INDUSTRIAL ECONOMICS AND STRATEGY: COMPUTING PLATFORMS

A FEW KEY CONCEPTS EXPLAIN LONG-RUN ECONOMIC FORCES FOR STRUCTURAL CHANGE AND STASIS IN THE PLATFORMS AND CLIENT-SERVERS THAT GOVERN PAST, PRESENT, AND FUTURE BEHAVIOR IN THE COMPUTER INDUSTRY.

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• • • • • • To the uninitiated, and even the old hand, the computer industry is an intimidating agglomeration of firms, markets, and buyers, all changing quickly in response to the latest innovation or recently invented applications. Technological opportunities arise rapidly, altering the technical landscape more quickly than in any other industry. Established firms feel perpetually under siege, particularly when they compare their lot in life to that of other firms in other industries. The computer industry's structure seems caught between forces of inertia and change, with the latter having an upper hand.

Change occurs in two broad places: technical frontiers and market relationships. As is often remarked, the menu changes quickly and often, but market relationships change less often. Why, in the face of a rapidly changing menu of choices, do buyers continue to make many of the same choices year after year? Why do the same firms and products seem to reappear in computing in spite of technical change? When changes to market relationships occur, what does it tell us about forces for stasis or change?

One cannot hope to develop a comprehensive understanding of the long-run forces for either change or stasis in one article. Nevertheless, to help in that endeavor, I outline a few key concepts. Instead of examining what firms should do, I explain why things happen, the former being much more strategy-oriented. This will be accomplished by showing both historical and contemporary events.

This review necessarily skims several books with important detail and theory. I'll also liberally draw from recent collaborative research with Tim Bresnahan[1-3] as well as other related work done by economists and market analysts.

Forces for inertia

Why do buyers continue to make many of the same choices year after year? Why does new technology turn over faster than most firms do?

Platforms

A platform is a cluster of technically standardized components that buyers use together with components to make applications.[2,3,4-7] Components include not only computer hardware but also software and trained labor. Computing has involved components sold in markets (hardware and some software) and components made by buyers (training and mostly software). Many of these components are long-lived assets. Thus, new technology can most easily find its way into computing when

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ESCs	Endogenous sunk costs (expenditures undertaken to improve products for users)
Firms	Usually act as vendors within this article
Founding	Start a brand new platform
Platform	Cluster of technically standardized components used with other components to make applications
Vertical relationships	Business dealings between firms that sell products to each other

new components enhance and preserve the value of previous investments in computing platforms. Hardware components may advance, for example, without the need to change software or human capital. Thus, platforms tend to persist, whether for cost minimizing, coordination-failure, or strategic reasons.

Vendors tend to sell groups of compatible product offerings under umbrella product strategies for platforms. Important computing platforms today include IBM 3090, IBM AS/400, DEC VAX, Sun SPARC, Intel/Windows PC, and client-server platforms linked together with well-known computing and communications hardware and software. Even though these labels may have proprietary names associated with them, such a label may stand in for a complex, often unintegrated and decentralized, market structure. Many of the largest and most popular platforms for client-servers today and historically include many different computing, communications, and peripheral equipment firms, software tool developers, application software writers, consultants, system integrators, distributors, user groups, weekly news publications, and third-party service providers.

The economic forces centered on a platform tend to work strongly within computer industry segments, distinguished by the types of computer applications demanded by users. For most of the last 30 years, most segments were distinguished by the size of tasks to be undertaken and by the technical sophistication of the typical user. A decade ago it was widely agreed that segments were distinguished by size, from big to small in the order of mainframes, minicomputers, workstations, and personal computers. Users were either technical (trained engineers or programmers) or commercial (secretaries or administrative assistants), which closely corresponded with the degree of sophistication and other features of the software or hardware.

