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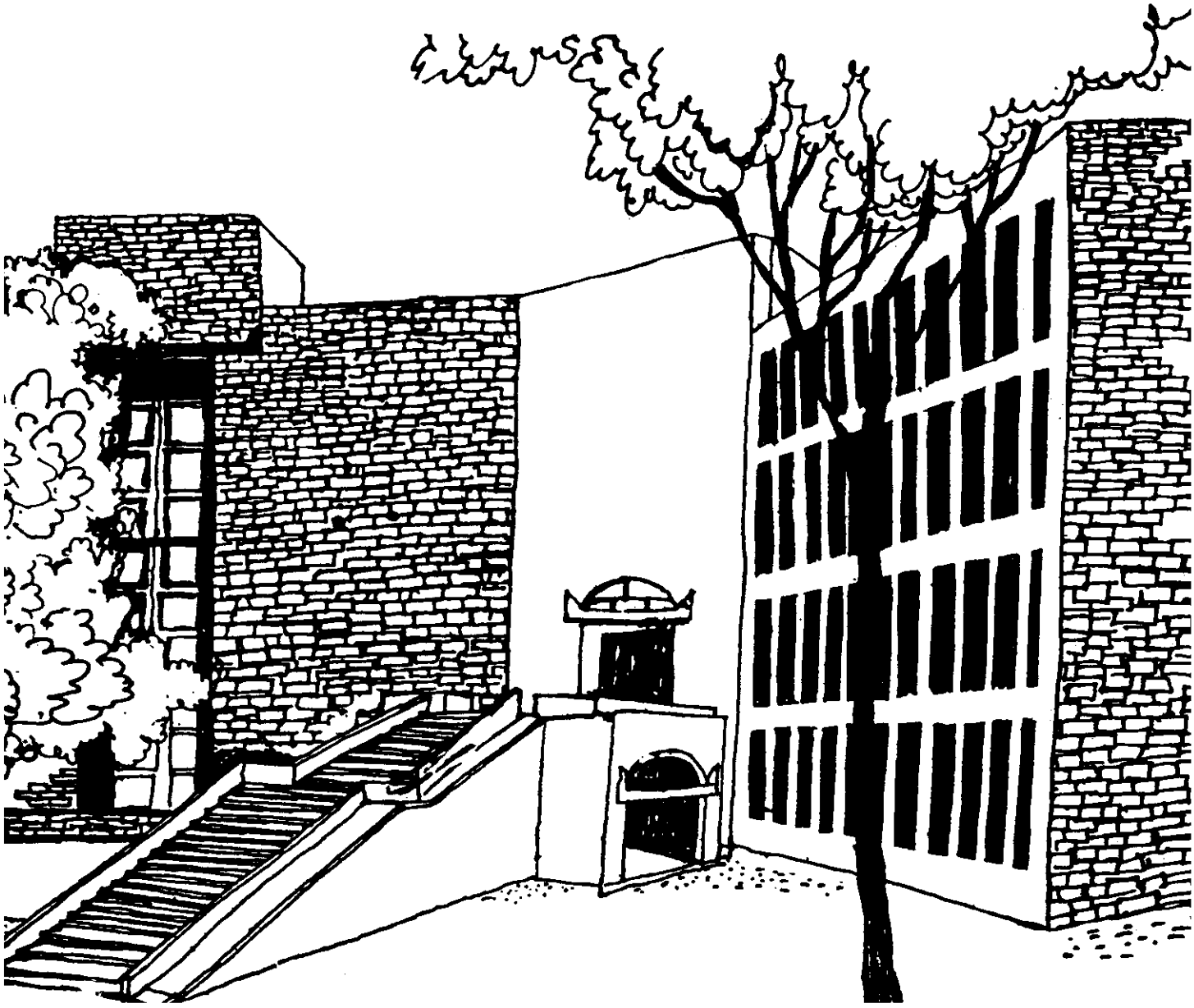

FUJITSU LTD: A CASE OF GLOBAL MANAGEMENT IN TELECOMPUTERS

By

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Abstract

It is now almost axiomatic that the essence of corporate success lies in a felicitous combination of constancy of purpose and well coordinated operations. However, for global companies functioning in highly strategic environments, such as telecomputers, the artistry and power involved in prosecuting this simple dictum should be of a much higher-than-average order. To gain insights into this question, we undertook an exploratory study of a key protagonist in the world telecomputer industry using a case history approach based on available information. The paper describes Fujitsu's development into a global leader in telecomputers over the last 55 years. It concludes by highlighting some interesting managerial lessons including the importance of (a) the firm's focal faculties (b) industrial management reforms (c) the management of multicultural research centres (d) the coordination of strategic moves with key industry competitors and (e) the development of a nation's global network of strategic entities in the post-industrial management era.

Fujitsu Ltd: A Case of Global Management in Telecomputers

P.S.Thomas & T.Madhavan

The re-structuring of the $200 billion world computer industry gathered momentum during the second half of 1990 due to recessionary conditions and the Gulf crisis. In July, Fujitsu Ltd announced plans to purchase an 80% stake in ICL, Europe's most profitable computer company, for $1.4 billion. When signed in November, the deal took Fujitsu to the No.2 spot among world computer makers (in sales dollars) with a strong European base from which to counter IBM's own highly profitable European operation. However, it also immediately put ICL's future participation in EC funded telecomputer research projects at serious risk.

The Fujitsu announcement overshadowed the unveiling of IBM's newest family of 18 mainframes in September 1990. These represented IBM's most significant product announcement since its standard-setting 360 and 370 series launched 20-25 years ago. When completed by 1992 IBM would have its strongest product line-up in over a decade. Meanwhile, Fujitsu simultaneously introduced an even more powerful mainframe (600 MIPs vs IBM's 210 MIPs) in its continuing effort to use technology to counter IBM's sheer market power. However, IBM resumed talks with British Telecom that were suspended six years ago under governmental pressure. It also decided to shift its telecom business headquarters to London within a year.

These developments pressured AT & T, the giant telecom technology and services company, which was initially engaged in friendly talks with NCR on the basis of a common interest in networked computers to suddenly wage a desperate bid for the fiercely independent specialised computer company. AT & T's hostile bid of $6.1 billion in early December represented a steep 15 times earnings compared to only 8 times earnings in the case of the Fujitsu - ICL deal. Prospects were for an interesting "clash of cultures" as both were reputedly "stodgy" companies in the face of rapid change in technologies and markets.

Finally, in a sort of footnote to the foregoing, Canada's Northern Telecom Ltd increased its stake in STC (ICL's erstwhile owner) to a controlling interest for $2.8 billion, half of which was recouped from Fujitsu's payment for ICL in November.

Thus the telecomputer industry consisting of computers, telecommunications and their underlying building blocks, integrated circuits or semiconductor chips, was a teeming mass of powerful competitors. In this milieu, Fujitsu was running neck and neck with NEC among the world's top ten electronics manufacturers. The rapid state of flux in its strategic environment made it necessary for Fujitsu top management under its new president and chief executive officer, Mr.T. Sekizawa, to chart its corporate strategy with cold realism, to the year 2000. According to global pundits, there was a fifty percent chance that during this period a company in the industry would experience radical change.

The case presents a brief profile of Fujitsu followed by accounts of its participation in the telecomputer industries of U.S., U.K., and Europe as well as India. It concludes with a description of challenges facing Fujitsu in the world's advanced electronics industry and a brief summary of some of the important lessons from the case.

Fujitsu: A Brief Profile

In 1923 the Furukawa business group collaborated with Siemens AG to establish Fuji Electric. Twelve years later the company's telephone equipment business was spun off under the control of a new company called Fuji Tsushinki. (The company's name was changed to its present style, Fujitsu, only in 1967). As an integrated producer of switching and transmission equipment, Fujitsu supplied products and services to the rigorous performance specifications and quality standards of the public sector telecom monopoly, NTT. To this day, Fujitsu is considered a leading member of the so-called Den Den family of telecom suppliers, with about 15% of its sales going to this sector. (In 1978 the corresponding percentage had been 25). But computers, which currently accounted for about 2/3 of its sales was the one in which Fujitsu was dominant in Japan. In fact mainframes alone generated 75% of its computer revenues.

Fujitsu was the first Japanese company to develop a computer, a relay based one called FACOM 100, in 1954 under the leadership of a manager named T.Kobayashi. But computers received low priority in what was then an essentially

telecommunications oriented company. Only when an outsider, K.Okada, took over as president in 1959 did Kobayashi's computer group get a separate facility and by 1960 Fujitsu was "committed to computers". In 1962 it even established the first Japanese laboratory specializing in computer research and development. By 1968 Fujitsu's computer revenues not only exceeded those from telecoms but Fujitsu moved into 1st place among Japanese computer companies which had charged ahead of it in the late 50s.

