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The Guts of a New Machine

By ROB WALKER

Two years ago this month, Apple Computer released a small, sleek-looking device it called the iPod. A digital music player, it weighed just 6.5 ounces and held about 1,000 songs. There were small MP3 players around at the time, and there were players that could hold a lot of music. But if the crucial equation is "largest number of songs" divided by "smallest physical space," the iPod seemed untouchable. And yet the initial reaction was mixed: the thing cost $400, so much more than existing digital players that it prompted one online skeptic to suggest that the name might be an acronym for "Idiots Price Our Devices." This line of complaint called to mind the Newton, Apple's pen-based personal organizer that was ahead of its time but carried a bloated price tag to its doom.

Since then, however, about 1.4 million iPods have been sold. (It has been updated twice and now comes in three versions, all of which improved on the original's songs-per-space ratio, and are priced at $300, $400 and $500, the most expensive holding 10,000 songs.) For the months of July and August, the iPod claimed the No. 1 spot in the MP3 player market both in terms of unit share (31 percent) and revenue share (56 percent), by Apple's reckoning. It is now Apple's highest-volume product. "It's something that's as big a brand to Apple as the Mac," is how Philip Schiller, Apple's senior vice president of worldwide product marketing, puts it. "And that's a pretty big deal."

Of course, as anyone who knows the basic outline of Apple's history is aware, there is no guarantee that today's innovation leader will not be copycatted and undersold into tomorrow's niche player. Apple's recent and highly publicized move to make the iPod and its related software, iTunes, available to users of Windows-based computers is widely seen as a sign that the company is trying to avoid that fate this time around. But it may happen anyway. The history of innovation is the history of innovation being imitated, iterated and often overtaken.

Whether the iPod achieves truly mass scale -- like, say, the cassette-tape Walkman, which sold an astonishing 186 million units in its first 20 years of existence -- it certainly qualifies as a hit and as a genuine breakthrough. It has popped up on "Saturday Night Live," in a 50 Cent video, on Oprah Winfrey's list of her "favorite things," and in recurring "what's on your iPod" gimmicks in several magazines. It is, in short, an icon. A handful of familiar cliches have made the rounds to explain this -- it's about ease of use, it's about Apple's great sense of design. But what does that really mean? "Most people make the mistake of thinking design is what it looks like," says Steve Jobs, Apple's C.E.O. "People think it's this veneer -- that the designers are handed this box and told, 'Make it look good!' That's not what we think design is. It's not just what it looks like and feels like. Design is how it works."

So you can say that the iPod is innovative, but it's harder to nail down whether the key is what's inside it, the external appearance or even the way these work together. One approach is to peel your way through the thing, layer by layer.

The Aura

If you want to understand why a product has become an icon, you of course want to talk to the people who dreamed it up and made it. And you want to talk to the design experts and the technology pros and the professors and the gurus. But what you really want to do is talk to Andrew Andrew. Andrew Andrew is a "highly diversified company" made of two personable young men, each named Andrew. They dress identically and seem to agree on everything; they say, among other things, that they have traveled from the future "to set things on the right course for tomorrow." They require interviewers to sign a form agreeing not to reveal any differences between Andrew and Andrew, because to do so might undermine the Andrew Andrew brand -- and since this request is more interesting than whatever those differences might be, interviewers sign it.

Among other things, they do some fashion design and they are DJ's who "spin" on iPods, setting up participatory events called iParties. Thus they've probably seen more people interact with the player than anyone who doesn't work for Apple. More important, they put an incredible amount of thought into what they buy, and why: In a world where, for better or worse, aesthetics is a business, they are not just consumers but consumption artists. So Andrew remembers exactly where he was when he first encountered the iPod: 14th Street near Ninth Avenue in New York City. He was with Andrew, of course. A friend showed it to them. Andrew held the device in his hand. The main control on the iPod is a scroll wheel: you spin it with your thumb to navigate the long list of songs (or artists or genres), touch a button to pick a track and use the wheel again to adjust the volume. The other Andrew also tried it out. "When you do the volume for the first time, that's the key moment," says Andrew. "We knew: We had to have one." (Well, two.)