The most interesting development today is the blurring of these old distinctions, an event that might be called the competitive crash. The networking revolution is primarily responsible for blurring these once-familiar distinctions, making it feasible to build client-server systems for virtually any type of user in any size category, by building platforms out of subplatforms. Whether it is cost-effective to do so in every situation is an open question. Judging from many recent reports, in many situations it appears to be.[1,2] One cannot hope to fully explain this blurring in a single stroke, as it resulted from complex and varied forces. More important for strategic thinking, these changes probably set the stage for the issues that will face this industry in the next few years.

A well-developed body of competitive analysis has arisen to explain how platforms and segments operate. These for-ces are particularly strong in segments serving commercial rather than technical users. Most of the strategic and policy issues regarding platforms also arise in the commercial segments of computing.

Concentration

Segments in which there are endogenous sunk costs (ESCs) will have a concentrated structure even with a great deal of demand. This pattern does not depend on how sellers interact strategically.[8] The key to analysis is the definition of ESCs—expenditures undertaken by sellers, vendors, and sometimes users to make their products better. ESCs are irreversible and raise the value of a platform with no potential bound, appealing to a large fraction of potential customers.

Fragmented segment structure is impossible when ESCs are important. If the segment structure were fragmented, a firm could invest in ESCs, thereby attracting many customers. Any other competing platform would have to do the same or lose its relative attractiveness. Thus, there is a tendency for all surviving platforms to have a high ESC; low-ESC platforms are relegated to niche status or death. What happens if market demand grows? Instead of simply supporting more firms and thus more competition, a larger market will have higher ESCs, but still only a few firms. For better or worse, more ESC goes into high product quality and other things valued by buyers, not less-concentrated segments.

Notice these observations are principally about platforms, not firms. Expenditures to make a platform more appealing raise the demand for all of its components regardless of who actually makes these expenditures. If

cloning firms, peripheral makers, or user groups succeed in enhancing the value of the platform, demand will rise. As a result, ESC theory can only be deployed to explain the concentration of platforms, not necessarily of firms.

We can learn two general lessons about computer industry structure from this. First, concentrated segments arise due to broadly compatible platforms combined with marketing organizations to support customers who use them. The second general lesson is closely related but very frequently overlooked by observers of this industry. The creation of a platform is not merely an engineering feat; it also involves commercialization.

Standardization

Computing platforms must adopt technical standards to make systems work well. In general, buyers and sellers of technology make platform-specific investments, where these standards are taken for granted.

Mutually reinforcing behavior arises when standards coordinate behavior at any point in time, and also when they coordinate technical change and investment activity over time. Buyers, sellers, designers, or third-party software vendors make long-lived, platform-specific investments in a platform, and this tends to keep platforms in operation for long periods. For example, many of the standards in the IBM 360 (introduced in the mid-1960s) survived in the IBM 370 and its descendants. Many firms, vendors, users, programmers, and other important players have a stake in continuing the use of the standards used within this platform.

This theory has implications for the origins and endings of platforms. Just as platform standards are hard to stop, they are equally hard to start. A platform needs a critical mass of adopters, complementary software, and sometimes other components. Positive feedback both underlies the survival of existing standards and helps new standards get over the hump of acceptance. If a new standard does get over the hump, positive feedback forces quickly favor it.

This problem so conditions a firm's behavior that it will take great pains to overcome its limitations and avoid producing an operating system wannabe—a rather distinguished group of products including IBM's OS/2, DR-DOS, multiple variations on Unix, and so on. For example, when IBM introduced the AS/400, it arranged well ahead of time for the development of thousands of application programs. Firms will coordinate their marketing campaigns with technical goals, too. For example, when Microsoft unveiled Windows 95, it did so with fanfare designed to avoid the possibility that the marketing for the operating system would crash on launch.

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The literature on standards persistence has hotly debated whether, in an uncertain environment of new technology, it may be difficult to coordinate platform-specific investments. Theories differ about exactly which agents have difficulty coordinating which decisions. These differences are not trivial, because each type of assumption leads to very different policy conclusions about the desirability of persistence. Sellers' roles in persistence are variously interpreted as efficient coordination or exploitative preservation of a monopoly position.

