

How coinvention shapes our market

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According to a popular view of technology, suppliers and buyers play distinct roles in sequence. Vendors first invent, sell, and improve. Buyers then adopt, upgrade, and retrofit.

The popular view is wrong

Users do not take such a passive and narrow role, nor are vendors the only inventors. Users actually do much of the inventing in the computer market. They invent for a simple reason. Rarely is a new technology useful immediately after purchase. It needs customizing, reshaping, and improving. Users change things after trying them out for a while. Users do a lot of "coinventing," as colleague Tim Bresnahan and I have termed it. Coinvention makes technology useful.

It is impossible to understand the computing market without appreciating why and how users coinvent. The costs of coinventive activity can be substantial and can easily swamp the initial outlay for the technology. More to the point, Bresnahan and I believe that coinvention is the key to understanding the diffusion of client-server systems.

In particular, we examined this diffusion to large-scale users. Why did some buyers act boldly and others cautiously? Why did some experiment early and others late? Our answer is all wrapped up with coinvention.

We studied establishments from 1988 to 1994. We started with 1988 because there was no real commercial action in large-scale networking of PCs before 1989. We stopped with 1994 because we started this project in early 1995. (It took more than a year to analyze and organize the data on over 12,000 establishments.)

To save on space, I've summarized our main findings here. If you are interested in the details, feel free to read the original study: Center for Economic Policy Research Working Paper #477. Call (415) 725-1875 or check out www-scip.stanford.edu.

Large-scale computing

Why did we study large-scale computer users? First, this was an interesting and complex place

to examine the diffusion of client-server computing. These applications tend to be supported by professional staff and large supplier networks. If we could analyze the behavior here, we could take the same insights to simpler situations.

Second, marketing folk know a lot about centrally managed facilities. They know the names of their CIOs or DP manager, and even what software they use. One of these marketing firms, Computer Intelligence Infocorp, provided us with very good information for as far back as 1984. We can never do empirical research without good data.

Third, centralized computing facilities came into existence decades ago when prices were higher and functionality was lower. These places first developed some extremely important applications, for example, on-line transactions processing, financial modeling, automatic payroll and check writing. Even if some of these applications are not on the cutting edge of technology today, all of them are still important to the economy and especially to the companies that run them.

Patterns of behavior

Figure 1 contains our principal observations. We tracked the type of large-scale computing that a fixed group of establishments were using over time. Based on the type of computing they were using in 1994, we classified them into four categories: bold, curious, cautious, and gone.

The bold establishments had done two things. They had experimented with client-server systems quite early. Then sometime later these users retired their mainframes—mostly by 1994.

The curious were not as quick to experiment, but did not resist client-servers for long. Most of these establishments began to experiment sometime in the early 1990s. However, by 1994 very few of them had retired their mainframes.

The cautious did not experiment, nor did they even consider retiring their mainframes. As of 1994, these users intended to stay with mainframes, upgrade them as they always had, and so on.

The gone were a more mysterious group. They stopped answering CII's surveys. Nobody is certain why, but it is easy to speculate. Some of them belonged to firms that went bankrupt. Some closed the computing establishment and moved it elsewhere. Some simply got tired of the surveys.

Why coinvention matters

The bold had one thing in common: very low coinvention expenses. Their computing organizations tended to be simple. That is not the same as saying their computing needs were simple. It means that their computing tended to take place in small groups and to be nonsynchronous (for example, unscheduled).

These buyers predominantly used computers for simulation and numerically intensive tasks, not complex data warehousing or other communication-intensive tasks. Most of their computing did not require simultaneous and extensive coordination of hundreds of employees.

In addition, the bold were usually scientists and engineers. Despite many idiosyncrasies in their needs, the bold did their own coinventing and relied less on market solutions than did the typical commercial user. Also, these users were accustomed to boldly going where no one had gone before—in this case, to client-servers before everyone else.

The curious tended to be a more heterogeneous group, unified mostly by their willingness to try a piece of the back-server pie but not swallow the whole. They had more complicated computing organizations than the bold and fewer scientific applications. Instead, the curious had some mix of back-office accounting and on-line information delivery. They had a few applications that resisted the new platform and a few that did not. They usually had a few idiosyncratic applications—either written by in-house staff or by a small third-party mainframe software vendor. The bottom line: Not all applications could be recreated on a new platform.

The curious eventually made some effort to benefit from client-servers. They experimented, started small, and tried to grow. However, as of 1994 the

coinvention costs associated with customizing all their computing on the new platform were prohibitive against an entire switch away from mainframes.

Virtually all of the cautious looked alike, and yet they differed greatly. Their computing facilities ran idiosyncratic and extremely valuable on-line applications (such as reservation systems). The computing applications were tied closely to the functioning of the organization (such as banking services). The computing coordinated hundreds of employees' actions.

At the cautious establishments, coinvention costs of even the simplest experiment on client-servers were very high. These users could not change to client-servers even if they really wanted to. Most did not bother to experiment, for what would be the point?

All in all, three factors drive up coinvention costs: the complexity of the computing, idiosyncrasy of computing demands, and thinness of vendor markets for software tools. The first two are features of buyers that change very slowly. The last one has gotten much better over time.

Some implications

Our analysis provides important clues as to why the experiences of the bold offered only limited lessons for the curious and the cautious. Engineers and scientists tended to be among the bold, while commercial users tended to be among the curious and cautious. Is it any wonder that vendors, who had early success with the bold, completely underestimated the difficulty of the transition to client-servers with the commercial users? The applications are different, and organizations must change more dramatically to take advantage of client-server functionality.

Coinvention also explains why the appropriate business model changed in client-servers in the last few years. In the early years, the sales were predominantly from computer engineer to computer engineer. Many engineering firms and software start-ups thrived in this situation.

In more recent times, commercial users dominate. Commercial users prefer the reassuring handshake of a salesman in a suit and the reliability of a

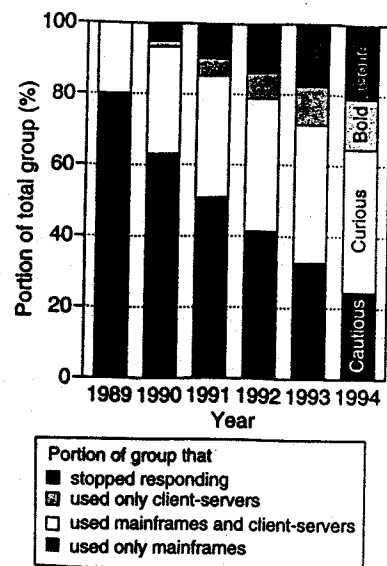


Figure 1. Type of computing used by the establishments in the survey group.

proven company. This plays to the comparative strengths of firms that integrate the coinvention of the past with the needs of commercial users. Firms such as IBM and Andersen Consulting could get into this game late and still do well. The future of this market now depends on whether some of the early high-flyers—SAP or Cisco Systems or Oracle or Sun, just to name a few of the many companies that seem to be making the transition—will adjust to a new type of customer or competitor.

Finally, this leaves me optimistic about the future prospects for client-server computing. The market for software tools has been growing, and at a pace that makes it hard to track. The consulting market is thriving and still growing. Lessons are being shared (through vendors) across enterprises. A few more key software tools, protocols, and design doctrines could further reduce the costs of customizing client-servers to user needs.

The next time you look at this market, remember the role of coinvention. Vendors invent and sell. Buyers coinvent and customize. The vendors and technologies that succeed are the ones that reduce a buyer's coinvention expenses.