Before you even get to the surface of the iPod, you encounter what could be called its aura. The commercial version of an aura is a brand, and while Apple may be a niche player in the computer market, the fanatical brand loyalty of its customers is legendary. A journalist, Leander Kahney, has even written a book about it, "The Cult of Mac," to be published in the spring. As he points out, that base has supported the company with a faith in its will to innovate -- even during stretches when it hasn't. Apple is also a giant in the world of industrial design. The candy-colored look of the iMac has been so widely copied that it's now a visual cliche.

But the iPod is making an even bigger impression. Bruce Claxton, who is the current president of the Industrial Designers Society of America and a senior designer at Motorola, calls the device emblematic of a shift toward products that are "an antidote to the hyper lifestyle," which might be symbolized by hand-held devices that bristle with buttons and controls that seem to promise a million functions if you only had time to figure them all out. "People are seeking out products that are not just simple to use but a joy to use." Moby, the recording artist, has been a high-profile iPod booster since the product's debut. "The kind of insidious revolutionary quality of the iPod," he says, "is that it's so elegant and logical, it becomes part of your life so quickly

that you can't remember what it was like beforehand."

Tuesday nights, Andrew Andrew's iParty happens at a club called APT on the spooky, far western end of 13th Street. They show up at about 10 in matching sweat jackets and sneakers, matching eyeglasses, matching haircuts. They connect their matching iPods to a modest Gemini mixer that they've fitted with a white front panel to make it look more iPodish. The iPods sit on either side of the mixer, on their backs, so they look like tiny turntables. Andrew Andrew change into matching lab coats and ties. They hand out long song lists to patrons, who take a number and, when called, are invited up to program a seven-minute set. At around midnight, the actor Elijah Wood (Frodo) has turned up and is permitted to plug his own iPod into Andrew Andrew's system. His set includes a Squarepusher song.

Between songs at APT, each Andrew analyzed the iPod. In talking about how hard it was, at first, to believe that so much music could be stuffed into such a tiny object, they came back to the scroll wheel as the key to the product's initial seductiveness. "It really bridged the gap," Andrew observed, "between fantasy and reality."

The idea of innovation, particularly technological innovation, has a kind of aura around it, too. Imagine the lone genius, sheltered from the storm of short-term commercial demands in a research lab somewhere, whose tinkering produces a sudden and momentous breakthrough. Or maybe we think innovation begins with an epiphany, a sudden vision of the future. Either way, we think of that one thing, the lightning bolt that jolted all the other pieces into place. The Walkman came about because a Sony executive wanted a high-quality but small stereo tape player to listen to on long flights. A small recorder was modified, with the recording pieces removed and stereo circuitry added. That was February 1979, and within six months the product was on the market.

The iPod's history is comparatively free of lightning-bolt moments. Apple was not ahead of the curve in recognizing the power of music in digital form. It was practically the last computer maker to equip its machines with CD burners. It trailed others in creating jukebox software for storing and organizing music collections on computers. And various portable digital music players were already on the market before the iPod was even an idea. Back when Napster was inspiring a million self-styled visionaries to predict the end of music as we know it, Apple was focused on the relationship between computers and video. The company had, back in the 1990's, invented a technology called FireWire, which is basically a tool for moving data between digital devices -- in large quantities, very quickly. Apple licensed this technology to various Japanese consumer electronics companies (which used it in digital camcorders and players) and eventually started adding FireWire ports to iMacs and creating video editing software. This led to programs called iMovie, then iPhoto and then a conceptual view of the home computer as a "digital hub" that would complement a range of devices. Finally, in January 2001, iTunes was added to the mix.