Focus on the platform, not the firm

The overriding message is that industry structure can be understood if one focuses on platforms, not necessarily firms. Consider the insights this yields. During the early years of this industry, the firm and its platform were nearly synonymous. For example, IBM kept tight control over its proprietary technology embedded in the system 360/370 and its descendants. With time, a rather substantial third-party software and peripheral market grew up around the platform, though IBM managed to retain a large degree of control over the standards.

In more recent experience, the dominant platforms became less centrally controlled. The most popular platform in the late 1980s was a descendant of the IBM PC, often called Wintel (Windows and Intel). From the beginning, this platform involved thousands of large and small software developers, third-party peripheral equipment and card developers, and a few major players in the hardware (IBM, Compaq, Dell, Intel) and software industries (Microsoft, Lotus, and so on). Control over the standard has completely passed from IBM to Intel and Microsoft, though neither firm can yet unilaterally dictate standards to developers (though

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both are trying). Indeed, the fight between software, subcomponent, and peripheral vendors and Intel and Microsoft continues today, lying at the heart of ongoing antitrust investigations.

The complex and changing sponsorship structure of the PC tells us a lot about the theoretical robustness of the positive theory of platform concentration and persistence. Rapid and coordinated technical progress has kept this platform in a dominant position for a decade and a half, which covers many generations of products. This is a rather remarkable outcome in light of the rate of technical change.

More affirmatively, the equilibrium supply of platforms is concentrated even when the rate of technical change is extremely fast. In equilibrium, existing platforms tend to persist. These outcomes occur whenever buyers and sellers jointly value compatibility in a wide variety of industry structures, even those in which the equilibrium supply of firms is not concentrated or when firm persistence is in doubt.

How do these ideas apply today? The emerging client-server platform has not yet standardized around a few key components, leaving many unsure about who controls what. Amidst this confusion, vendors fight for control over pieces of the emerging standard. Intuit would like to determine standards in home banking, Netscape or Microsoft in Web browsers, Oracle in network design and databases, Sun in network software, Microsoft in virtually every aspect of client-server software but particularly core client-software and server-operating systems functions, IBM/Lotus in shareware and electronic commerce, SAP in enterprise computing, and so on.

By definition, the strategies of these firms overlap and conflict over the platform. All firms want to sell products, use competitive success to achieve control of the emerging platform, and be in a position to control technology design for years to come. These conflicts shape important parts of every firm's product design and distribution strategies.

Forces for change

Most disruption to market relationships comes from outside a segment. Yet, if historical patterns are any guide, such events infrequently go very far. More to the point, attempts at disruptive entry were somewhat common, but success was not. The interesting and somewhat puzzling question is this: since the menu of technical options changes so often and so rapidly, why is it so hard to radically disrupt market relationships? Why don't the names of the leading firms change each year? What does it take to successfully disrupt existing market relationships?

New platforms

Consider the founding of a whole new class of computer platforms, like mini- or microcomputers. From a narrow, technical perspective, these were radical developments, taking advantage of expanding technological opportunity to introduce whole new classes of products. From a competitive perspective, however, there has been very little disruption associated with these events. Successful foundings have tended to avoid competition with existing computer platforms, instead creating new segments for previously unserved classes of demanders.

Established commercial platforms are very difficult to dislodge due to the strong ESC and backward-compatibility forces in commercial computing. Since commercial computing platforms need expensive marketing campaigns, it is cheaper to start a new platform in the noncommercial (or technical) arena. Of unserved users, technical users' needs tend to be fewest, particularly since this class of users does not demand that platform components work well right away. Hence, new platforms have typically served the technical demands of users such as scientists and engineers.