Unlike these companies which had entered into separate collaborations with American computer companies between 1961 and 1964, Fujitsu followed a "go it alone" route. As a result the company was characterised by the American media as "an insular enterprise stubbornly pursuing its own ways." But various reasons have been given for this state of affairs. One was its reluctance to dilute its historic ties to Siemens. Another was that its competitors had largely pre-empted the available pool of American collaborators. Finally, though eventually Fujitsu made overtures to IBM, it was unwilling to become a 100% subsidiary as required by the latter. Hence it necessarily had to pursue computer development on its own.

Semiconductors formed the third strand of Fujitsu's business portfolio with 15% of sales accounted for by this segment. A merger with Kobe Kangyo in 1968 gave the company a foothold in the Japanese semiconductor market with a 4% share. Ten years later, Fujitsu was the first to sell the 64K DRAM chip

representing very large scale integration, or VLSI technology on the open market though it was quickly improved upon by rivals. This feat is generally labelled a turning point in world semiconductor competition.

The DRAM chip had been invented by Intel in 1971 and its capacity has steadily increased till it stands today at 64 megabits. The Japanese displaced the Americans in 1978 by using a conservative chip design and an older, proven process technology in conjunction with superior clean room processes and production controls. It took leading American "merchants" two years to close the Japanese lead in 64K chips which became a basic electronic component in the 1980s.

Fujitsu specialized in the production of semiconductors such as EPROMs for advanced electronics. Its semiconductor design teams worked closely with computer design teams. Because its semiconductors were "technology intensive" the business had to be subsidized by end products. At the end of 1990 Fujitsu had begun constructing a $770 million plant in Japan for making the state-of-the-art 64 Megabit DRAM chip.

During its ascendancy Fujitsu spun off a number of businesses as semi-independent entities. In 1968 it incorporated Fujitsu Labs as one such entity. Fujitsu's' robotics and car audio divisions were subsequently spun off as Fujitsu FANUC and Fujitsu TEN respectively in 1972. FANUC, in which Fujitsu's share is 41%, dominates the numerically controlled (NC) machine

tool market with a 70% market share in Japan and 50% world wide. On the other hand Fujitsu's consumer electronics revenues represent only 4% of its sales.

Fujitsu simultaneously entered into several key collaborations. In October 1971 Fujitsu and Hitachi established closer inter-firm coordination for purposes of cloning IBM's computer architecture. Both companies were members of the Dai-Ichi Kangyo Bank (DKB) Keiretsu or diversified business group. DKB was Japan's second largest commercial bank.

A joint venture was established between Fujitsu and Matsushita in July 1973 in mini and micro computers. In 1986, Fujitsu, Hitachi and Mitsubishi entered into a collaboration for developing 32 bit microprocessors. All told Fujitsu had about 150 subsidiaries in Japan.

Unhindered by foreign collaborators' restrictions, Fujitsu embarked very early on a global strategy by exporting its first computers in 1966. During the 1970s Japanese computer companies launched a cut-price sales offensive in South East Asian countries. But IBM's total dominance of international markets behind its formidable software investment barrier proved an insuperable challenge to the sale of competing hardware. In the meantime Fujitsu launched sales compaigns in Australia (a proxy for developed country markets) as well as Brazil and Philippines which were developing countries. The strategy used was to undercut IBM's prices to obtain government/public sector

business. When the private sector followed the government's lead, prices could generally be raised.

In 1984 Fujitsu accounted for about 1/3 of the mainframes installed in Japan. The declared aim of Fujitsu management was to achieve a long term growth rate of about 20% per annum. With overseas sales of more than $4 billion (out of total 1988 revenues of $18 billion) Fujitsu was among Japan's active international companies. It had shifted over the years from exports to overseas production and localisation of design and technology. In 1978 Fujitsu's exports represented 11% of sales slightly above the 8% average for the Japanese computer industry as a whole. Its revenues in the key U.S. market represented about 7% of total Fujitsu sales in 1988. The company scrapped its annual export target of 30% in 1985.

With a complement of nearly 120,000 employees Fujitsu had 14 plants operating in 7 countries. Another 3 plants (in two countries) were in varying stages of completion. Besides these plants a number of new centres for R & D, maintenance and support and procurement were also being built or expanded. According to top management Fujitsu's overseas activity was undertaken on the principle of "cooperation and mutual prosperity" in which "we try to view all activities through international lenses."

IBM Moves into Japan

IBM's activities in Japan date from the pre-War year of 1937. Later it set up IBM Japan as a 100% subsidiary in 1950, a

year before the corporation began making electronic computers in the U.S. In 1960 it applied for permission to start manufacturing activities which duly began in 1963. As a yen company, IBM Japan was outside the formal control of MITI over "foreign companies." But Japanese policy makers had already concluded that information technology was crucial to national progress. So MITI was committed to strengthen domestic computer companies. It compelled IBM Japan to grant access to its patents, to charge a maximum of 5% royalty and to divert its sales to export markets rather than to the domestic market.

In 1961, Japanese companies had 18% of their market with the balance primarily in IBM's favour. Imported computers accounted for 70% of the market in that year. By 1975, 85% of the Japanese market was served by domestic companies and IBM Japan's share declined to 35%. In 1979 Fujitsu overtook IBM Japan to occupy the No.1 spot in Japan and later NEC also passed IBM Japan. By 1986 about 80% of the Japanese market was controlled by Japanese firms. The remaining 20% was divided among IBM, NCR and Unisys' local subsidiaries. With a 15% share, IBM Japan was still proving useful to IBM Corp. in denying Fujitsu and Hitachi, its main rivals in the mainframe business, both production experience and cash flows to develop the distribution and software capabilities essential to success in the U.S. mainframe market.

But the loss of IBM Japan's market dominance was one of the conspicuous developments in the world management scene. Observers

provided several reasons. The Japanese policy environment (both via regulation and procurement) proved to be a favourable one for Japanese computer companies. The Japanese data processing market was initially limited to large users such as those among the top 500 companies. But the market broadened with government assistance to include medium-sized firms and public sector agencies. The government moreover, adopted a coordinated approach to market development, assigning responsibility for different segments to competing pairs of Japanese companies. This resulted in efficient concentration of resources in multiple segments of the computer market and enabled the Japanese as a group to effectively match the broad range of IBM's product line.

On the other hand, IBM Japan enjoyed a considerable measure of operating freedom in the IBM system. It had a Japanese president but it did not develop as a completely indigenous manufacturer. Nor was it closely coordinated with headquarters, even though it was the third largest of about a dozen overseas IBM affiliates (after UK and Germany). It was only in the mid-80s that IBM established a 550 strong American group to coordinate IBM Japan's activities in the Asia/Pacific region.

These efforts bore fruit in terms of making IBM Japan a showcase in IBM's global network. Its workforce increased to 25,000 persons after a brief "hold" in the early 80s. IBM Japan's revenues were close to $8 billion in 1988 with profits of $1.2 billion. Significantly, it began to emphasize technological

factors much more than before. In flat-panel displays, for example, IBM Corp. was the only technically competitive American firm. But manufacture of this sophisticated item was carried out by IBM Japan. Indeed it is the Japanese elements rather than the typical IBM elements which may have actually been accentuated. IBM Japan's new competitive strategy included Japanese-style joint ventures, discounts and systems integration. IBM Japan also finally entered the Kanji (Chinese character) data processing market on which Fujitsu had focused all along.

A considerable increase took place in IBM Japan's alliances. These included links with RICOH in distribution and sales of low end computers; with Nippon Steel in systems integration; with Fuji Bank in financial systems marketing; with OMRON in computer integrated manufacturing and with NTT in value added networks. While IBM had lined up many allies in Japan, in the U.S. it had only a few important (mostly American) allies. The Japanese firms in this group included Matsushita with which there was a collaboration for personal computers and terminals.

Fujitsu in America

The IBM Factor

IBM traced its origins in America to the early years of the 20th century, producing office machines such as typewriters and tabulating equipment. Through a series of post-war developments in the United States the first electronic computer - UNIVAC - was

invented in 1951, not by IBM but by Sperry Rand. This prompted IBM's own entry into computers in the same year with its first electronic computer being launched in 1953. IBM developed very rapidly thereafter spanning two technological generations of computers (vacuum tubes and transistors) by 1960.

This was followed by a four-year $5 billion development programme to launch the third generation 360 series in the mid-60s. The product IBM's first true mainframe, represented more of a software breakthrough than merely a hardware one. It contributed to increasing IBM's dominance over other American computer companies and the industry structure was characterized as "IBM and the Seven Dwarfs." But IBM's real strength was in the mid-range of mainframes. Other companies, were able to enter segments such as high performance computers required for scientific applications or machines for particular sectors like banks, stores and manufacturing process control using operating systems different from each other and from IBM. Besides, the exit of its personnel also led to a certain amount of leakage of its technology. In 1967 a key executive of IBM Japan joined Fujitsu as head of its computer division. Another person from whom Fujitsu benefited greatly was Dr.Gene Amdahl.

