jughead or Veronica might lead to thoughts about how to avoid spillage of food or nail polish into the buttons; observations of Moose might lead to ideas about developing drop-proof remotes; observations of either Archie or Veronica on a weekend night might lead to design of a remote with large “glow-in-the-dark” buttons that could be hastily be programmed with just one hand in a darkened room.

²⁷ R. Garner, *San Francisco Examiner*, May 23, 1994, p. B-1.

PHASE II: Evaluating/Refining

The purpose of this stage was to develop functional prototypes and resolve technical problems as well as problems users faced. The emphasis shifted over the course of this stage from human factors and ergonomics to engineering. Concurrent engineering often occurred, through filling in previously unspecified features using an iterative process. This process, of course, required constant communications between various subgroups to ensure that the final outcomes would mesh well together.

By the end of Phase II, a functional model as well as a “looks like” design model was delivered. The industrial design solutions eventually became documented using CAD tools. With finalization of technical specifications, detailed engineering could occur.

PHASE III: Implement (detailed engineering)

During this phase, the team completed product design and verified that the product worked. It validated the manufacturability and performance of the final product. Although engineering efforts predominated, continuous low-level involvement with design team members occurred. For designers, frequent visits to the machine shops during this phase provided a reality check. By the end of this phase, the team delivered a fully functional design model, tooling databases, and technical documentation. Testing might also be undertaken in this phase to meet government regulations. The team also started selecting vendors.

PHASE IV: Implement (manufacturing liaison)

In this phase, the team resolved issues involving the final design to ensure smooth product release to manufacturing as the product moved from the shop floor to the client’s factory lines. The team still supervised production of tooling, regulatory approvals, and construction of pilot runs of the manufacturing line. Testing of manufacturing feasibility was crucial: each day’s loss of a production line’s output might cost the client company a substantial amount in lost revenues. By the end of this phase, the product would be formally handed over to the client.

Source: IDEO.

Exhibit 4 Sample of Products Developed by IDEO (See www.ideo.com For More Products)



Product: Apple Mouse
 Year: 1983
 Client: Apple Computers
 Function: Input device for the Apple Lisa and Macintosh computers



Product: Vertech Alpine/Ski
 Year: 1994
 Client: Avocet
 Function: Sports wristwatch with altimeter; records total feet of ascent or descent per session



Product: Oral-B Squish Grips
 Year: 1996
 Client: Oral-B
 Function: Soft-handled kids' toothbrushes



Product: Heartstream ForeRunner
 Year: 1996
 Client: Heartstream (now Agilent)
 Function: Portable defibrillator for cardiac arrests

Source: IDEO.

Exhibit 5 From Concept to Production: Prototyping and Experimentation During the Palm V Project



LEFT TO RIGHT:

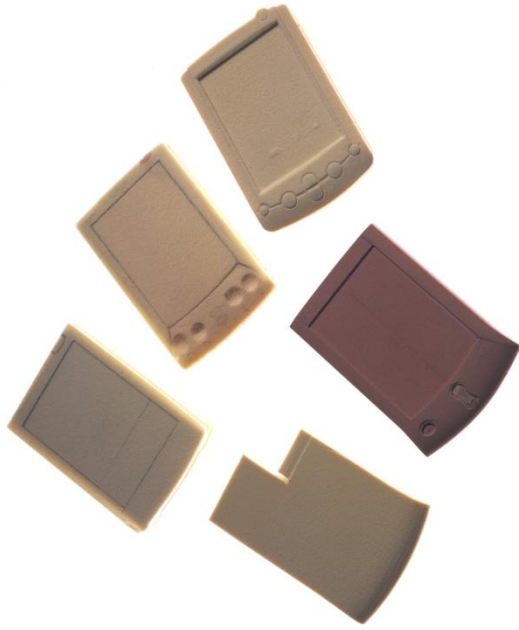
- Low-density foam study
- High-density foam study
- Phase I industrial design prototype with stylus concept

LEFT TO RIGHT:

- Machined engineering prototype
- Final industrial design prototype
- Preproduction prototype

Source: IDEO.

