

Innovation and Life Cycle

By Bart Stuck and Michael Weingarten

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In “Death of Innovation (Revisited)” and “Innovation and Profitability” (downloadable at www.signallake.com/publications), we concluded from an examination of 1300 high tech IPOs that the level of technological innovation is relatively low and has declined significantly since 1996, despite a increasing willingness by the market to value high-innovation companies at a premium. The issue is why.

In this article, we examine another of the possible drivers of reduced innovation: Life cycle factors. The life cycle argument goes something like this: (a) innovation goes through periodic cycles of rapid innovation rather than continuous change, and (b) we are now in one of the slow periods, so (c) a slowing of the degree of innovation is inevitable.

Is this valid idea or is it a convenient excuse? We look below at factors pro and con:

Pro-Life Cycle Factors

In general, there is something to be said for the idea of discontinuous change. In biology, paleontologists have pointed out that there are periods of rapid evolution and periods of slow evolution – triggered either by climactic changes and/or random genetic mutations that show immediate natural selection value. Increasingly, it looks as though evolution is not continuous.

The computer industry had a period of technology evolution that led to a seven year cycle of product innovation, starting in the 1960s:

- **1965** was the peak growth rate in revenues for **mainframe** computers, led by IBM, and followed by Sperry Univac, GE, RCA, CDC, NCR, et al
- **1972** was the peak growth rate in revenues for **minicomputers**, led by Digital Equipment Corporation, Hewlett Packard, Data General, Prime, Wang, et al
- **1979** was the peak growth rate in revenues for **personal computers**, led by Apple Computer, Tandy, Commodore et al
- **1986** was the peak growth rate in revenues for **workstations**, led by Sun Microsystems, Apollo Computer, MIPS et al

What happened in the computer industry was that a set of technologies advanced (integrated circuitry was the underlying driven force, but this impacted the design and tradeoffs between processor instruction sets and clock rates, memory, secondary disk storage, and busses for interconnecting these elements. Every seven years sufficient change had occurred that a new design point, based on a common set of technologies, made possible a new product family. The older product lines had developed a customer base and a set of applications; the new product lines developed a new customer base and a new set of applications. If we follow this forward in time, something happened in the 1990s that broke the seven year cycle for the computer

industry; we would argue this was the mobile cellular telephone and the World Wide Web, which saw its peak growth rate in the 1993 time frame around the globe, with a whole new set of applications and services that the earlier computer centric product lines were not serving. Once there was a large installed base of computers around the globe, the technology shifted from computers to networking: the need to permit end users to access information in all the different devices in a coherent manner when and where they chose to access this content.

The development of the PC, the Internet and TCP/IP routing, UNIX, the World Wide Web, photonics and optical networking; and cellular telephony. These changes enabled the formation of some truly innovative companies: Apple, Cisco, Netscape, Corning Fiber, Sun and Qualcomm (Microsoft was less an example of true technological innovation than brilliantly executing against a horrendous IBM error).

Once these changes occurred, there was less need and less opportunity for additional T1 improvements. Instead, what was needed were Moore's Law linear improvements to existing technologies (i.e., going from .18 to .13 nm chip trace size) that could support 5-10x annual bit stream increases without the entire Internet crashing and burning). We also needed (and got) e-commerce plays leveraging the new Internet capabilities in different ways.

If so, then one reason for the lack of T1s and T2s¹ is that the 1997-2002 period wasn't a time for fundamental change. It was a time for T3 Moore's Law improvements and T5 e-commerce plays.

Counter-Arguments

There are two basic counter-arguments to the life-cycle thesis. The first is quantitative. In our article "Death of Innovation (Revisited)," we noted that during the period 1993-1996, there were on average five companies per year that we regarded as meriting a high T1 or T2 ranking (Table 1). By 1997-2002, this dropped by a factor of more than five times to 0.83 T1/T2 companies per year. We find it hard to believe that innovation drops off a cliff that quickly.

We particularly find the innovation drop-off hard to believe when we consider that during 1997-2002, VC spending increased by a factor of ten times. Even if, say, the supply of T1/T2 innovative ideas dropped by a factor of 5 times, a 10x increase in VC funding would lead to a 2x increase in the number of companies. It's hard to see how a 10x increase in VC funding translates into a 5x decline in innovation, just a few years after our 1993-1996 baseline period.