The historical record will not necessarily demonstrate that firms understood this strategic argument and deliberately avoided established platforms. It is probably a better theory that industry equilibrium initially selected those firms that found cost- and competition-avoiding strategies. Later, by the early 1970s, new entrants into the minicomputer industry understood this strategic logic very well. Hewlett-Packard, upon entering the technical minicomputer business, was very cognizant of the costs of competing for commercial cus-

tomers and the marketing strengths HP already had with technical customers. It also accounts for the formidable competition HP might expect from established commercial providers.[9]

Mobility of platforms

Some entry costs are lower when platforms move from an old customer base to a new one. Examples of mobility in computer platforms include the creation of the commercial superminicomputer from the technical minicomputer and creation of the office PC from the hobbyist microcomputer. Adapting an existing platform to a new kind of use costs less than creating a new, fully capable platform. Simply put, many of the existing components of the platform can be reused. In general, the reused components are usually technologies; firms must make new investments in marketing connections, service networks, and so on.

Even with these lower costs, any entrant platform must sell to an existing platform's main customer base. Thus, it confronts the ESC and standardization forces leading toward persistence of the opposing platform. Often a platform moves to a new use that was previously badly served, rather than continuing to serve the main body of customers in a preexisting segment. Commercial superminicomputers, for example, serve customers much like traditional mainframe customers, but in smaller departments or firms.

The conflict between the entrant's lower costs and the incumbent's advantages can be resolved in a variety of ways, and neither factor dominates. Platform mobility can lead to competition and expansion of the range of commercial computing uses.

As with foundings, mobility has brought the industry closer to disruptive competition, but it tends to avoid direct competition with incumbent platforms. Unlike the analysis of founding, potential entry of mobile platforms necessarily comes from existing platforms; hence, the structure of industrywide supply is a key determinant of outcomes. In historical experience, mobility is rarely competitively disruptive to established dominant platforms.

As an example of a less-disruptive platform, consider the entry of the commercial minicomputer. The development of distinct minicomputer and mainframe segments left a gap among small commercial sites, such as medium-size firms or departments in larger firms. Mainframes were too expensive and minicomputers lacked software and other support services. The invention by entrant Digital Equipment Corp. of the commercial superminicomputer was the breakthrough. From a hardware engineering perspective, DEC's supermini platform, called the VAX series, was very similar to its technical ancestor, the PDP series. However, from a marketing standpoint, the supermini category was new. DEC coordinated development of the components of a commercial platform, including software, services, and support. Over the next few years, many different firms became part of the VAX network, providing software, services, and so on.

As the computer industry has matured, so too has the possibility for mobility of platforms.

The virtue of the superminicomputer over a mainframe was its combination of convenience, capacity, reliability, and low cost for small applications. This initially appealed to experienced users who were dissatisfied with the 360/370 platform, suggesting that users would be willing to pay for considerable service and customized support.[4,5,10] It also appealed to geographically remote divisions in large organizations that did not want to contact a centrally managed mainframe through low-grade communication links.

After an initial period of innovation in the components, superminicomputers began to be adopted for simpler commercial uses left behind by mainframes. These systems also began to compete at the margin for mainframe sites. Over time, the supermini segment took on increasing ESC and backward-compatibility equilibrium features, with corresponding tendencies toward concentration and persistence.

This entry into commercial computing was cheaper than the creation of a whole new platform because it involved the mobility rather than the creation of platform components like hardware. It was more competitive than a founding because there was less product differentiation between existing and entrant platforms. Superminicomputing impinged on the mainframe's traditional commercial customer body, but did not retain all the size and capabilities of the mainframe platform.

Potential entry and the future

All participants in existing platforms, both

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buyers and sellers, approach new opportunities after long periods of investment in platform-specific components. It is very costly for a new platform to re-create the same investments found with old platforms. After some investment in components, a platform has sufficient capabilities to move toward somewhat more contested bodies of demand. If a new platform succeeds, it can eventually grow strong enough to move into another platform's main market.

As the computer industry has matured, so too has the possibility for mobility of platforms. From the perspective of any given segment, there has been an increase in potential competition from outside firms and possibly mobile platforms. From the perspective of any established platform, there are more opportunities to someday expand into another's segment.