Exhibit 6 "Enlightened Trial and Error" at IDEO: Families of Palm V Prototypes



Early Industrial Design Form Studies



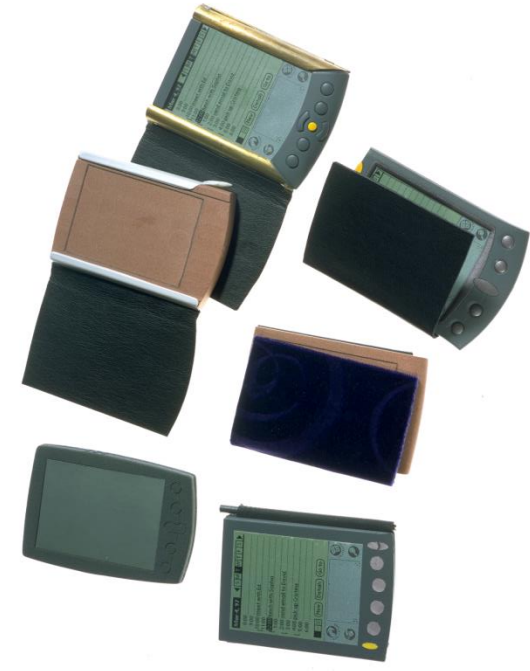
Foam, Wood and Mechanical Prototypes of HotSync Cradle

Preliminary Modem Concept Prototypes



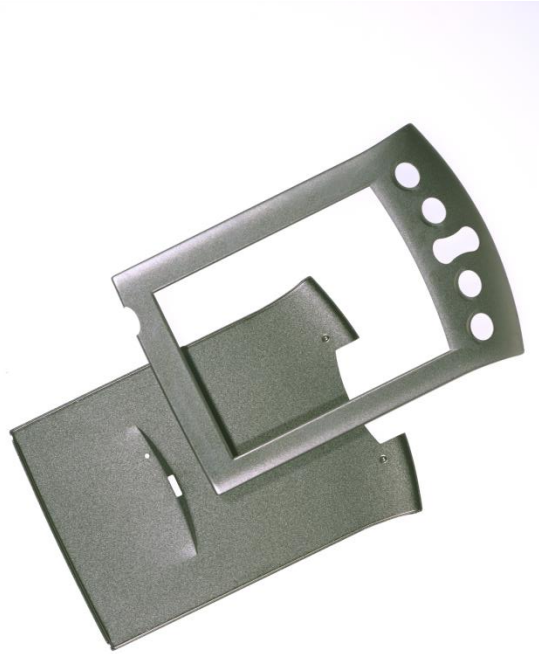
Prototypes Used for Button Location and Feel Experiments

Exhibit 6 (continued) "Enlightened Trial and Error" at IDEO: Families of Palm V Prototypes

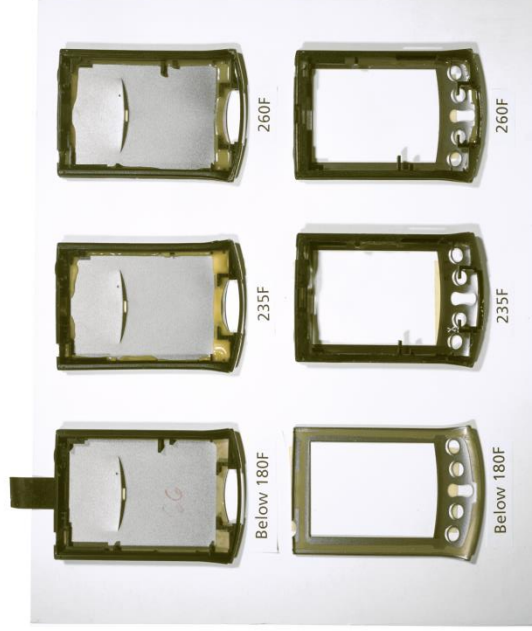


Stylus Retention and "Experiential" Mechanical Prototypes

Cover and Stylus Attachment Concept Prototypes



First Articles from Production Case Stampings



Experimentation to Determine Optimum Glue Bonding Temperatures

Source: IDEO.