And although the next step sounds prosaic -- we make software that lets you organize the music on your computer, so maybe we should make one of those things that lets you take it with you -- it was also something new. There were companies that made jukebox software, and companies that made portable players, but nobody made both. What this meant is not that the iPod could

do more, but that it would do less. This is what led to what Jonathan Ive, Apple's vice president of industrial design, calls the iPod's "overt simplicity." And this, perversely, is the most exciting thing about it.

The Surface

Ive introduces himself as Jony, but really he seems like more of a Jonathan: Friendly and soft-spoken, almost sheepish at times, but also, with his shaved head and English accent and carefully chosen words, an extremely precise man. We spoke in a generic conference room in Apple's Cupertino, Calif., headquarters, decorated mostly with the company's products.

Before I really had a chance to ask a question, Ive spent about 10 minutes talking about the iPod's packaging -- the way the box opens, how the foam is cut. He talked about the unusually thin and flexible FireWire cable, about the "taut, crisp" cradle that the iPod rests in, about the white headphones. "I remember there was a discussion: 'Headphones can't be white; headphones are black, or dark gray.'" But uniform whiteness seemed too important to the product to break the pattern, and indeed the white headphones have become a kind of secondary, unplanned icon -- as Apple's current ads featuring white-headphoned silhouettes now underscore. It's those details, he said, that make the iPod special: "We are surrounded by so many things that are flippant and trivial. This could have been just another self-important plastic thing."

When it came to pinning Ive down on questions of how specific aspects of the product came to be, he stressed not epiphanies but process. Asked about the scroll wheel, he did not mention the Bang & Olufsen BeoCom phones that use a similar radial dial; rather, he talked about the way that his design group collaborates constantly with engineers and manufacturers. "It's not serial," he insisted. "It's not one person passing something on to the next." I'd push for a lightning bolt moment, and he'd trail off. Finally, at one point, he interrupted himself and said, with sudden energy, "It's almost easier to talk about it as what it's not."

The surface of the iPod, white on front and stainless steel behind, is perfectly seamless. It's close to impenetrable. You hook it up to a computer with iTunes, and whatever music you have collected there flows (incredibly fast, thanks to that FireWire cable) into the iPod -- again, seamless. Once it's in there, the surface of the iPod is not likely to cause problems for the user, because there's almost nothing on it. Just that wheel, one button in the center, and four beneath the device's LCD screen. (The look, with the big circle at the bottom, is reminiscent of a tiny stereo speaker.)

"Steve" -- that would be Steve Jobs -- "made some very interesting observations very early on about how this was about navigating content," Ive says. "It was about being very focused and not trying to do too much with the device -- which would have been its complication and, therefore, its demise. The enabling features aren't obvious and evident, because the key was getting rid of stuff."

Later he said: "What's interesting is that out of that simplicity, and almost that unashamed sense of simplicity, and expressing it, came a very different product. But difference wasn't the goal. It's actually very easy to create a different thing. What was exciting is starting to realize

that its difference was really a consequence of this quest to make it a very simple thing."

Before Ive came to Apple, he worked independently, often on projects that never got out of the prototype phase; one working model would be made, and then it would sit on a shelf in his office. You can think of innovation as a continuum, and this phase is one end of it. The dreams and experiments that happen outside of -- and in a state of indifference toward -- the marketplace. At the other end of the continuum are the fast followers, those who are very attuned to the marketplace, but are not particularly innovative. They let someone else do the risky business of wild leaps, then swoop in behind with an offering that funnels some aspect of the innovation into a more marketable (cheaper? watered down? easier to obtain?) package -- and dominates. Fairly or not, the shorthand version of this in the technology world would have at one end of the continuum Xerox PARC, the famous R&D lab where all manner of bleeding-edge innovations (including some of the "look and feel" of the Mac) were researched but never developed into marketable products. And at the other end you'd have companies like Microsoft and Dell.

