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EVOLUTION OF THE AMERICAN COMPUTER INDUSTRY

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EVOLUTION OF THE US COMPUTER INDUSTRY

Never before has the American stock market shown quite so much enthusiasm about an industry as it has lately about the computer industry. Recent prices of computer stocks represent some of the highest price-earnings ratios ever recorded. Even the shares of giant I.B.M., which increased sixfold between 1957 and late 1966, have doubled since. In July the market valued I.B.M., whose physical assets amount to less than $6 billion, at more than $40 billion - more than any other company in the world, actually as much as the gross national product of Italy. And the market value of smaller and newer companies in the industry has gone up even more steeply than I.B.M.'s. In less than three years the price of the University Computing Co. of Dallas rose from $1.50 a share (adjusted for splits) to $155. The stock market valued this newcomer, whose sales last year were less than $17 million, at more than $600 million.

Hardly a decade old, the electronic data-processing industry has already waxed faster than any other major industry, any time. During each of the past two years it has grown a stupendous 40 to 50 percent, depending on how growth is measured. Although the annual production of computers and related hardware is expected to flatten out at $4 billion to $5 billion during the next three years or so, the value of the nation's general-purpose computer installations, now about $15 billion, is conservatively expected to more than double by the end of 1972.

By then, U.S. business, government, and science, which are now spending at least $8 billion a year buying, renting, programm ing, and operating general-purpose computer systems, may well be laying out upwards of $18 billion a year. According to the generally accepted forecast, what's more, this growth will be accompanied by total profitability. Most of I.B.M.'s larger competitors have been forced time and again to postpone realizing their profits. Now some are at last beginning to make money, and before long practically all will be in the black. And over the next decade, as the total market doubles and triples and even quintuples, it should provide profitable opportunities for many other companies. So, at least, runs the prevailing view in the computer industry.

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Some optimists, indeed, see no clear end to the increase in demand for computers and all that goes with them. More and more of the uses for computers, such as improving the quality of management decisions, are quite unmeasurable. The computer is becoming a device for enlarging brain power, which cannot be costed like machine power, and the electronic data-processing industry is becoming the knowledge-expansion industry, whose limits are indefinable. Thus the market for computers, the argument goes, is limited only by the industry's own ability to sell customers on new uses for the machines.

The high cost of success

This exhilarating prospect, however, may be overdrawn. IBM's major competitors may find the struggle harder than they now anticipate. And the whole industry may be running into difficult, if transitory, problems because the profit-making potential of computer systems, though increasing all the time, may take longer to realise than is now generally supposed.

What IBM's competitors may yet be up against is well illustrated by what they have experienced in the past. IBM, which still accounts for about 70 per cent of the nation's total computer-manufacturing business, accounted until recently for more than 90 per cent of the industry's profits. Far behind, in roughly the following order, marched Sperry Rand, Honeywell, Control Data, RCA, Burroughs, NCR (National Cash Register), Scientific Data Systems, General Electric, and Digital Equipment Corp.

All entered an industry whose profitability they correctly appraised as extraordinary. Profit margins can run to more than 35 per cent of the cost of making the hardware and confecting the basic "software", the detailed instructions involved in using the hardware. The only catch is that it takes time to realise such a return. More than 85 per cent of the new machines are leased at rates calculated to return their list price, which itself includes a generous profit, within four to five years. But installation costs, "support" activities, and marketing expenses are particularly heavy in the first two or three years. Most companies, moreover, use accelerated depreciation, which means they charge off a large percentage of costs in those early years. So revenues do not overtake costs for at least three years. For, if it sells successfully, it has to keep laying out huge sums to develop and build new machines and to compose software for them; the more successful it is, the more expensive its success becomes. Not until rental revenues build up to the point where they cover research and development and start-up costs on new machines does a company make money.

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A few companies, notably Control Data of Minneapolis, Scientific Data Systems of Santa Monica, and Digital Equipment Corp. of Maynard, Massachusetts, got around this bind from the start by turning out big computers for universities and scientific institutions, which often bought the machines outright. But the rest of IBM's competitors had to struggle with delayed revenues and mounting capital expenses and wait for the day when their rental money would begin to pile up the way IBM's did. Moreover, IBM had been dominant in punch-card tabulating machines since the early 1920s. This headstart endowed it with not only a ready-made market for computers but also a continuous profit that still probably runs into nine figures a year. Competitors, however, were not discouraged by IBM's built-in advantage; sooner or later, they were sure, their rewards would also come rolling in.