Amdahl:

Amdahl had joined IBM in 1951 to design the circuitry of its early computers. He played a key role in the development of the 360 series. But in subsequent development activities he had

trouble getting top management backing for high performance computers involving aggressive technological and pricing policies. The situation was complicated by IBM's unhappiness about his directorship in his brother's consulting company.

Meanwhile Fujitsu management had concluded by 1968 that, in order to compete in international markets, it had to make computers that were compatible with IBM's software. Users were reluctant to replace computers for technological reasons if they had to invest in fresh software for this purpose. In 1969 IBM was legally required to "unbundle" programming software from operating hardware and make the software available to any user. Amdahl was convinced that there was an opportunity for IBM-compatible machines which did not carry an inordinate burden of software development and other support costs. Hence when Fujitsu learned of Amdahl's difficulties it contacted him in November 1969 clearing its approach with Hitachi whose American collaborator RCA had previously tried (unsuccessfully) to make IBM compatible computers. Amdahl resigned from IBM in August 1970 aged 47 years and started Amdahl Corp in Feb. 1971. With this the so called plug-compatible mainframe (or PCM) strategy came into existence. These mainframes could simply be "plugged" into the standard interfaces and software developed for the IBM 360.

In 1970 IBM launched its even more powerful 370 series. This led to a shake out in the U.S. computer industry and the

resulting smaller group of non-IBM companies came to be known by their combined initials as the BUNCH. The Japanese companies that had American collaborations were also affected. In this upheaval Amdahl had trouble raising funds for his venture. But the Japanese government began to extend significant support to the industry in Japan. Hence Fujitsu provided $5 million, 1/3 of the total loans raised initially by the new company. Amdahl Corp. began operations with 70 employees including MBAs.

Fujitsu established a small research lab at Amdahl's California premises where its leading computer scientist Dr. T.Ikeda worked closely with Gene Amdahl who was then invited to give a series of ten lectures to Fujitsu management in Tokyo. The new company encountered numerous problems. The prototype which was to be ready by 1972 could not be completed till 1974. Not only did the design of the machine prove quite complex but in the interest of compatibility Amdahl wanted to match some new features that IBM had introduced. These problems created financial strains for Amdahl and the company turned to Fujitsu for financial as well as technical help. Fujitsu's stake increased to 29% with the infusion of an additional $23 million.

In a significant move, Fujitsu agreed to perform the assembly of the Amdahl computer in Japan on extended terms of payment. However it insisted that the work force in Amdahl's plant required drastic reduction. Eventually this was effected by Eugene White who joined Amdahl Corp as President in August 1974.

During the remainder of 1974 and early 1975 the design of the Amdahl computer was finalised jointly with Fujitsu. A distinctive feature of the design was the crucial "top hat" packaging technology needed to cool the high-density computer circuitry based on emitter coupled logic (ECL) chips. Due to the close link between design and manufacture, Fujitsu expanded production rapidly once the final design was ready. The first Amdahl computers were sold in late 1975 and were an immediate success. Amdahl's V/6 was clearly superior in price, performance and reliability. The machine's reliability was praised by users as "the most incredible engineering feat."

As a result of market response to the V/6, Amdahl Corp's financial position in 1977 became much stronger compared to the near-bankrupt situation of 1975. It was at this juncture that Fujitsu (and Hitachi) achieved technological parity with IBM because of Amdahl.

IBM reacted in late 1977 when it announced a more powerful model at a 30% discount. Amdahl countered with the even more powerful V/7 at a premium of a mere 3%. At the same time Amdahl reduced the price of its V/6 and introduced a smaller version called the V/5. This response was hailed by the market as "the fastest major business decision of 1977."

In order to sustain its price reduction strategy Amdahl obtained a 20% price cut on Fujitsu's subassemblies. It

simultaneously switched to cheaper memory chips and also shifted final assembly from Japan to California. Computers for the Asian and Australian markets continued to be made by Fujitsu in Japan while units destined for Europe, Canada, Middle East and South America were manufactured from 1978 in a new factory in Ireland. Five hundred Irish employees produced 40% of Amdahl's worldwide mainframe output.

According to Louis Turner, an international industrial researcher, [Fujitsu and Amdahl] work closely together particularly in the joint development of computer systems. Amdahl takes the lead in international marketing, the collection of information and the development of new computer ranges. Fujitsu has concentrated on financing, the provision of basic technology and the production of computers in Japan. However, their relationship involves both collaboration and competition for the two companies compete in much of the world.

Gene Amdahl himself left the company in 1979 to pursue his entrepreneurial interests in computer ventures which he launched such as Trilogy Systems and Grid Systems but he had proved that it was possible to establish a mainframe business with a capital base of $100 million rather than the $1 Billion that had been previously estimated. By 1984 Fujitsu's stake in Amdahl Corp increased to 49%. Currently Amdahl Corp's top management consists of John C.Lewis (Chairman), Eugene R.White (Vice Chairman) and E.Joseph Zemke (President and chief operating officer).

Amdahl Today

Amdahl crossed the $1 billion sales mark in 1987 reaching $2.2 billion sales and $184 million in net profits in 1990 with a staff of about 9000 employees. It continues to operate in only one segment of the computer market, designing and selling large IBM-compatible mainframes that use 370 software and its extensions. Because of its commitment to IBM compatibility, Amdahl necessarily has to keep up with IBM's new product introductions and manufacturing capabilities. But in its operating approach Amdahl takes the customer's existing computer system as an investment to be protected whether or not it currently involves Amdahl's equipment. However, Amdahl equipment could be upgraded at the customer's site instead of removing old machines and replacing them with new ones. Other features of Amdahl Computers included the ability to partition a processor to make it function like four separate computers.

But Amdahl had secured a competitive edge in the areas of service support, both technical and educational. As measured by Datapro, in the 6 year period 1981-87 Amdahl's lowest rating in troubleshooting was the same as the best rating earned by its competitors. In customer education Amdahl's score was 9.5 vs an average of 2.8 for its four mainframe competitors. It was the 6th straight year at the top of the group. In documentation it received the best rating in five out of the six years. In its education courses more than 60% of the enrollment consisted of users of competitive products. Amdahl also provided systems

consulting services in five areas - performance analysis and capability management, data processing systems design, data centre management, network management and data base/data communication management - to help current and prospective customers develop effective responses to changing information management needs. Amdahl's mission in a nutshell was "to provide solutions which give our customers a competitive edge." IBM, on the other hand, was sometimes accused of using FUD (Fear, Uncertainty and Doubt) - tactics intended to "lock in" its customer base.

Other American Deals

In 1980 Fujitsu formed a joint venture with TRW to market its point-of-sale terminals and small computers in the U.S. market. Three years later it bought out TRW's 49% share. Through this deal Fujitsu got a ready made marketing organization in the U.S. In 1986 as the yen appreciated sharply against the dollar Fujitsu moved to take advantage of that buying power. It began making magnetic disc drives for large computers in Hillsboro, Oregon; it bought the fax division of Burroughs and it signed a pact with GTE to launch a joint venture in Tempe, Arizona aimed at the office telephone (PBX) market. Fujitsu owns 80% of Fujitsu-GTE Business systems. (GTE was essentially a telephone operating company with a position in defence and lighting products. Its 1988 revenues totalled $16.5 billion with net income of $1.2 billion.) Fujitsu also took a 30% stake in Poqet a new U.S. producer of brick shaped "hand held" PCs. These PCs

(when combined with modems and printers) were used by Frito Lay, (a highly profitable Pepsico subsidiary) to integrate the merchandise supply, invoicing and information reporting work of its 10,000 strong field sales force with headquarters management. In Canada, Fujitsu held a 25% share of Consolidated Computers, Inc which produced terminal equipment under license from the Japanese company.

Semiconductor Base

In 1984 Fujitsu considered building an integrated semiconductor facility in Gresham, Oregon but postponed the investment the following year due to the onset of a recession in the semiconductor industry. With only a small ($8 million) production base (dating from 1979) in San Diego, California, Fujitsu was handicapped especially in relation to the U.S.-Japan semiconductor trade agreement of 1986. In October that year, Fairchild Semiconductors, (one of the best known chip manufacturers which ran into financial difficulties in the 70s leading to its acquisition in 1979 by Schlumberger) began negotiations with Fujitsu over the proposed sale of 80% of its equity for $200-250 million. Although Schlumberger was French, Fairchild was generally considered an American company and did extensive semi-conductor business with the U.S. Defense Department. It had an excellent U.S. sales and distribution network which Japanese companies such as NEC were trying to duplicate. But the proposed deal generated great concern about U.S. "security" so Fujitsu withdrew its offer. In August 1987

Fujitsu revived its plan to build a full-production facility in Oregon that was commissioned in late 1988. Fujitsu had an arrangement to supply Sun Microsystems, the leader in work stations, with advanced microprocessors called SPARC which Sun had designed for use in mid-range computers since its establishment in 1982. Sun was a proponent of "open systems" consisting of computers built specifically around AT & T's UNIX operating system software.