Indeed, this trend lies behind the most unique feature of today's market (by historical standards)—the division of technical leadership among so many firms. This is not like the industry of two decades ago in which a small number of firms such as IBM, DEC, and (arguably) Univac, Burroughs, CDC, NCR, Honeywell, and Wang led the pack. This is an industry in which dozens of firms lead, and any of them could potentially move ahead or fall back. This list includes IBM, Compaq, Dell, Intel, HP, Microsoft, Oracle, Sun, Cisco, SAP, 3COM, EDS, Computer Associates, Novell, and on and on. Nobody owns the dominant platform today. Instead it is more accurate to say that many firms shepherd development of important components within the commonly used platform.

Vertical disintegration

As noted, it is rare in the computing industry of today for any firm to fully control all elements used on a dominant platform. This raises many difficult questions about how to interpret firm behavior in segments that have experienced vertical disintegration.

When different firms possess roughly equivalent technical skills and supply complementary components, technical leadership is easily divided among them. It is quite difficult to maintain leadership over a platform under such conditions. In this type of world, firms seem to take one of several strategies. One strategy is to act as coordinator for a whole array of third-party vendors, all of whom commit resources to a new platform. For example, Sun Microsystems has a good reputation for standard coordination standards due to their good standing within the developer community. This strategy hopes to retain the advantages of speedy product introductions without sacrificing too much control over a product.

Most vendors, however, rarely have the opportunity (or the resources) to introduce and coordinate an entirely new platform. Instead they must make peripheral components or software for an existing platform. Long-term strategic issues for these vendors involve the frequency of their upgrade cycles and the extent to which they can use proprietary standards. Vendors must decide whether they ought to respond to rivals that alter their complementary products, whether they ought to merge with other firms to cover a wider set of products within a platform, or whether they ought to build products for more than one platform. These are the central strategic issues in virtually all companies.

The interesting feature of all of these decisions is that they inevitably have important platform-specific elements to them, involving issues of control and platform development. Hence, even in a vertically disintegrated industry, the day-to-day existence of most firms becomes intertwined with platform-wide issues over platform development.[11]

Thus, as every paranoid CEO knows, the wrong strategic choice can have massive consequences. For example, in the mid-1980s, Lotus CEO Jim Manzi decided to fully support IBM's OS/2 and delay support for Microsoft Windows. This was part of an attempt to slow down the acceptance of Windows, and it hinged on the incorrect assumption that Lotus had sufficient market power to sink or float any operating system platform. This decision delayed the release of 1-2-3 for Windows 3.0, leaving the market entirely to Excel at an early crucial stage, and it (along with a few other related errors) effectively doomed Lotus spreadsheets to second-rate status forever.

Competitive crashes

Many have inferred from the experience of the PC market that competitive crashes are fre-

quent and easy to accomplish. Coincidences of circumstances, like those underlying the entry of the PC, do not arise with any great frequency in computing.

By 1980 the PC market had already grown, largely to satisfy a hobbyist demand. The existing 8-bit architectures, which had not been developed by IBM, had aged technically more rapidly than expected and needed to be replaced with a 16-bit hardware architecture that would permit larger and more powerful programs. This need could have been met by a variety of responses from new or existing firms.

IBM's strategy combined two elements in an open architecture. Abandoning the vertically integrated strategy it had used in other segments, IBM used other firms' technology in key areas such as the microprocessor, the operating system, and many applications. The architecture was open in a second, distinct sense. Any firm could add hardware or software components to an IBM-compatible PC, and eventually any firm could make an IBM-compatible computer.

With the passage of time, history tends to highlight only the extraordinary events in light of today's market structure. So analysts tend to focus on IBM's later failures, misunderstanding its earlier success. The strategy of IBM's Boca Raton-based PC team led to a quick introduction, a marketing splash, and spectacularly large hardware sales for many years. IBM's marketing capability and reputation helped overcome the advantages of the incumbent platforms.[12,13] Growth was rapid and sales were enormous. By the mid-1980s, the hardware dollar sales in PC platforms equaled sales in mainframe platforms (and exceeded them by the end of the decade). The competitive effect was also substantial. After IBM introduced the PC, the number of platforms available to buyers decreased in a short time.