Apple presents itself as a company whose place on this continuum is unique. Its headquarters in Cupertino is a series of connected buildings arranged in a circle. Behind this surface is a kind of enclosed park. It looks like public space, but of course it isn't: You can't get to it unless you're an Apple employee or are accompanied by one. Along one side of this hermetic oasis are a bunch of tables, set just outside the company cafeteria, and a sign that says Cafe Macs. Here I sat with my P.R. minder and watched Steve Jobs approach in long, energetic strides. It was a perfect day, and he wore shorts with his black turtleneck, and sneakers.

He was very much on message, and the message was that only Apple could have developed the iPod. Like the device itself, Apple appears seamless: it has the hardware engineers, the software engineers, the industrial designers, all under one roof and working together. "As technology becomes more complex, Apple's core strength of knowing how to make very sophisticated technology comprehensible to mere mortals is in even greater demand." This is why, he said, the barrage of devices made by everyone from Philips to Samsung to Dell that are imitating and will imitate the iPod do not make him nervous. "The Dells of the world don't spend money" on design innovation, he said. "They don't think about these things."

As he described it, the iPod did not begin with a specific technological breakthrough, but with a sense, in early 2001, that Apple could give this market something better than any rival could. So the starting point wasn't a chip or a design; the starting point was the question, What's the user experience? "Correct," Jobs said. "And the pieces come together. If you start to work on something, and the time is right, pieces come in from the periphery. It just comes together."

The Guts

What, then, are the pieces? What are the technical innards of the seamless iPod? What's underneath the surface? "Esoterica," says Schiller, an Apple V.P., waving away any and all questions about the iPod's innards. Consumers, he said, don't care about technical specs; they care about how many songs it holds, how quickly they can transfer them, how good the sound quality is.

Perhaps. But some people are interested in esoterica, and a lot of people were interested in knowing what was inside the iPod when it made its debut. One of them was David Carey, who for the past three years has run a business in Austin, Tex., called Portelligent, which tears apart electronic devices and does what might be called guts checks. He tore up his first iPod in early 2002.

Inside was a neat stack of core components. First, the power source: a slim, squarish rechargeable battery made by Sony. Atop that was the hard disk -- the thing that holds all the music files. At the time, small hard disks were mostly used in laptops, or as removable data-storage cards for laptops. So-called 2.5-inch hard disks, which are protected by a casing that actually measures about 2 3/4 inches by 4 inches, were fairly commonplace, but Toshiba had come up with an even smaller one. With a protective cover measuring just over 2 inches by 3 inches, 0.2 inches thick and weighing less than two ounces, its 1.8-inch disk could hold five gigabytes of data -- or, in practical terms, about a thousand songs. This is what Apple used.

On top of this hard disk was the circuit board. This included components to turn a digitally encoded music file into a conventional audio file, the chip that enables the device to use FireWire both as a pipe for digital data and battery charging and the central processing unit that acts as the sort of taskmaster for the various components. Also here was the ball-bearing construction underlying the scroll wheel. (The newer iPod models got slimmer by replacing that wheel with a solid-state version and by using a smaller battery.) It is, as Carey notes, an admirable arrangement.

Exactly how all the pieces came together -- there were parts from at least a half-dozen companies in the original iPod -- is not something Apple talks about. But one clue can be found in the device itself. Under the Settings menu is a selection called Legal, and there you find not just Apple's copyright but also a note that "portions" of the device are copyrighted by something called PortalPlayer Inc. That taskmaster central processing unit is a PortalPlayer chip. The Silicon Valley company, which describes itself as a "supplier of digital media infrastructure solutions for the consumer marketplace," has never publicly discussed its role in the iPod. Its vice president for sales and marketing, Michael Maia, would talk to me only in general terms.