Software Strategy

In January 1991 Fujitsu announced a collaboration agreement with aircraft maker McDonnell-Douglas' Systems Integration Co which was No.8 among U.S. software houses, with total 1989 revenues of $290 million and 2000 employees. One of its acquisitions was a U.K. Software firm, Applied Research of Cambridge. The agreement involved computer software development, technology and marketing. Fujitsu and McDonnell Douglas were also reportedly discussing broader cooperation in the future. McDonnell Douglas was the No.1 weapons supplier to the U.S. armed forces with more than 50 plants across the country generating total 1989 revenues of $14.6 billion. Its star product the Apache attack helicopter was made in a factory which had been completely reorganised in 1990 to operate on JIT lines. "Mack Dack" was critically trying to boost the sales of its commercial aircraft including the MD-11 jumbo jet. McDonnell Douglas was one of the leaders in the creation of the U.S. Malcolm Baldridge

National Quality Award and had made an extensive commitment to Total Quality Management (TQM) systems.

IBM's Response

When Fujitsu and Hitachi caught up with IBM technology in the mid-70s, IBM's dominance was seriously challenged. Hence IBM moved to direct the full force of its market power against the Japanese computer industry introducing numerous new products, shortening product life cycles, abandoning its usual practice of announcing large models before smaller versions, "unbundling" software and sharply cutting prices on medium sized mainframes. These measures sent successive shock waves through the industry. But the Japanese stayed with IBM all the way. Besides IBM itself fell victim to its strategies. This was also the time when IBM moved into the fast growing commodity-type desk-top computer (or PC) market which the VL91 chip revolution had brought into existence. In 1979 for the first time in two decades IBM's net income declined from that of the previous year and in Japan, IBM decided not to recruit new staff in fiscal 1980.

In 1978 IBM began to seek copyright protection for new releases of its operating systems software. In 1982 the US Justice Department withdrew its suit to dismember IBM due to fears of Japanese competition in computers. IBM then began legal action over Fujitsu's alleged unauthorized use of IBM copyrighted software. A preliminary settlement was reached the following year. Over the next four years Fujitsu paid IBM more than $400

million in licence fees and this resulted in a slide in Fujitsu share prices. The final settlement under the auspices of the American Arbitration Association arrived at a figure of $395.9 million as the licence fee to cover Fujitsu's use of IBM copyrighted material.

The agreement also set the terms under which future IBM software would be available for inspection by Fujitsu and vice versa. IBM's technology had become the industry standard and information about it had to be shared with other manufacturers such as Fujitsu. The latter was given the right to access some of IBM's proprietary software till January 1994 in order to maintain compatibility with IBM. All programming except that which was demonstrated to be a "fundamental and extraordinary advance" could be accessed. In 1989 Fujitsu paid fees of $25 million to $50 million depending on the extent to which it actually reviewed IBM software in a secured facility established by Fujitsu. An arbitrator kept track of what Fujitsu employees saw and calculated the value of such information. By adhering to the terms of the agreement Fujitsu ensured immunity from future copyright infringement suits by IBM.

Despite such measures (as well as the encrypting of microcode more thoroughly into the read-only memories of IBM's machines to make copying more difficult), there was a rapid rise of Japanese computer imports into the U.S. market. By 1982 Japan reached parity in bilateral computer trade with the U.S. and by 1987 it had moved into a surplus position which increased to $20

billion in 1990. By 1987 the combined sales of Japanese computer companies reached $53.7 billion (@ ¥ 138 per dollar) compared with world wide revenues of $54.2 billion for IBM. Japanese computer company sales were growing rapidly while IBM's were tending to level off. By 1989, IBM's US profitability had become nil and it was overseas operations that was sustaining corporate profitability. In 1988, Fujitsu, Hitachi and NEC together expended more than double what IBM spent on R & D with Fujitsu's own spending rate estimated at 9.5% of its sales (compared to 4-6% in most Japanese computer firms). Their investment in plant and equipment were also higher with about 20% of it going for productivity enhancing equipment such as factory automation, robotics and material handling systems. At the same time they relied more on outside suppliers for subassemblies, peripherals and the like. The Japanese were also developing "software factories" (for operating systems) using programming tools that made software development faster and more efficient.

For its part, IBM relied on re-organization to solve its problems in a way which had become characteristic of the company. It had emerged from the most recent restructuring with 8 major divisions: mainframes, minis, PCs, telecommunications, chips, programming software and services and a marketing arm which was common to all the others. IBM had 25 product Labs and three basic research centres (in New York, California and Switzerland). IBM's revenues totalled $69 billion in 1990, short of its explicitly stated long term goal of $100 billion for that year.

Fujitsu in Europe

In 1978, at the height of IBM's struggle against the PCM strategy, Fujitsu entered into an agreement with Siemens to supply mainframes on an OEM basis and to licence software. This deal was viewed as a "natural alliance" because of the historical links between Siemens and Fujitsu's parent, Fuji Electric. But when IBM took legal action against Fujitsu, Siemens stopped accepting software supplied by Fujitsu until arbitration was over.

As of 1965 Hitachi had an agreement with ICT (see below) but in 1980 Hitachi entered into OEM supply arrangements with BASF in Germany as well as Olivetti in Italy. In the following year Fujitsu's new president T.Yamamoto (who had just taken over from T.Kobayashi) signed a three year agreement with Britain's ICL covering the development and supply of Fujitsu's VP-200 mainframes on an OEM basis. At the time, a technical collaboration agreement between Fujitsu and ICL was also signed.

The aim of the Fujitsu - ICL collaboration was to produce a new British designed computer with Fujitsu's manufacturing technology. On the expiry of the three year agreement period, ICL was taken over for pound sterling [PS] 411 million in 1985 by STC, a British telecom equipment company, because of the convergence visualised between the computer and telecom industries especially as the latter was being de-regulated in the U.S. and privatised in Britain and Japan. Consequent upon the STC

takeover, the Fujitsu-ICL agreement was extended to 1991. However, as reported at the beginning of this case, Fujitsu negotiated an 80% stake in ICL with STC in July 1990. Hence the changes which occurred at ICL during the 1980s are worth a close look for clues regarding the achievement of the required compatibility in a dynamic way.

ICL Background

ICL traced its origins to BTM which was formed in the early years of the 20th century and was, along with IBM, responsible for a number of patents on which the computer industry is based. After a 1959 merger BTM became ICT and in March 1968 the company assumed its present form through an amalgamation of ICT and English Electric's computer division. At the time, ICL was 2nd to IBM on a worldwide basis and had a larger share of its home market than IBM which dominated all other overseas markets. In 1964, the British government recognised the importance of the nation's computer industry and initiated moves to assist it.

However, ICL's formation in 1968 created stresses and strains within the organization especially in the engineering and technical groups where technological traditions tended to differ. In addition to its 1900 series and the System 4 range (inherited from English Electric), ICL was responsible for maintaining fifteen other systems. The 1900 series introduced by ICT in 1964 was a highly developed architecture with "upwards" and "forwards" compatibility similar to IBM's 360 series. Though the System 4

was not nearly as popular as the 1900 it was software- compatible with IBM's 360 series and had a real-time communications capability. Because it was extremely expensive to support two main systems, ICL decided to replace both these ranges with a new series which appeared in 1974 as the 2900 series.

During 1976 further developments occurred with the take over of Singer Business Machines bringing with it System Ten (smaller than any existing ICL computer), the 1500 series of terminals and the Point of Sale (POS) terminal. This take over also took ICL into markets in which it had not previously been involved e.g. Italy, Spain, Norway, Finland and also added 2500 customers to ICL's customer base of 5000.

The UK market accounted for about half of ICL's business, the rest being split between Europe, Australia, South Africa and the USA. Australia and South Africa had quite strong ICL sales subsidiaries. But ICL's position in continental Europe and the U.S.A. was marginal with market shares in France, Germany and the U.S. hovering around just one or two percentage points. In traditional Commonwealth markets especially India, ICL was stronger. It also had a strong position in Eastern Europe where its share of imports into Comecon was 35-40% compared with IBM's 25%.