But by the late 50s came an unpleasant shock. The "first generation" of computers, such as the Univac I and the IBM 701, both vacuum-tube models, had been introduced in the early 1950s. So swiftly had computer technology advanced that within three years these relatively slow machines were growing obsolete. IBM called the turn, late in 1958, by introducing its second-generation 1400 and 7000 series, utilising solid-state components. Rivals had no choice but to begin marketing their own second-generation machines. By 1960 most of them were so occupied in making and selling new machines and building up their sales and service organisations that their expenses increased much faster than their rental revenues. The day of profitability again receded into the future.

Meanwhile everybody was developing third-generation computers, featuring integrated circuits and higher out-put at less cost. Early in 1964, just about the time IBM's rivals were once again beginning to talk about making money, IBM again called the turn by introducing its third-generation family of computers, System/360 on which it had literally staked billions. Once again IBM's competitors found themselves eating their predictions of just-around-the-corner profits. System/360 hardware was less advanced than many competing machines, and early versions contained many bugs. But IBM corrected the system's faults. Today System/360 accounts for more than 50 per cent of the dollar value of all computers installed and on order.

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Going for the weak spots

Some of IBM's rivals, however, have also been fairly successful with their own new machines, particularly when they concentrated on gaps or weaknesses in the IBM line. Control Data, Scientific Data Systems, and Digital Equipment have been consistently profitable mainly because they did just that. Now three more companies have reached, or almost reached, the happy state of making money on their computers.

Sperry Rand's Univac Division has managed to stay in a strong second place, putting its advanced hardware and wide military experience to good use in special, complex applications such as airline management information systems. Univac has been profitable for two years, and last year actually contributed more to the increase in Sperry Rand's earnings than any other division.

In 1964-65 Honeywell achieved considerable success with its 200 series, which it deliberately built to be compatible with IBM machines; and recently it brought out a whole new line of machines. Since its previous models could not provide enough rentals for an early payout, it achieved profitability swiftly by setting up an equipment-leasing subsidiary, which buys Honeywell computers outright. So Honeywell began to make money in 1967.

Burroughs, strong in the banking market, recently landed $90 million worth of contracts to install remote-terminal systems in three leading British banking chains. Having pioneered in multiprocessor machines, which can handle many programmes concurrently, Burroughs also has a strong position in very large computers and supercomputers. It recently sold an advanced supercomputer system to US Steel, which will use it for scientific and engineering work and as a management information system. For the Defence Department and the University of Illinois, Burroughs is building the Illiac, which will contain no fewer than 256 processing (or computing) units, and will push multiple processing "to its practical limit". It is expected, among other things, to revolutionise weather forecasting.

Those deep rental pools

So among IBM's major competitors, only General Electric, RCA and NCR have no immediate prospect of making money on hardware. Nevertheless, all three companies are optimistic.

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NCR has brought out a new line and GE says it is making money on time sharing. Wall Street analysts also believe the three will turn a profit on computers sooner or later and will eventually find the business increasingly lucrative. There are, in the main, two reasons for this optimism. One is that the industry's so-called rental pools or backlogs are increasing enormously. Rental pools of companies other than IBM have doubled since 1964, and by 1970 will amount to five times their 1964 size. Since it is already huge, IBM's pool will, of course, grow less rapidly.

The other reason for optimism is that the industry's growth and profitability do not depend, to the extent they did in 1964, on the introduction of a new generation of computers. The third generation has been remarkably adaptable. It not only does routine jobs such as billing and making out payrolls; fortified with all manner of peripheral equipment - random-access files, auxiliary memories, improved input-output devices - it is being used for advanced applications such as market analysis. So it seems likely that there will be few radical changes in the fourth generation. It will probably be introduced gradually, perhaps beginning in 1970; its peripheral units and software will probably be compatible with the "architectural structure" of the third generation.

Everything, of course, depends on what IBM does and when. But the industry is inclined to think IBM will adopt the evolutionary rationale - if for no other reason than that, it does not want to repeat the "horrendous, complicated, and expensive process of implementing a whole new system of programming" (Arachtingi report).

According to a common assumption in the computer industry, business is growing so fast that IBM's competitors need only maintain their share of it to grow sizable and profitable. Rental pools, in other words, will grow to the point where they will be more than sufficient to cover development costs. The sceptics say this isn't always so. As your business increases, one computer executive explains, you may have to expand disproportionately the resources you need to maintain that increase. And despite the general confidence that the fourth generation will make no trouble, there are those who feel that IBM will come up with a fourth-generation product, in either hardware or software or both, that will force competitors to funnel much or all of their rental-pool income into further development.