PortalPlayer was founded a little more than four years ago with an eye toward creating basic designs for digital computer peripherals, music players in particular. Specifically, the company wanted to build an architecture around tiny hard disks. Most early MP3 players did not use hard disks because they were physically too large. Rather, they used another type of storage technology (referred to as a "flash" chip) that took up little space but held less data -- that is, fewer songs. PortalPlayer's setup includes both a hard disk and a smaller memory chip, which is actually the thing that's active when you're listening to music; songs are cleverly parceled into this from the hard disk in small groups, a scheme that keeps the energy-hog hard disk from wearing down the battery. More recently, PortalPlayer's work has formed the guts of new players released by Samsung and Philips. A trade journal called Electronics Design Chain described PortalPlayer as having developed a "base platform" that Apple at least used as a starting point and indicated that PortalPlayer picked other members of the iPod "design chain" and helped manage the process.

Interestingly, the legal section in the first version of the iPod used to include another copyright notice on behalf of a company called Pixo, which is reported to have created the original operating system for the iPod. Pixo has since been bought by Sun Microsystems, and the credit has disappeared from both newer iPods and even more recent software upgrades for the original model.

Apple won't comment on any of this, and the nondisclosure agreements it has in place with its suppliers and collaborators are described as unusually restrictive. Presumably this is because the company prefers the image of a product that sprang forth whole from the corporate godhead -- which was certainly the impression the iPod created when it seemed to appear out of nowhere two years ago. But the point here is not to undercut Apple's role: the iPod came together in somewhere between six and nine months, from concept to market, and its coherence as a product given the time frame and the number of variables is astonishing. Jobs and company are still correct when they point to that coherence as key to the iPod's appeal; and the reality of technical innovation today is that assembling the right specialists is critical to speed, and speed is critical to success.

Still, in the world of technology products, guts have traditionally mattered quite a bit; the PC boom viewed from one angle was nothing but an endless series of announcements about bits and megahertz and RAM. That 1.8-inch hard disk, and the amount of data storage it offered in such a small space, isn't the only key to the iPod, but it's a big deal. Apple apparently cornered the market for the Toshiba disks for a while. But now there is, inevitably, an alternative. Hitachi now makes a disk that size, and it has at least one major buyer: Dell.

The System

My visit to Cupertino happened to coincide with the publication of a pessimistic installment of The Wall Street Journal's Heard on the Street column pointing out that Apple's famous online music store generates little profit. The more interesting point, noted in the back half of the column, is that Apple doesn't expect it to generate much profit -- it's a "Trojan horse" whose real function is to help sell more iPods. Given that the store was widely seen as a pivotal moment in the tortuous process of creating a legitimate digital music source that at least some paying consumers are willing to use, this is an amazing notion: Apple, in a sense, was willing to try and reinvent the entire music business in order to move iPods.

The column also noted that some on Wall Street were waiting to see what would happen to the iPod once Dell came out with its combination of music store and music player. (The Dell DJ is slightly bigger than the iPod but claims a longer battery life, which the company says is what its consumer research indicated people wanted; it costs $250 for a 15-gigabyte version, $300 for 20 gigabytes, or nearly 5,000 songs.) Napster's name has been bought by another company that has launched a pay service with a hardware partner, Samsung. But it was Dell that one investor quoted in the Journal article held out as the rival with the greatest chance of success: "No one markets as well as Dell does." This was causing some eye-rolling in Cupertino; Dell is not a marketer at all. Dell has no aura; there is no Cult of Dell. Dell is a merchandiser, a shiller of gigs-per-dollar. A follower. Dell had not released its product when I met Jobs, but he still dismissed it as "not any good."

About a week later Jobs played host to one of the "launch" events for which the company is notorious, announcing the availability of iTunes and access to the company's music store for Windows users. (In what seemed an odd crack in Apple's usually seamless aura maintenance, he did his demo on what was clearly a Dell computer.) The announcement included a deal with AOL and a huge promotion with Pepsi. The message was obvious: Apple is aiming squarely at the mainstream.