In the U.K. ICL gradually concentrated on specific segments such as central and local governments, financial institutions, retailing and distribution and manufacturing. This approach led

to the recruitment of industry specialists and to the improved training of its salesmen in techniques and market requirements. A critical aspect of ICL's position was that the UK government, through its explicit preferential purchase policies, relied on ICL for its own computers. Thus ICL computers supported the operations of some 20 government departments. Thus the UK public sector accounted for 30% of ICL sales.

By the end of 1979, however, ICL's competitive position in world markets suffered severe erosion due to a global recession, and high inflation in the UK and an over-valued pound sterling. In November 1980, 2500 persons were laid off and ICL's Winsford plant was closed. But ICL was investing heavily in a computerized system of storage and handling the thousand parts which went into its computers. Finally, in March 1981 Margaret Thatcher's government stepped in with guarantees of up to PS 200 million to enable ICL's bankers to increase their lending to the company which lost PS 50 million that year. According to the terms of the guarantee the government had the right to appoint three directors. In May 1981 Mr.C.Laidlaw was appointed Chairman and Robb Wilmot was appointed Managing Director. A non-executive director was also appointed. Wilmot, an electronics engineer was 36 years of age at the time and had been heading Texas Instruments' (TI's) UK pocket calculator subsidiary since 1978. From TI (UK), Peter Bonfield was recruited as ICL's Marketing Director. He had also worked in TI (US).

Wilmot had observed on joining ICL:

> The whole question of how to create an industrial strategy is still an open national issue in the U.K...The (computer) industry is intensely competitive and any government that puts its national industry at a disadvantage in the real world of today is clearly taking great risks. The rate of change is so high that it is extremely difficult to catch up once you get left behind. Above all, therefore, a long term industrial strategy is a vital ingredient in international success.

Wilmot's Moves

Wilmot identified the primary task of ICL's Board and Management was to restore the company's profitability. His watchword became "profits before growth". Wilmot's first target was ICL's payroll which then stood at about 30,000 persons. A month after his appointment he announced 5200 redundancies of which 1700 came from manufacturing. He also made many staff cuts at the senior level. Wilmot's style at the time was characterised as "shoot first, talk later". Following the large scale retrenchment to nearly 50% of the original position, ICL's profitability was restored very soon and Wilmot stepped back from operational decision-making to develop a strategic vision for ICL.

Wilmot's strategy was based on the concept of "information technology dependent on distributed computing and the convergence of communications with information processing systems." This crystallized into the concept of a "Networked Product Line" (NPL) in which the products ICL offered would be increasingly capable of communicating both with each other and with equipment from

other suppliers. Hitherto the complexity of networking between proprietary systems had prevented many organizations from enjoying the full benefits of the computer equipment at their disposal.

Networking encompassed the integration of whole product ranges based upon advanced systems architecture developments. IBM first launched its Systems Network Architecture (SNA) in 1974. ICL had followed with Information Processing Architecture (IPA) in 1980. Central to Wilmot's strategy was to aim at the large IBM market with the ability to "talk" to IBM mainframes, to supply plug-compatible processors and to "encircle IBM" with ICL peripherals. In order to effectuate the strategy, Wilmot trimmed the diversity of ICL's inhouse products by dropping some machines and software. At the same time he increased the diversity of the range by entering into numerous collaborations. These included one involving a scientific and graphics workstation and another for a digital PABX. In October 1981, ICL announced that agreement had been reached with Fujitsu to obtain its CMOS chips for a new mainframe designed by ICL and launched in 1985 as the Series 39.

In January 1983, ICL management testified in the House of Commons that ICL would not limit itself to an IBM-plug compatible strategy because this was not considered viable in the long-run. "Our policy is to maintain such a degree of compatibility with IBM products as will permit reasonable ease of communication with

or conversion from IBM systems while preserving the desired freedom of choice necessary if we are to continue to compete successfully with IBM on the direct merits of our (own) systems and support activities." Within these parameters, ICL saw itself as a "total systems company" that aimed to meet all the data processing needs of customers including via highest service standards in maintaining, upgrading and improving customer computer equipment and systems.

Initially ICL policy was to compete against IBM mainframes with Fujitsu's machines and to sell plug compatible peripherals using links relying on a very low level of SNA in IPA. But soon it became evident that SNA was more important than ICL's own IPA. The SNA link was developed much further into the heart of an IBM site and allowed systems up to the size of the ME29 (ICL's smallest mainframe) to become nodes in an IBM network.

From 1981 onwards the aim of ICL was to achieve a measure of "focus" in order to improve ICL's responsiveness to the market. Wilmot emphasized the need for faster reactions at ICL and the stressed that the company had to shorten drastically the time needed to develop products and launch them in the market. He emphasized both the development of products with inherent reliability as well as the need for taking innovative risks in product development.

Organizationally this involved:

1. the establishment of a new product marketing division

2. the creation of a strong team to develop standard applications software

3. the creation of separate development divisions for distributed systems, mainframes and network systems

4. the revamping of logistics to reduce worldwide inventory levels.

But somehow ICL was slow in moving into the rapidly growing PC business.

Changes in Marketing

Beginning with "Retail" in 1983, five industry specific groupings were formed at ICL for marketing purposes. 150 specialists from 9 different locations were brought together with the goal of helping the retailer market improve its efficiency using ICL's minicomputer products. "Retail" was narrowed further to supermarkets. In 3 years, ICL was able to obtain a 50% share (and clear market leadership) in electronic POS systems, overtaking IBM and NCR. Retail accounted for nearly 60% of total ICL sales and was divided between UK (35%), Europe (20%) and North America, Asia and Pacific (45%). The group's approach was to work back from the retail stores through warehousing and distribution into the central trading departments of supplying firms. Orders for systems integration had been obtained from Marks and Spencer, Sainsbury and Burton (of the UK) Euromarche (France) and Woolworths (Australia).

The other four groups, formed were manufacturing, financial services (other than banking), public administration (all set up

in 1984) and defence (set up in 1985). The five groups are jointly called "Industrial Systems". The manufacturing group was based in Dusseldorf, Germany. Reflecting its centrality in ICL, Industrial Systems accounted for as much as 50% of ICL's R & D funds allocation with the rest going into mainframes, office and distribution systems.

Change in Top Management

After four years as ICL's Chief Executive, Robb Wilmot left in 1985 to intensively pursue his entrepreneurial interests. He explained that he believed in the 80/20 rule of management according to which only 20% of time is spent on high value added activity while 80% is spent on relatively low value added activity. This led him to leave corporate life to found five new companies "with the intent of spending the right 20% with each of them."

Among his other views on managment was the following:

> I believe...that management by recipe is a dead end... If you follow a recipe your actions are predictable and aggressive competitors with strategic intent can topple you just as in judo. You become transparent to your enemy.

In 1985, ICL was acquired for PS 411 million by Britain's telecom equipment company STC and Wilmot's position as MD was taken by Peter Bonfield (47) who has been credited with "putting ICL together as a cultural entity." Bonfield soon became Chairman of ICL. Fujitsu extended the agreement with ICL for a further period ending 1991.

Manufacturing Changes

Traditionally, ICL tended to excel in computer design but not marketing or even manufacturing. The latter was in fact, a problem area with industrial disputes occurring regularly in its Ashton Plant (which opened in 1979), customers complaining frequently of late deliveries and products with serious defects at times. ICL's multiple merger history had brought with it significant involvement in trade unions. Relationships with the unions were never acrimonious though pay/performance matters always proved contentious.

During the 1980s, ICL had converted its manufacturing facilities into a competitive weapon. ICL succeeded in building quality products. And by using its own computer systems in manufacturing, ICL made its facilities a marketing tool rather than just a modern operation. By 1986 ICL had 3 plants. Besides Ashton, there were plants at Kidsgrove (for PCBs) and Letchworth (for volume products). At Stevenage there was an ICL warehouse where hardware was integrated with the correct software.

The plant at Ashton produced Series 39 mainframes, System 25 mini computers and video display units (VDUs) at the annual rate of 1100, 15,000 and 60000 respectively. The plant worked one shift with 630 employees (350 less than in 1981). Although computers were produced in the thousands each year, over 900 separate configurations were involved making the plant a low volume/high-complexity operation. The products, moreover, were

being constantly updated as technology improved. ICL could deliver mainframe computers three weeks after order (more than twice as fast as IBM and nearly 6 times faster than others). Previously ICL's lead times were over 10 weeks.

In 1985 an FMS line called Mercury was set up at a cost of PS 2 million. It was 70 metres long with assembly operations on one side and test operations on the other. It was built around a moving computer controlled crane which fed components to assembly stations and moved completed cabinets to test cells. Assembly itself was not automated. The time taken to test a mainframe fully had been reduced drastically from 3 months to a 5 day automated test on a knowledge-based diagnostic system dubbed "plug and play." It tested whether a machine ran perfectly the first time it was switched on. Mercury was suitable for building any metre cube "box" - whether computer, TV or photocopier. The line was thus flexible enough to produce both Series 39 and System 25 products. The Series 39 was produced in two models - level 80 and level 30. The latter (smaller mainframe) was produced in much larger volumes than previous mainframes. The "cube" at the core of Series 39 was shipped by Fujitsu from Japan. It cost around PS 100,000 each and included ICL technology.

