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Material Witness: Technology takes tiny steps

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How does technology advance? The scientific literature insists on the following trope, to the point where it provides the template for the introduction of most papers on applied science: "Fabulous applications would be possible if only we could solve the following outstanding technical problem....". Then every so often an industrial researcher comes along and points out that there's not much gained by solving problems if you can't do it affordably. So the picture emerges in which technical barriers are first breached by technical wizardry and then the costs are lowered. And that's what gives you your Blackberry, or drug, or superalloy.

But not even discovery and economics account for everything. The commercial world just isn't that simple. Take, for instance, the development of non-volatile memory. You might think the reason we don't have non-volatile random-access memories in computers — eliminating boot-up, avoiding data loss when the power fails, and slashing power consumption — is that the technical hurdles remain too high. And so we muddle along with flash memory, which suffices for cameras but not for laptops, and pray for the day when magnetic or ferroelectric or phase-change RAMs become feasible.

Which is why I was surprised to discover that the Sony Playstation 2 already contains a ferroelectric RAM (FeRAM) chip, made by Fujitsu. (A Fujitsu device in a Sony product? Yes — Sony tried but failed to develop its own FeRAMs, and so bought them from a 'rival' instead. It can happen in Japan.) Samsung, meanwhile, markets a 64 Mb FeRAM. And the state-of-the-art is currently a 0.3 Tb FeRAM array — that's nearly a trillion bits per square centimetre, a device density that the semiconductor industry's road map puts over a decade away.

So what's going on? Jim Scott, a FeRAM specialist at Cambridge University, says that no one at Samsung, Sony or any other company is going to work on a 1 Tb FeRAM right now, because even if they succeeded, there's no product to put it in. Sure, it could replace computer hard disks in principle, but you don't transform the whole technical basis of an industry like that overnight. So you work instead on devices that have applications waiting tomorrow: low-cost, low-capacity FeRAM chips are churned out in their millions for 'smart cards' such as Japanese railway tickets.

And on the back of the profits that roll in, you can risk the next step: making FeRAMs to replace flash in cameras. That has to happen sooner or later anyway, as an international agreement to ramp down the voltage of all microelectronics will eventually make today's flash devices inoperable. Only after that do you aim for computer memory. So although the technical capability is already here and the cost might be brought under control, you don't strive to make something today that you can't sell tomorrow.

Innovation, then, is barely half the story. To succeed in industrial research, there are other priorities too — ones that are never mentioned in the literature.