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The biology of technology

Why do commentators talk about the PC market as if it were a biological process?

Industry watchers often talk about the "birth" of industries or the "death" of obsolete technology. Conservative investors discuss the stable stocks of "mature" industries (as if mercurial earning reports are found only at "adolescent" firms). Similarly, the "product life cycle" metaphor has become shorthand for regular and repeated patterns that accompany turnover of products.

Biological metaphors, much like any metaphor, are incomplete and inexact, but suggestive. For example, the life cycle in computing has many different and overlapping meanings. There are at least three in common use today. Technology enthusiasts use the metaphor one way, buyers another, and sellers yet another.

Differences in meanings say much about the person using the metaphor. Some people have warm feelings for the computing cycle, but others do not.

Technologists love the life cycle

Enthusiasts focus on the invention—and only the invention—of technology. For technologists, the product cycle in the PC industry provides entertainment, loads of it. Old products die and new products replace them. (The mundane part is that every new computer system contains more memory and faster chips at lower cost. This has been going on so relentlessly for so long that even the technologists take it for granted. It has become routine.)

However, each new generation of products offers new features, extends the range of old capabilities, or lowers the cost of obtaining existing features. Imitations turn novelty into new standards.

Technologists are also entertained by other by-products of the product life cycle. New and

better programming languages diffuse to many systems. Peripherals such as printers, terminals, network connections, and countless other minor components also undergo innovation.

One invention feeds on another. Somebody invents new software, fueling invention of faster chips to handle it, fueling invention of better printers to show the results. This then gives another software inventor an idea for a new CD-ROM program that starts the whole pattern again. It's a *virtuous* circle.

Technology enthusiasts typically care little about the firms that introduce a new bell and whistle. To be sure, sometimes a firm gets credit for being first. If so, that firm crows about it. (If the firm's marketing strategy depends on having technology on the cutting edge—for example, as Apple's did for many years—then that firm crows a bit louder.) Technology enthusiasts typically have short memories, however, and begin drooling over the latest thing as soon as it arrives.

Occasionally the arrival of a new technical platform brings about the restructuring of old technologies. Technical standards change, emphasizing a new set of core applications and altering every system. Some observers call these changes technological "revolutions." For example, today we are in the client-server revolution, and previously there was the notebook revolution. The workstation and microcomputer revolution came before that, and so on.

Revolution is not a biological label, but I am not sure a good one exists for drastic shifts in technical standards or in the technical patterns of the product life cycle. Should we call these shifts a "change in the ecosystem" instead? I don't want to split hairs over semantics, but "ecosystem" seems to stretch biological metaphors too far.

That said, did you ever notice that technolo-

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gists tend to value the births within a product cycle? They focus on the renewal of the cycle at the introduction of each innovation.

What do buyers see?

For a buyer, the product life cycle involves installing new systems or upgrading, retrofitting, and improving existing systems.

Here is the typical pattern. Most buyers know they are perennially out of date, but do not have time to catch up. So they periodically reevaluate their situations. Buyers learn about technological opportunities as new products are introduced and as old products become obsolete.

From the buyer's perspective, this is like a movie played by a VCR stuck on fast forward. Things change way too fast.

In piecemeal fashion, buyers modify the memory and speed of their CPUs, but keep other useful investments in software or peripherals. Or buyers enhance particular software programs or peripheral components, but not other parts of their systems. Peripheral and software upgrades then induce bottlenecks in CPUs, which induce further memory upgrading. This, in turn, motivates the buyer to try further peripheral and software enhancements. For example, the recent craze for all things multimedia is just

another example of the same pattern.

That said, scientific and engineering users usually first take advantage of faster computing speeds and larger memories, not to mention other technical bells and whistles. At one time, these technical users were closely followed by hobbyists and then, many years later, by business users. In more recent times, the business PC market has split into so many camps—home, office, technical, sophisticated executive, administrative support, networked, and so forth—that it has become difficult to predict who will adopt which bell first and which whistle next.

As an aside, the product life cycle for buyers has one particularly adolescent feature. Upgrading often occurs due to competition around the water cooler. Much the way teenage boys might compare the racing fins of their hot rods, many technical users compare the features of their workstations, upgrading to impress their buddies.

More to the point, for most buyers the product cycle is like being in perpetual adolescence. Just when they think they have it figured out, something else shakes their view of the world; and the future always holds promise, though it never seems to arrive.

The sellers see it differently

From the vendor's perspective, the product life cycle concerns product design, sales, and marketing issues. These arise at rapid speed, requiring decision makers to come up with quick, decisive answers, and inviting mistakes. This is an executive's nightmare.

Vendors expect a fraction of their customers to desire frequent upgrades of systems or backward-compatible improved designs. Vendors also expect a fraction of old customers and customers who are starting from scratch to compare the technical capabilities of all new systems. Therefore, vendors expect that all designs become technically obsolete with the passage of time, the entry of more competitors, the expansion of technical possibilities, and the expansion of buyers' needs.