In 1987 the success of the Mercury line led to a further investment of PS 2 million in a second FMS line called Apollo with about 40 stations. This line employed 5 AGVs which handle

boxes with base of upto 1/2 metre squared. Apollo functioned as a feeder cell to Mercury. In 1989 ICL planned to complete the installation of a third PS 2.2 million line which will handle 2 metre squared boxes. The three FMS lines would then combine to form an "FMS Cascade" activated by electronic Kanban.

Ashton was linked to other ICL sites by Wide Area Network (WAN) and had some Electronic Data Interchange (EDI) connections to outside suppliers. In 1979 Ashton made products whose material content was 40% and the value added was 60%. By 1986 materials accounted for 90% with the shift to flow line processes and labour content was just 10% since most of the manufacturing units had lost their machine shops. Direct labour was just 1% of revenues. Over the organisation as a whole materials constituted 80% of manufacturing costs. About 40% of materials originated from overseas (Japan and USA).

According to the Director of Manufacturing, "We have some simple numbers. We want a 10% reduction in total product cost every year, a 15% increase in productivity, 100% delivery reliability without relaxing lead times, constant inventory while we double turnover and quality equal to or better than competitors." With manufacturing propelled by the forces of cost reduction, material movement and flexibility, ICL was able to concentrate even more effectively on product design, one of its key capabilities. "We are starting to get into collaborations with the designers earlier and earlier. New product development is the biggest thing for us to tackle in future." As lead times

were shortened ICL's ability to respond to market changes increased even more..

Organisation and Management

Robb Wilmot's legacy to ICL was its mission. A market led enterprise, ICL focused on specific market segments. It aimed to be a major European supplier of information technology seeking a reputation for high quality systems integration work. Formally, ICL's mission was "to be an international company dedicated to applying information technology to provide high value customer solutions for improved operational and management effectiveness." ICL's key strategies were a) a commitment to open (i.e. interchangeable) systems which provided customers with greater flexibility in choice and b) collaborations to gain market or technological footholds.

The main contribution of Peter L.Bonfield and his new team was to develop an organizational structure to match the mission and strategies. The process, an agonizing, cultural transformation, involved re-orienting every single aspect of the organization to the market requirements represented by the industrial systems, group. It was a process which adapted ICL to continuously changing market demands. The aim was to get ICL to welcome change and to initiate it rather than merely to respond to change.

An important part of this effort was an 18 month program of management education and training which set a European record for

intensity, thoroughness - and cost. In an article co-authored by him, STC's personnel director later wrote:

> In ICL there was no doubt about the extent of top management vision and determination. Never in the history of the company had the board not only backed such a training program but actually attended themselves. Nor had any training program been made mandatory for all managers..... These programs were set up to support the strategies. They did so successfully and became a major plank in our management development portfolio.

One of the main features of ICL's personnel policy was the targeting of 40 years as the age for top level appointments for its high flyers. ICL's (experienced) board averaged 44 years. A slower stream peaked at 45 years. The main appraisal milestones were 2 to 3 years after joining ICL and 8 to 10 years after being with the company. ICL planned for an 80:20 ratio of internal promotees to external recruits.

ICL's organizational chart had two special features. One was a group called "marketing and technical strategy." This unit was involved in collecting market and competitive intelligence, tracking the changing ratios of software to hardware, setting prices and entry strategies etc. It also evaluated decisions regarding technologies ICL should acquire and which to spin off. The decisions were based on whether a technology was central to ICL's mission or not.

The other special unit was the collaborations office which had been formed to support ICL's strategy. ICL entered into

several alliances mostly with American companies at the same time as it tied up with Fujitsu. Managing alliances posed special problems which needed full time attention. A key concern was to strike a careful balance between too much and too little trust. The alliance with Fujitsu was by far the most successful one as far as ICL was concerned. Fujitsu too had a single office, "the collaboration section" to which all its partners went to request information and assistance from different divisions.

By 1987, after concentrating first on ICL's survival and then consolidation, Chairman Bonfield visualized that ICL was moving into the growth phase of the recovery. He declared: "We have to show five years of superlative returns on capital while reaching the goal of PS2 billion turnover in 1991. We're pursuing a strategy - and we feel pretty good about that. We set out to rebuild a culture and an orgagnization. The pilot trial works and we've proved that focus gives benefits to both supplier and customer. We know how to run a company of this type. Its beginning to give repeatable results. The upside is all to come."

Search for a Partner

By 1990 ICL with PS 1.4 billion in revenues and 21,000 employees became the major part of STC group accounting for 60% of group turnover. ICL operated in 70 countries and 40% of revenues originated overseas. Between 1985 and 1987 ICL contributed about PS 100 million a year in profits to STC. In

1984 profits were only PS 32 million. In 1989 ICL's profits rose to PS 148 million. But STC stumbled and could not finance ICL's growing need for R & D investment. So since 1987, STC searched for a European partner for ICL. Extensive talks were held with Olivetti. Other exploratory talks took place with Philips and with Nixdorf (which had been one of the original investors in Amdahl, along with Fujitsu). Discussions were held with Fujitsu itself, Bull, NCR, Siemens, DEC and Nokia Data. But only Fujitsu made an offer. Some felt that its offer was the only one STC was likely to get. Most of the European computer companies were in trouble and were unable to put up the cash which Fujitsu had.

Siemens which had a very strong cash position was known to have discussed cooperation and/or merger with ICL at least 5 times since 1980 but when it linked up with a British company it was with GEC to take over the Plessey electronics group in 1990 and enter the UK telecom market. Subsequently Siemens took a 51% stake in Nixdorf in 1990 since the latter a German company, was in financial difficulty.

ICL's well established reliance on Fujitsu's chips fuelled rumours that Fujitsu had used the supply weapon to veto any agreement with other partners. But Fujitsu's Yamamoto denied that any "strong arm tactics" were involved. "This was just a normal business deal," he said. Agreement between Fujitsu and STC over the ICL purchase was reached in July 1990 and the deal was signed in November 1990. Peter Bonfield continued as Chairman of the Board on which Fujitsu's representation

increased. But Fujitsu announced that eventually it intended to make ICL a board managed company placing 25% of the shares in public hands while diluting its holding from 80% to 65% with a corresponding reduction in STC's share from 20% to 10% in a few years.

European Computer Scene

On Feb.6, 1989 the EC adopted tougher rules of origin on semiconductors in an attempt not only to shield European chip makers from foreign competition but also to force foreign companies to do more advanced chip making in Europe. For chips to be treated as EC products the expensive process of diffusion (whereby raw silicon wafers are converted into chips) had to take place in the EC.

NEC was the only Japanese company with full European chip production based in U.K. In April 1989 Fujitsu began construction of a $680 million semiconductor plant to be commissioned in the U.K. by late 1991. It also began setting up an R & D centre in Britain for semiconductors used in telecommunications. In Europe, ICL was a vigorous supporter of the Open Systems Interface (OSI) protocol in competition with IBM's SNA.

The European computer industry was in difficulty in 1990. Olivetti had slumped through 4 straight years of falling profits laying off 7000 workers in the process. Groupe Bull had laid off

5000 workers. Its operating losses reached $1.2 billion in 1990 and two more years of red ink were anticipated. The diversified company Philips suffered an even greater loss of $2.5 billion and was cutting back on research. SGS-Thomson, a chipmaker, went into the red in 1990 and was looking for a partner. A proposed deal with Siemens did not materialise because of German opposition. Siemens' own chip unit lost more than $100 million in 1990. Reportedly, Siemens had teamed up with IBM to develop the 64 Megabit DRAM chip. It acquired Nixdorf, which was German, to form Siemens Nixdorf Information systeme (SNI), the largest indigenous European computer company with revenues of about $8 billion.

SNI planned to introduce a proprietary 170 MIPS mainframe in 1991 to counter IBM's new S3900 family. In the mid range, SNI intended to create an applications programming interface in UNIX for customer information control systems, on line transaction processing and reduced instruction set computing processors by 1992. At the low end SNI began re-selling laptop PCs made by Matsushita Electric Industrial Co.

Siemens, however, seemed to have its sights set on leading the telecom equipment market buying out IBM's stake in most of Rolm. Telecom revenues of $7.5 billion in 1989 put it in third place worldwide. One third of its profits came from the telecom side of its business. It also set up joint ventures in telecom semiconductors with AMD, in computer systems with Intel and in

factory automation with Westinghouse. It acquired a majority interest in Allied Signals, an automotive electronics group.