This sounded like a sea change. But while you can run iTunes on Windows and hook it up to an iPod, that iPod does not play songs in the formats used by any other seller of digital music, like Napster or Rhapsody. Nor will music bought through Apple's store play on any rival device. (The iPod does, of course, work easily with the MP3 format that's common on free file-swapping services, like KaZaA, that the music industry wants to shut down but that are still much more popular than anything requiring money.) This means Apple is, again, competing against a huge number of players across multiple business segments, who by and large will support one another's products and services. In light of this, says one of those competitors, Rob Glaser, founder and C.E.O. of RealNetworks, "It's absolutely clear now why five years from now, Apple will have 3 to 5 percent of the player market."

Glaser says he admires Apple and likes Jobs, but contends that this is simply the latest instance of the company's tendency, once again, to sacrifice commercial logic in the name of "ideology." Not that Apple can't maintain a business by catering to the high end and operating in a closed world. But maintaining market leadership, while easy when the field of competitors is small, will become impossible as rivals flood the market with their own innovations and an agnostic attitude about what works with what. "The history of the world," he says, "is that hybridization yields better results." With Dell and others aiming a big push at the Christmas season, it's even possible that Apple's market share has peaked.

Jobs, of course, has heard the predictions and has no patience for any of it. Various contenders have come at the iPod for two years, and none have measured up. Nothing has come close to Apple's interface. Even the look-alike products are frauds. "They're all putting their dumb controls in the shape of a circle, to fool the consumer into thinking it's a wheel like ours," he says. "We've sort of set the vernacular. They're trying to copy the vernacular without understanding it." (The one company that did plan a wheel-driven product, Samsung, changed course after Apple reportedly threatened to sue.)

"We don't underestimate people," Jobs said later in the interview. "We really did believe that people would want something this good, that they'd see the value in it. And that rather than making a far inferior product for a hundred dollars less, giving people the product that they want and that will serve them for years, even though it's a little pricier. People are smart; they figure these things out."

The point that companies -- like Dell -- that have no great reputation as innovators but a track record of winning by playing a price-driven, low-margin volume game was dismissed. The iPod has already been improved several times, Jobs said, and will keep improving in ways that keep it ahead of the pack. (He wouldn't get specific.) "For whatever reason," he said with finality, "the superior product has the largest share. Sometimes the best product does win. This may be

one of those times."

The Core

Actually, Jobs seemed a little annoyed. Looking back at my notes, I found it remarkable how many of his answers begin with some variation of "No," as if my questions were out of sync with what he wanted to say. (Before I could finish a question about the significance of Apple's pitching a product to Windows users, for instance, he corrected me: "We're not pitching the Windows user. We're pitching the music lover.") After half an hour of this, my inquiries really did start to fall apart, so I didn't expect much when I resorted to asking, in so many words, whether he thinks consciously about innovation.

"No," he said, peevishly. "We consciously think about making great products. We don't think, 'Let's be innovative!'" He waved his hands for effect. "'Let's take a class! Here are the five rules of innovation, let's put them up all over the company!'"

Well, I said defensively, there are people who do just that.

"Of course they do." I felt his annoyance shift elsewhere. "And it's like . . . somebody who's not cool trying to be cool. It's painful to watch. You know what I mean?" He looked at me for a while, and I started to think he was trying to tell me something. Then he said, "It's like . . . watching Michael Dell try to dance." The P.R. minder guffawed. "Painful," Jobs summarized.

What I had been hoping to do was catch a glimpse of what's there when you pull back all those layers -- when you penetrate the aura, strip off the surface, clear away the guts. What's under there is innovation, but where does it come from? I had given up on getting an answer to this question when I made a jokey observation that before long somebody would probably start making white headphones so that people carrying knockoffs and tape players could fool the world into thinking they had trendy iPods.

Jobs shook his head. "But then you meet the girl, and she says, 'Let me see what's on your iPod.' You pull out a tape player, and she walks away." This was an unanticipated, and surprisingly persuasive, response. That's thinking long-term, I said. "No," said Steve Jobs. "That's being an optimist."

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