As already noted, this process feeds

on itself. If a design meets with any initial commercial success, then later parts of the cycle involve potential upgrades and sales of complementary components. All parts of this cycle—designing, prototyping, manufacturing, initial rolling out, selling systems, servicing, and customer-upgrading—involve risk to the vendor, as well as much technical and commercial uncertainty.

More so than most markets, the PC market is brutally unforgiving of marketing mistakes. Yet, mistakes are inevitable. Unpleasant experiences must arise often.

If the vendor sells its product to customers through third-party distributors (such as national chains of electronics stores), the third parties will mercilessly drop it when it becomes obsolete or gets bad reviews. Large discount distributors will relegate shrink-wrapped software with no name recognition to a low shelf, indifferent to the design's underlying merits. Catalogs and magazines put components from unknown companies in the back pages, favoring long-time advertisers. To avoid these fates, vendors must advertise, push products on magazine reviewers, or establish "buzz" at conventions. This activity is as dignified as selling deodorant.

A vendor that sells its product with its own workforce does not fare much better. Salespeople on commission make their quotas by any means possible. They push new versions before the product is ready (even if the customer doesn't need it), invite lawsuits by misrepresenting the features of their competitor's product, promise more technical support than any rational firm could ever profitably offer, and conveniently forget last year's unkept promises. And, of course, every salesperson assures customers that a bug-free upgrade will be coming 'round the bend within a year—even when designers think this impossible.

Perhaps the most unpleasant feature of the product life cycle is that everyone's stock options are tied to the commercial success of the firm's products, which are, in turn, tied to the rhythms of the product life cycle. Long after the designers have done their job, every-

one's financial payback depends on marketing augury and a fickle market.

In sum, for vendors the product cycle is Darwinian evolution at its most brutal. The cycle is about survival of the fittest and living to fight the next battle.

Parting observations

The product life cycle in PCs has changed over time. Accordingly, so too have people's views of it. With only rare exceptions, only technologists brag about the speed with which things change today. Vendors no longer boast about it; most just endure each new competitive episode and celebrate surviving another day. Except for the most technical user (or the most competitive office situation), the speed of change comes too rapidly for most users. It upsets old arrangements even when the old investments are still useful.

A century ago, new technology was also associated with rapid change on this scale. Then, the development of national transportation and communication networks transformed the US economy, upsetting old economic relationships, eliminating old ways of doing business, and creating new ones. Is that where we are going today?

If the PC revolution or the client-server revolution actually succeeds in upsetting old habits, perhaps we will stop using biological metaphors. Instead of talking about life cycles (or revolutions, for that matter), perhaps we will begin to look for metaphors associated with earthquakes and tectonic movements.

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Micro Standards

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IEEE standards development

In my first column (Mar.-Apr. 1997), I promised to discuss how various standards-developing organizations work. My last column, based upon ECMA, might have led you to ask, What about the IEEE? Well, at least I hope you asked this.

We in the Computer Society are probably familiar with many IEEE-developed standards—802 LANs, 1003 Posix, 488 standard digital interface for programmable instrumentation, 896 FutureBus, 1284 Printer, 1394 Firewire, and so on. But the IEEE develops many other standards as well, such as those for power, switch gear, and test technology. (In fact, there is probably more activity in the power sector than in computers, although power tends to address more stable and slower-developing technologies.)

The IEEE is a major worldwide developer of electrical, electronic, and computer standards. Its standards are developed and accepted globally, though most of the work takes place in the United States. In the case of computer standards, most of the IEEE-developed standards go on to become international standards via ISO/IEC.

What is the Standards Board?

As an accredited organization of the American National Standards Organization, IEEE Standards meets ANSI's accreditation criteria. Accreditation in this sense means that ANSI verifies that IEEE Standards' procedures allow all

materially affected parties to participate, that the standards developed meet industry consensus, and that there is an avenue for appeals. This is important in the US because it allows the IEEE to submit its standards to ANSI for approval as ANSI standards. Once the IEEE approves a document as a standard, it can submit it not only to ANSI but also to ISO and/or IEC for further standardization.

How does the CS fit in?

What has this to do with the Computer Society? Let's start at the top, with the IEEE. This professional organization has many areas of interest covering a large geographical area, the world. One of these interests is standards, so some of the IEEE's societies, such as the Computer Society, include standards as part of their work. Not all of the 30-some-odd IEEE societies have an interest in standards. Those with an interest work similarly under the rules of the IEEE, but for this discussion I will use the CS as an example.

The IEEE maintains a Standards Board, which has extensive policies and procedures. This board covers all standards within the IEEE via its many societies. The Computer Society, for its part, has a Standards Activity Board (SAB), which provides some oversight functions and many sponsors. Each sponsor has one or more technical committees and working groups, which do the actual standards development work.