Sixty percent of the European computer market was controlled by 10 large U.S. firms (35% by IBM alone which even enjoyed access to EC sponsored computer research programs). Germany, France and UK accounted for about 28% while the remaining 12% was shared by Olivetti, Philips, Ericsson, etc. But in the UK mainframe market Fujitsu had a 42% share comprising Amdahl's 15% and ICL's 27%. In comparison IBM's share of the UK mainframe market was 36%.

Other Realms & Roads

Indian Computer Scene

The Indian computer industry (hardware & software) was of the order of $1 billion (Rs.17,000 million) in size. Although small by international standards (no Indian computer company figured in the world's top one hundred) it had experienced very rapid growth averaging 50% p.a. since 1985. However, price trends mirrored those in international markets, declining to one tenth of those prevailing a decade ago. Price levels were still several times higher than those abroad for comparable products.

Productwise, PCs accounted for 75% of industry (hardware) sales. While HCL dominated the upper (386 based) end, scores of others led by WIPRO, Sterling Computers, Essen and Zenith competed in the rest of the segment. Forty percent of PC demand

was due to first time buyers. Sales were sensitive to fiscal policy measures such as investment allowances, depreciation norms and credit availability. This made computer industry sales seasonal with 30% in the 3rd quarter and 40% in the 4th quarter.

Large systems including mainframes, minis and superminis accounted for 10% of industry sales. The leaders in mainframes were, ICIM (ICL's subsidiary), ECIL (a public sector firm which produced CDC computers) and PSI Data System (a subsidiary of Bull). This segment had seen the entry of Hewlett Packard (in collaboration with HCL) and DEC. Demand for mainframes was sluggish. Their high cost required detailed assessments which typically took 9 months to a year. Mainframe sales were also affected by the growth of minicomputers. Demand for UNIX based systems were relatively impervious to change in the short term.

Peripherals accounted for 15% of the market. These consisted of monitors, keyboards printers and power supply systems. Japanese products were acknowledged to dominate the peripherals segment.

For the industry as a whole, reliance on imports was estimated at about 50% though in some specific categories such as mainframes it was close to 100% of the capital goods, testing and measuring equipment tools and moulds, 85% were estimated to be imported though "country of origin" was obscure. The Indian electronics industry was characterized by the requirement of a large number of different circuits in small quantities.

The Bureau of Industrial Costs and Prices (BICP) had summarized the weaknesses of the structure of the Indian computer industry as follows:

- high import intensity
- high incidence of indirect taxes
- negligible value addition at international prices for some products
- Internationally uncompetitive prices of domestic production

IBM had exited India in 1978 because it did not agree to the government's requirement of reducing the level of ownership from 100% to 40% because it would set a precedent that would affect its other affiliates. Till the early 70s its 1401s had dominated the Indian market. These machines were refurbished at its Bombay factory having been imported against the proceeds of key punch equipment exported from the plant. These activities clashed with the government's policy of encouraging the development of the latest computer technology in India. Currently, IBM was keen on re-entering the Indian market offering to produce a million PCs for export to the Soviet Union. Imports of IBM equipment continued to remain substantial.

ICL in India: ICIM

After IBM's departure, ICIM, a 40% ICL company with headquarters in Bombay and a modern factory in Pune, was the No.1 computer firm in India till fiscal 1987. (Burroughs which entered India in the late 70s, concentrated on software exports).

Then suddenly, in the wake of market shifts toward PCs and some instability in top management policies as well as adverse ratings of its mainframe for the banking industry by CMC (whose chief executive was an ex-ICL manager) it slipped to number four. ICIM experienced low sales, rising debts and piling up of stocks all of which affected cash flow. In 1988, ICL went in for an alliance with the RP Goenka (RPG) group which took a 10% stake in ICIM. RPG appointed one of their "loyalists", Sumantra Banerjee aged 40, (who had no computer industry experience but who had helped the group with its Dunlop and other interests) as Chief Executive. Currently (since July 1990) ICIM is headed by Ashok Jain, formerly the marketing chief of HCL, India's No.1 computer company today with sales of Rs.176 crores (nearly US $100 million).

During 1989 ICIM shifted its emphasis from solely relying on mainframes (such as the Series 39) to a "total solutions" strategy. It launched a plethora of products especially in the PC range and in telecom equipment (the mainstay of ICL's parent, STC). Its crucial advantage lay in offering direct connectivity between all models. It did not phase out mainframes by any means. Instead Series 39 sales increased from a mere 2 in the previous year to 10 in FY 1990. Besides 5 were exported (mainly to Russia). These sales accounted for Rs.23 crores of revenues (out of a total for 1990 of Rs.63 crores). It also added two upgraded S-39 models. PC sales were of the order of 6000 per

annum. Currently it was looking for a replacement for its 101 mini and also considering entry into the growing CAD/CAM market.

During 1989, ICIM had invested Rs.1 crore in testing equipment and surface mount technology at its modern Pune factory where 300 persons were employed in manufacturing and development. ICIM's total staff strength was 920. Capacity utilization was 70% at present. Its main sales territory was the Western Region followed by Southern Region. These accounted for 34% and 28% of sales respectively. ICIM's main competitors in mainframes were ECIL and PSI. In late 1990, ICIM was installing one of the largest integrated systems in India at IIT, Delhi with whom ICL had a relationship spanning two decades. The system was intended to be a showcase for ICL and ICIM products and services.

ICIM had 3 ICL directors on its board including ICL's director of manufacturing, ICL's President of International Trade and International Trade's Director of Finance. Mr.Paul Whitman, ICL's President of International Trade who had been with ICL for 20 years said to Dataquest(India): "We liked RPG enormously". ICIM managers also believed that "RPG was the best thing that happened to ICIM". But in the wake of press reports about Fujitsu's takeover of ICL, and in the face of uncertainities regarding Fujitsu's role in ICIM, RPG had reportedly bought up more shares in ICIM leading to a spurt in ICIM share prices. Later, in the aftermath of the Gulf crisis and its severe impact on India's balance of payments "electronics" had almost become a bad word because of the industry's import intensity.

Sterling Computers

This Madras based company made a dramatic entry in 1985. It was headed by C.Sivasankaran (35), a flamboyant figure who brought price wars to the Indian PC industry. It earned revenues of Rs.60 crores in 1989-90 and profits of Rs.5 crores from the sale of 8000 PCs. Sales of 13000 PCs were expected in the current year with total revenues not much more than the previous year's figure due to price cutting. Price and delivery were the cornerstones of the company's strategy and "Siva" has been strengthening its production process accordingly. The company employed 300 persons with 30 in market support, none in direct sales. Its entire sales were to OEMs and dealers. Reportedly, the company had tied up with Fujitsu in 1991 to introduce peripherals such as a printer and a keyboard to the Indian market. Plans for a Fujitsu workstation were also being mentioned. Sterling computers had opened an office in San Francisco.

Foundations for the Future

Chip making is considered one of the most complex manufacturing processes of all time. In chips, the 64 Megabit DRAM whose prototype was unveiled in mid-1990 by Hitachi represented the state-of-the-art. As stated earlier Fujitsu was engaged in building a full scale facility for this chip, samples of which were due in 1994. The 64 Megabit memory chip had circuit lines of 0.25 microns (millionths of a metre). For such fine linewidths, a new light source was required, the choice

being between X-rays and deep ultra violet. Besides, the number of process steps required in chip making had increased from 230 in 1985 to 550 today, the variety of equipment involved being 20% greater. Clean room requirements had also become more stringent. Instead of a maximum 30 particles of 0.3 micron size in a cubic metre of space, the new requirement was for no more than 5 particles (i.e. bacteria) of 0.1 microns each. So-called "cluster equipment" was being developed in which several processes were integrated in controlled-vacuum units. The silicon wafers moved by means of magnetic levitation between processes in vacuum conduits. The new semiconductors required innvations in packaging, testing and interconnection also.

As an IBM executive had noted: "More and more of a computer's function is migrating to the silicon chip." So the competitiveness of computer products increasingly depended on the speed with which new chip technologies were incorporated into computers. The gap, at present, was of the order of 2 or 3 years and was likely to remain at this level.

Currently there was a mismatch between the realisation of increases in speed of memory chips and increases in the speed with which instructions were executed. The former had averaged only 7% p.a. while the latter had averaged 30% p.a. over the 80s. Prospects were for annual doubling of computer speeds in the 90s using technologies such as Reduced Instruction Set Computing (RISC) in which Sun Microsystems was one of the leaders.