This was the first competitive replacement of an established computing platform by another. The rarity of such an event illustrates the remarkable coincidence of circumstances in this instance. First, there was an entrant (IBM) with a strong market and marketing position from outside the segment but within the industry. Second, the entrant came in without undercutting its position in its own segments, so IBM's managers did not initially delay their action due to concerns about cannibalizing existing product lines. Third, the incumbent platforms were facing an abrupt and technically uncertain transition in their architecture, in this case from 8- to 16-bit computing. IBM was prescient and picked the forward-looking, faster chip. Fourth, the entering platform's open architecture and vertically disintegrated market structure met the market's need for rapid technical advance.

The fight for control of technical standards is an important facet of competition between vertically disintegrated firms producing for the same platform.

More generally, changes in vertical industry structure have underlined entrant success in recent client-server platform experience. Quickly executed, mobility-based entry is easier in a vertically disintegrated market. Individual platform components rather than whole platforms can move to new segments. The client-server platform takes the best of existing microcomputer platforms and the cheapest of powerful computer platforms. A wide variety of firms compete to steer the direction of a newly assembled platform, leading to a new kind of competition in which a very new kind of computer firm succeeds.

From the 1960s through the early 1980s, foundings and mobility expanded the range of computer market segments, ultimately offering capable computers for both technical and commercial uses. Through the 1980s, all these different market segments advanced in parallel, with different kinds of customers, technologies, and supplying firms. In the 1990s, components that had been built up in different segments combined into new platforms and moved into competition with some of the longest-standing commercial successes.

The recent transition in the industry was the inevitable, but very difficult to foresee, consequence of long-term trends. First, consider inevitability. The supply of potential entrants grew as platforms serving different kinds of uses grew up in distinct segments, out of competition with one another, and developed distinct technical and market capabilities. Vertical disintegration arose because small firms initially could take advantage of economies of specialization, especially related to rapidly changing technical possibilities in component markets. Second, think about the difficulty to foresee. Could IBM, the traditional dominant firm,

New platforms tend to be founded within engineering markets first before moving, if at all, to commercial customers.

have headed off the competitive threat? Probably not. The key damage was done long before IBM knew there was a threat, which was also long before the potential entrants themselves knew they were a threat. Thus, the demise of IBM's position occurred due to the changing nature of competition and competitive equilibrium in the industry.

Diffusion of client-server platforms

It is impossible to understand the competitive crash without understanding the pattern of diffusion of client-server technology. To do that, we must understand that users also invent to make the new technology useful. Tim Bresnahan, a frequent coauthor, and I have coined the term coinvention—the amount of invention users must perform after they adopt a system.[2]

All in all, coinvention costs are driven up by three factors: the complexity of computing at a user enterprise, the idiosyncrasy of computing demands at establishments, and the depth of vendor markets for software tools. The first two are features of buyers that change very slowly. The last one, a feature of the client-server industry in its early years, has gotten better over time.

It is a cliche to say that the markets for software tools have been getting thicker and better. Capabilities have been growing everywhere. Lessons are being shared (through vendors) across enterprises. It seems only a matter of time before this market standardizes on a few key software tools, protocols, and design doctrines. These will bring down the costs of customizing a client-server to user needs.

One of the hottest topics today is associated with standards on new platforms. Standards come from many directions, using parts of Windows NT, Java applets, Unix tools, Novel netware, TCP/IP, and dozens of other products from dozens of other vendors. In general, standards are not proprietary when buyers have choices among a variety of technical solutions, but they are when they force vendors to be open or risk losing business. This is because, if they can help it, buyers do not desire proprietary solutions to their coinvention problems. That said, there is a growing realization that many firms are placing proprietary technology on servers all over the world. The Java/NT fight is only the most recent and highest profile example.