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Rain under the umbrella

There is some doubt, indeed, that IBM's competitors can even be sure of maintaining their combined share of the business. Estimates indicate that IBM accounted for 73 per cent of the dollar value of general-purpose hardware shipments in the US last year, against 71 per cent the year before. IBM's world position vis-à-vis that of its US competitors apparently has improved even more. According to a set of figures compiled by one computer-industry specialist (there are no official industry data), total world shipments by US companies increased from $3.8 billion in 1966 to $5.7 billion in 1967, up roughly 50 per cent in one year. But IBM expanded its share from $2.7 billion, or 71 per cent, in 1966 to $4.25 billion, or 74 per cent, in 1967. In other words, IBM copped 81 per cent of the total increase. These figures suggest that keeping up with IBM will be harder than it sounds.

Keeping up with IBM, some feel, would be easier if the Justice Department forced that company to price its software and hardware separately. Just last May, indeed this perennial proposal was discussed vehemently at the Joint Computer Conference, a semi-annual affair sponsored by the whole industry. IBM's profits on hardware are so great, the argument goes, that it can afford to give its customers free service and software its competitors cannot afford. If hardware, software, and services were priced separately, competition would be fairer.

The trouble with the argument, as the trade paper EDP(1) Industry Report has pointed out, is that separate pricing would surely make life tougher for the other hardware manufacturers, which could not hope to cope with IBM's economies of scale in a more price-competitive market. For the same reason the proposal might also work against independent software companies, whose resources are only a fraction of IBM's. Separate pricing might also block the development of the new "software in hardware" approach, which involves building basic programming into hardware at the factory. In effect, the EDP Report said, the industry is flourishing under the price umbrella of IBM, and has more to lose than gain by getting out from under. But it is clear that an IBM rival wanting to make money has to do more than tag along under the umbrella.

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(1) EDP = Electronic Data Processing.

One branch of the industry that has been able to make money tagging along is computer leasing. The companies in it buy computers and lease them to users at discounts of as much as 20 per cent below the manufacturers' rentals. Manufacturers depreciate their machines over four or five years, but most leasing companies gamble that the useful life will run to ten years. So their books, despite the discounts, show very nice profits. Their big problem is to keep the equipment leased long enough to make it profitable. To reduce the risk of being left with an unwanted machine before it is fully depreciated, nearly all deal only in IBM computers.

Data-processing laundromats

Hundreds of companies are counting on basic changes in the structure of the computer industry to help them latch on to shares of its future volume and earnings. One of these changes is the growing importance of software, whose dollar volume is even now greater than the dollar volume of hardware. According to estimates by the EDP Industry Report, software outlays in the US this year will come to nearly $6 billion. Of this, some $4.5 billion is being spent directly by computer users, $250 million by independent suppliers, and $1,250,000 by computer makers, whose software outlays are of course included in the price of their hardware. By 1972 the total figure will come to $11 billion. One reason software outlays are rising faster than hardware outlays is that the price of hardware, in terms of work done, is declining steadily. A more important reason is that the third-generation computer systems are being used in increasingly complex jobs, such as capital-investment analysis, resource allocation, sales forecasting, and research and development. Software for this kind of work is complex and expensive. The customer must analyse his problem and structure a model of it before he can write his programme. Installing even a relatively simple credit-information system, for example, can use up something like 30,000 man-hours of systems analysis and programming, at about $15 per man-hour.

Although the big hardware companies are continually building up their own software potential, a growing number of independents have established themselves in the field. Among the important ones are Computer Sciences, Computer Usage, Computer Applications, Planning Research, and Computing and Software. Largest and perhaps most aggressive is Computer Sciences of Los Angeles, founded in 1959 by Fletcher Jones, a North American Aviation computer executive,

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together with Roy Nutt, a systems analyst at United Aircraft. He has obtained stockholder approval on both sides to acquire Western Union, whose wire network he intends to use in converting Computer Sciences Corp. into a worldwide service agency.

Jones' ambition is riding with another salient change in the industry - the rapid growth of the so-called service-bureau business. Some 800 service bureaus now gross more than $650 million, and are increasing their take at about 40 per cent a year. Although large companies like IBM, ITT, Control Data, and NCR get much of the trade, many smaller firms are prospering.

In their simplest form, service bureaus offer batch processing. They may be loosely described as data-processing laundromats, to which customers bring batches of calculating and computing work and either wait or come back for the solutions. More advanced are batch service bureaus that provide direct lines to customers, who can feed the data to the computer from their own offices. Many bureaus go further and offer direct access to computers, with immediate response; customers use them for a wide variety of processing jobs, and for retrieving up-to-date data on file in the computer's memory, such as credit ratings, stock prices, and statistics.