Table 1
IPOs With T1/T2 Technology Rankings
For 1993-1996 and 1997-2002

Technology Ranking	1993-1996		1997-2002		Ratio 97-02/93-96: Companies Per Year
	# Companies	Companies Per Year	# Companies	Companies Per Year	
T1	5	1.25	2	0.33	0.27
T2	15	3.75	3	0.50	0.13
T1/T2	20	5.00	5	0.83	0.17

Source: Signal Lake analysis from "Death of Innovation (Revisited)"

¹ Our top technology rankings; for a complete set of definitions, see "Death of Innovation (Revisited)"

The second counter-argument against the life-cycle thesis is anecdotal; namely that as VCs, we've seen too many instances where genuinely innovative ideas don't get funded, or at least funded adequately. Here are two examples, which we disguise for confidentiality reasons:

Our first example is a technology that would increase functionality versus alternative approaches by 2 to 3 orders of magnitude within 5 years (i.e., 100 to 1000 times improvement), in a market with annual sales of over \$20B per year and growing at xx% annually. The technology was developed at a major research laboratory over a period of decades by a multi-disciplinary team of scientists and engineers; these researchers built up a sizeable patent portfolio to protect their IP.

By the late 90s, the technology was sufficiently well developed that the technology was commercializable. Based on this, a senior management team from the relevant industry was recruited, and the business unit was spun out from the corporate lab.

What happened? The company tried to get investment from A-list VCs on multiple occasions but failed, and has had to rely on contributions from smaller VCs and corporations who appreciate the upside potential and have entered into co-marketing agreements with the company. The last funding round has been for low double figures, for a business that someday could be worth billions.

What was the problem? It is something that we call the 'Innovator's Catch-22' (we would have called it The Innovator's Dilemma, but that one is already taken). The particular innovation here, despite the fact that it works in a lab setting, required four years of engineering development prior to commercialization. Once the product was commercialized, there would be a line at the door from interested customers. However, most VCs wanted to see orders in advance as a validation of the concept, and 4 years of development was too long for them to wait.² Even now, with the company planning to complete its development work by year-end 2004, the company is not getting investment interest. [Of course, once the device is perfected, every mezzanine fund and investment bank will be all over the company throwing money at it.]

Our second example is a technology that would revolutionize a large established market, relying on highly esoteric approaches developed by some world-class mathematicians coming from a university background. They developed their concepts on their own time and with their own money, developing their own patent portfolio, which was then assigned to the company they controlled. The technology could be developed into a number of different products, and each product line would address a multi billion dollar a year market opportunity.

What happened? The company tried to get investment from A-list VCs on multiple occasions but failed, and has had to rely on contributions from angel investors, and from non recurring engineering contracts from different potential customers, for a business that someday might be worth billions.

What was the problem? The first issue is that investors want to see a complete team in place that has enjoyed success one or more times in commercializing new technology, and it was difficult to attract all the skills because there was little funding available and the terms offered were not compelling to new management. The second issue is that the technology is a component of a larger system, and either a complete solution based on the technology has to be offered by the company (e.g., using industry standards to gain cost effective access to other

² Parenthetically, it took John Harrison (the 18th century inventor of the first working chronometer for determining longitude), 33 years and four prototypes to perfect his device. Of course, he wasn't venture funded.

needed components) or a larger system company has to be willing to commit time and money to working with the startup. As above, the particular innovation here, despite the fact that it works in a lab setting, required at least two years of engineering development prior to commercialization and perhaps three or four years. Once the product was commercialized, there would be a line at the door of interested customers. However, most VCs wanted to see orders in advance as validation of the technology being viable, and four years of development was too long for them to wait.

Conclusion

In 1997-2003, there were 763 high tech IPOs (excluding spin-offs of established companies), of which we identified five companies as having T1 or T2 technology (with high innovation). While we recognize the validity of innovation cycles, we can't help thinking that with a 10x increase in VC spending, there couldn't have been more than five high-innovation IPOs. We also can't help thinking that the 5x drop-off from the 1993-1996 period is more than can be explained solely by cyclical factors.

Instead, our two anecdotal examples suggest that a non-trivial part of the problem is structural, not cyclical. If VCs, flush with more money than they've ever seen before, are not willing to take a chance on high innovation deals, maybe VCs are a fundamental part of the problem.