The appropriate business model has changed in client-servers over the last few years. In the early years, the sales were made from computer engineer to computer engineer. Many engineering firms and software start-ups thrived in this situation with a less than perfect product. Many of these firms, from SAP, Cisco, and 3COM to Oracle and Sun, are now trying to make the transition to providing products for commercial users. Commercial users prefer the reassuring handshake of a large firm and a salesman in a suit, which plays to the comparative strengths of traditional firms such as IBM, EDS, and Andersen Consulting. These traditional vendors could get into this game late and still do well, despite the built-in ESC factor of the older firms. So too will many third-party consultants and vendors who translate lessons of the past into tools that users need today. Again, the eventual structure of the market is an open question.

Remember the role of coinvention—vendors invent and sell, buyers coinvent and customize. The vendors and technologies that succeed are the ones that find ways to lower the buyer's coinvention expenses. The segmentation that arises, if it does arise, will follow the ease with which buyers coinvent and vendors meet their needs.

Formulating strategy when platforms are fluid

Despite the size, complexity, and technical turbulence of the electronics industry, market relationships in the computer industry tend to follow a few important patterns. Market segments tend to be organized around platforms. A small number of platforms tend to dominate any segment at one time and tend to dominate it for a long time. New platforms tend to be founded within engineering markets first before moving, if at all, to commercial customers.

Once established, dominant platforms are not easily dislodged, and if they face competition from anywhere, it is from previously distant platforms. Disruptive crashes of market relationships tend to be rare because so many forces prevent established platforms from losing their preeminence.

While the main thrust of this investigation has been positive in focus, there are many

implications for policy formulation. Compare common arguments for and against what firms ought to do against what tends to happen in practice.

Emergence of dominance after the competitive crash

Today's competitive crash seems to be one of those rare disruptions to market relationships. Eventually, there should arise only a few dominant platforms that persist over long periods. For now, however, market boundaries will blur until the diffusion of client-server systems determines how the platform will segment users, if at all. It is not yet apparent which early standards will persist, unify, and coordinate different firms and users, or fade away.

Persistence of incumbents

As one thinks about formulating strategies, either as an investor or as a technology watcher, during (what now appears to be) this era of transition to client-servers, historical patterns provide some guidance. First, there should be a presumption that existing market relationships will persist into the future. This is not the same as saying the industry will remain technically static or that all relationships will persist. Incremental advances will be incorporated into existing platforms by existing vendors, if at all possible.

IBM, Microsoft, Intel, Sun, and several other leading firms that potentially control key components in future client-server platforms claim they are under perpetual competitive siege. This must be taken with appropriate measure. None of these firms would stay profitable if they failed to innovate, but none of them would lose market share immediately if they made a minor incremental technical mistake. One should interpret most of today's competition in terms of attempts to expand capabilities with the purpose of becoming the dominant platform in client-servers.

On predicting the direction of technical change

Any particular guess about technical direction is bound to be wrong. Yet, making such guesses is central to investment strategies. The menu of technical options represents an enormous superset of the potential commercial options under consideration by users and vendors. At best, several patterns can frame analysis. First, there are strong biases toward adding incremental technical advances into existing platforms and away from radical new platforms. Second, the list of potential entrants from a technical standpoint is always large, but the list of feasible entrants from a commercial standpoint may be quite small. Thus, to all but the analyst with the most finely tuned crystal ball, it will be difficult to distinguish between what is really under siege and what is not, who really has commercial momentum, and who is losing it. Additionally, what may have been appropriate in one era and with one set of platforms can become outdated quickly, as the next era's platforms come with different users, firms, or technical foundations.

Understanding how platforms evolve is essential to understanding how this industry will evolve.