Where the future is

Relatively new are the bureaus offering complete data processing services to companies or industries that can be accommodated with identical or fairly similar programmes. These bureaus are already immensely successful; hundreds of retailers, distributors, auto dealers, grocery chains, and hospitals are subscribing to them. An important and fast-growing sector of the service-bureau business is time sharing, which reduces costs and speeds up service by enabling a number of customers to "converse" directly and simultaneously with a computer from their own offices. Time sharing has run into some technical problems.

Some computer-industry prophets regard the service bureaus as the key to the industry's future. The computer business, they say, will evoke into a problem-solving service. What they envisage is a kind of computer utility that will serve anybody and everybody, big and small, with thousands of remote terminals connected to the appropriate central processors. The central processors, sharing a common memory, will often be enormous and highly efficient, with the ability to execute dozens of programmes concurrently.

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The big hardware companies themselves are making sure that they will be in a position to take advantage of the trend, when and if it comes. Univac, strong in multiprocessing and peripherals, has set up an Information Services Division to capitalise on any trend toward the utility concept. "The future of the business is in service", says Robert E. McDonald, head of Univac.

Keeping up with the centres

Whatever happens to the computer utility concept, the hardware business is bound to change. The dollar volume of peripheral equipment, which already exceeds that of central processor units, will continue to grow much faster. The central unit, whatever its capacity, can process data only as fast as the peripheral equipment can put it in and take it out. Without adequate input-output devices, time sharing, for example, is impossible.

So far, however, the speed of central units has increased faster than the capacity of peripheral units. One result has been an explosion of technical and sales activity among makers of peripheral equipment. Punch-card devices and other kinds of equipment that require a lot of clerical attention are giving way to a wide range of speedier innovations. Many of the hundreds of small companies now in the field have already hit the jackpot with a proprietary product. There are more than fifty independent makers of remote terminals and improved input devices, including Mohawk Data Sciences, Sanders Associates, Digitronics, University Computing, and Tally. There are makers of optical character-recognition machines, such as Recognition Equipment, Farrington, Optica Scanning, and Cognitronics. There are makers of magnetic tapes, disk packs, and peripheral memories bearing brave names like Memorex, Caelus, and Consolidated Electrodynamics.

Despite the proliferation of independents in the field - from about 100 companies in 1960 to more than 250 today - most of the peripheral equipment is turned out by the big computer makers. Since they do not report separate figures for this equipment, it is difficult to estimate total peripheral sales. A good guess is around $2.5 billion. By 1972 the figure will probably be at least $4 billion, so there will be plenty of room for inventive independents to grow. But the independents' combined share of the peripheral-equipment market has probably declined from 35 per cent or so in 1960 to less than 15 per cent today. Although the market is growing so fast that the independents' volume is still expanding, it seems inevitable that the independents generally will find the going harder.

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In another segment of the computer business with excellent growth prospects, small independents will not be able to compete at all. This is the market for very powerful central computers - the very large machines such as the Control Data 6400 and the Univac 1108, and the so-called supercomputers such as the Burroughts 8500 and the Control Data 6600. Only big computers are able to handle large scientific jobs and extensive information systems for corporations or computer utilities. Moreover, because software is getting more expensive while hardware is getting cheaper relative to capacity, there will be a tendency to use plenty of hardware rather than spend a good deal of money creating software that will maximise hardware efficiency.

Every now and then some observer of the computer industry points to a cloud - small yet vaguely threatening - that sometimes appears to hang over its future. The costs of computer systems keep climbing but the returns keep getting harder to calculate. Until fairly recently, most business computer applications were devoted to relatively routine, well-structured jobs such as billing and invoicing, in which they paid off measurably and handsomely. As computers grew more complex and expensive and were assigned more sophisticated tasks, the payoff became less easy to achieve and more difficult to measure.

To define problems clearly enough

There is evidence that the computer industry is not going to wait for competitive pressures to push the laggards into realising the computer's potentialities. IBM, for example, is finally installing an integrated management-information system in its own organisation. In the past, IBM has made abundant use of computers at the plant or division level, but its new $100-million Management Information System will encompass the whole company. When complete, it will consist of some 3,700 terminals connected to dozens of central computers. IBM's announced aim is to improve its own internal efficiency, but if successful the system will manifestly improve IBM's ability to show others how to use computers profitably in ways few are yet using them.

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Precisely because the potentialities of the computer have been only partly realised so far, the industry is sure that the business market for its computer systems will grow faster than business itself. But that growth will not be automatic. It will depend to a large degree on how well the industry can show customers and prospective customers how to define their problems clearly enough to make full use of the computer's marvellous capacity to provide solutions.