Communications in vertical relationships

In a market where vendors invent while buyers coinvent and customize, close contact between buyer and seller facilitates communication to aid in finding solutions to bottleneck problems. While the concentrated structure of the typical platform seems to work against sharing information widely, an unheeded rush to abandon contact between buyer and seller where no commercial relationship presently exists seems counterproductive for coinvention activity.

Firm contact in vertically disintegrated markets

The fight for control of technical standards is an important facet of competition between vertically disintegrated firms producing for the same platform. This fight is simply a fact of life. It pervades virtually every phase of market development: institutionalized standardization committees and related decision-making bodies, joint-product development and marketing agreements, and contractual arrangements between ostensible upstream and downstream suppliers.

This fight cannot be wished away or ignored. The principal social expense of these fights seems to be a reduction in technology coordination within a single platform. The principal benefit is the check it places on the ability of any single firm to determine the direction of technical change exclusively for its own benefit.

Competition check on vertical relationships

Does competition among platforms limit

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the scope of potential abuse of vertical relationships by a firm that dominates vertical relationships within a platform? This question goes back to the IBM antitrust trial in the United States, but has many antecedents.[14]

The historical record gives mixed indicators. On one hand, there seems to be a reasonable presumption that platform competition does not limit vertical relationships, at least in the short run. Established platforms cannot be easily dislodged, except by unexpectedly mobile platforms in rare circumstances. Indeed, there seems little reason for a broad presumption that the threat of potential entry from another new platform will alone restrain behavior.

On the other hand, the entry of client-server platforms seems different from the past. First, they are not yet platforms largely defined around proprietary standards, so the lessons from the era of proprietary platforms may be inappropriate. Second, a client-server's development takes advantage of vertical disintegration in the PC market. Until such time as standards are clearly defined, threats by buyers to use different combinations of components to form client-server arrangements may provide a competitive threat for existing combinations.

Use of structural reform as a policy instrument

Governments have been known to attempt to deconcentrate markets where firms appear to have monopolized or attempted to monopolize a product market. The popularity of calls to break up Microsoft today echoes this antitrust tradition. These actions may arise from concerns about the inherently large size of a firm or its behavior. There is no point in reducing the degree of concentration of a market (as an end in itself) if concentration naturally arises due to the strong tendency of a single platform to dominate. Similarly, policies aimed at restricting established firms (rightly or wrongly accused of monopoly behavior) may only give rise to another firm that achieves similar ends.

This would suggest that policy-makers should take a cautious approach to structural reform if there is any reason to doubt its need. If structural change is strongly desired by the political process, a policy encouraging radical change should not necessarily break up an incumbent. Instead, it could favor policy initiatives with a broad presumption in favor of encouraging platforms from potential entrants, even entrants not yet on the horizon.

Growing new platforms for today's systems

As a result of commercial initiatives from Sun, Oracle, and others, it is popular today to speculate about a future in which a reconfigured client-server system consists of thin clients and fat servers. This contrasts with today's networks, which are often a hodgepodge of components from a variety of users for a variety of applications.

Historical patterns suggest that a new platform of this type, like any new platform, will succeed if (1) it is first diffused to technical and sophisticated users, (2) it eventually offers a radical new functionality that the old platform cannot imitate, and (3) it develops into a platform that uses or reuses the capabilities of existing platform components already in place. This is a tall order for any new entrant, especially in today's market, where competitive forces are so unforgiving. Yet, it also strongly suggests that some types of commercialization strategies will succeed, while others will almost certainly fail, which should help guide marketing and development.

What does the future hold? It is a cliche that high-technology markets change frequently. Despite such change, this article tries to show that the same concepts provide insights about market behavior this year, last year, and the year before that. These concepts also represent my best guess about what will likely remain relevant in the future.

That said, almost by definition something in this article will become incorrect by the time it is published. As much as one can make a sure bet in this industry, I am willing to make this one: for the foreseeable future, the market economics and strategies of the dominant firms will be interlocked with the economics and strategies of the dominant platforms in use. Understanding how platforms evolve is essential to understanding how this industry will evolve. MICRO

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