In applications where speed was important a semiconductor material called Gallium arsenide (Ga As) was promising. Ga As had higher carrier mobilities and provided a five to ten fold increase in speed. Fujitsu aimed to be a world leader in mainframes using Ga As chips. However, Ga As suffered from difficulties in processing the materials. As a result, silicon was more suitable for memory chips where feature sizes were critical. IBM conceded that Ga As would be valuable in communications and display devices but discounted its potential in computers.

The potentially shortest switching speeds (of 1 picosecond) were achieved using Josephson Junctions (JJs). These consisted of lead alloys separated by a gap of 50 Angstroms which when supercooled to liquid helium temperatures exhibited semiconductor properties. IBM Corp had abandoned 14 years of work on JJs in 1983 but the Japanese had pressed on. In 1986, scientists at IBM's Swiss research centre discovered that superconductors could be operated at the higher temperatures of liquid nitrogen. They soon won the Nobel Prize for physics for this discovery. This gave a fillip to further work on JJs. The search was on to discover superconductors at room temperature. In the meantime Fujitsu had developed devices called High Electron Mobility Transistors (HEMTs) which were many times faster than Ga As and nearly as fast as JJs. HEMTs were commercialized by Fujitsu in the early to mid 1980s but it was only in 1988 that Fujitsu could deliver its HEMT for actual use in supercomputers which until

then had employed slower silicon bipolar devices (SBDs). Fujitsu considered that HEMTs would be the most suitable devices for supercomputers.

Fujitsu's work on advanced semiconductors (large memories, high speed switching) was linked to its development of supercomputers. This was a market which IBM had stayed out of since the 1960s. But the Japanese introduced their first supercomputers in 1983 to compete with those of Cray and CDC. The supercomputer market was of the order of $2 billion worldwide; it was politically a "super sensitive" one. NEC, Fujitsu and Hitachi were ahead of Cray in packing MIPs into single processors (which were more versatile) but Cray was far ahead in multi-processor machines (whose performance depended on the applications assigned). Cray had also developed a library of 500 programs which could be run on its machines while Fujitsu offered 300. The Japanese were employing American software houses to develop programs. Cray was disadvantaged by its lack of a semiconductor manufacturing capability. Worldwide, the Japanese had about one third of the supercomputer installations, most of them in Japan where they were in use in industry. Cray dominated the top end comprising installations in Japanese universities and public agencies who emphasised high performance. But overall, Fujitsu accounted for 50-60% of the installed base of more than 110 supercomputers in Japan. Significantly, IBM Corp had recently provided financial backing to Steve Chen when he left Cray to design his own supercomputer.

Although Fujitsu's PCM strategy rendered heavy investment in software development and international distribution unnecessary it did make the company vulnerable to IBM's strategic moves. Besides, it was not enough to know just the hardware side (since software was taken as given). Hence Japanese computer firms decided to develop a capability in software that was unrelated to the von Neumann architecture to which IBM was wedded. Japanese computer companies wanted to effect a shift from an "IBM computer culture, to redefine the rules of the game." Hence they participated in a government sponsored research project on Artificial Intelligence (AI) which emphasized knowledge processing rather than numerical processing. The research was conducted at a centre called ICOT (formally, the Institute for New Generation Computer Technology) which integrated the expertise of eight leading computer firms, a few government research labs and several universities. The 5th Generation project covered the period 1982-1991. it served to upgrade knowledge of logic programming - and computer science - in Japan to American levels. It also helped to develop an organizational mechanism for integrating multi cultural research (since the firms involved represented different organizational cultures even though they were all Japanese). Among the fruits of AI work at Fujitsu, which began in 1978, were machine translation systems, parallel inference machines, expert systems, knowledge based design systems etc. One of the products consisted of intelligent software development support systems aimed at efficient software

development, using automatic and semiautomatic methods. This was critical to Fujitsu in developing up-to-date operating systems software to run on its hardware products.

Insights Gained & Directions Discerned

We conclude by providing a sampling of some of the lessons learned fron the study. The development of an integrated analytical framework to explain the dynamics of global management is, however, left to future studies.

1. The concept of a firm's focal faculties (FFs) is the starting point for global management. These FFs refer to the things the firm does best on a long term basis. Fujitsu's specialisation ratio (95% in telecomputers) and IBM's at 90% have been sustained over decades.

2. FFs are represented by its prime products (PPs) (or services based on proprietory processes). These (e.g. silicon chips) are incorporated into a variety of final products (such as computers). It is also necessary to develop alternates to prime products (APPs), such as GaAs chips in Fujitsu's case, as well as Break through prime products (BPPs) which in the semiconductor field consist of flat panel displays that have integrated circuits printed directly on the glass surface. APPs and BPPs provide the impetus for future growth in FFs.

3. A global company seeks FF formation in overseas firms with which it establishes cooperation agreements. The FF formation process is facilitated by comprehensive and contemporary industrial management reforms (IMRs) undertaken by the cooperating firm (e.g. ICL). Over time the long term relationship so established is cemented by equity investment whose level may subsequently be adjusted downward to a "spin off" mode.

4. To further enhance FF formation in cooperating firms, the global company develops and manages multi-cultural research centres (e.g. at Amdahl in the early 70s) in which advanced technological work is undertaken jointly and then diffused by participating members to their units.

5. To provide an essential measure of long term environmental purchase the global firm coordinates its overseas moves with key competitors in the domestic industry. Coordinated competition lies somewhere between (and is thus different from) involuntary imitation and fraudulent collusion.

6. A post-industrial management era is envisaged in which nations will develop a global network of strategic entities in order to continuously augment the domestic resource base. Though spearheaded by the corporate sector, such networks will be coordinated with governments (local as well as foreign) and will blend the best management modes available anywhere. The host country's best antidote to the adverse

effects of such cross-border moves is to quickly upgrade management education to post-industrial levels at the international plane.

Bibliography

Agmon, T. and C.R.Hekman (eds.)(1989) Trade Policy and Corporate Business Decision, New York: Oxford University Press.

Anonymous, (ca 1980) "Amdahl Corp. vs IBM," (Photocopy from private collection).

Anonymous, (1990) "Top Twenty: ICIM", Dataquest, July, p.76.

Bhagnari,S. (1990). "ICIM: Turning Around a Giant" Dataquest, February, p.114-119.

Beattie, D.F. and F.M.K. Tampoe (1990), "Human Resource Planning for ICL", Long Range Planning, 23, 1, February, p.17-28.

Borrus, M.G. (1988). Competing for Control, Cambridge, MA: Ballinger Publishing Co.

Breheny, M.J. and R.W. McQuaid (eds)(1987). The Development of High Technology Industries, London: Croom Helm.

Caulkin, S. (1985), "Fujitsu Sights its Future", Management Today, December, p.62.

_____, (1987), "ICL's Lazarus Act", Management Today, January, p.56.

Dertouzos, M.L. et al (1988) Made in America, Cambridge, MA: MIT Press.

Evans, P. et al (eds) (1989). Human Resources Management in International Firms, London, Macmillan.

Ferguson A. (1989), "Britain's Best Factories", Management Today, November, p.68-96.

Ferguson C.H. (1990), "Computers and the Coming of the U.S. Keiretsu", Harvard Business Review, July-August, p.55-70.

Finkelstein, J. (ed) (1989). Windows on a New World. New York: Greenwood Press.

Flamm, K. (1988). Creating the Computer, Washington D.C.: Brookings Institution.

Fransman, M. (1990). Market and Beyond Cambridge: Cambridge University Press.

Gregory, G. (1985). Japanese Electronics Technology, Chichester: John Wiley.

Grieco, J.M. (1984). Between Dependency and Autonomy, Berkeley: University of California Press.

Grove, A. (1990). "The Future of the Computer Industry," California Management Review, 33, 1, Fall, p.148-160.

Harman, A.J. (1971). The International Computer Industry. Cambridge, MA: Harvard University Press.

Jelinek, M and C.B.Schoonhoven (1990). Innovation Marathon, Oxford: Basil Blackwell.

Jacquemin, A. (ed) (1984). European Industry, Oxford: Clarendon Press.

Kelly, T. (1987). The British Computer Industry, London: Croom Helm.

Kenny, B. et al (1987). Cases in Business Policy, New York: Basil Blackwell.

Kotler, P. et al (1985). The New Competition, Englewood Cliffs: Prentice Hall.

Larsen, J.K. and E.M. Rogers (1984). Silicon Valley Fever, London: George Allen & Unwin.

Lawrence, A. (1988). "Inside ICL's JIT Showcase". Industrial Computing. November.

Linvill, J.G. et al (1984). The Competitive Status of the U.S. Electronics Industry. Washington, D.C.: National Academy Press.

Mahalingam, S. (1989). "Computer Industry in India: Strategies for Latecomer Entry". Economic & Political Weekly, XXIV, 42, October 21, p. 2375-2384.

Moskowitz, M. (1987). The Global Marketplace, New York: Macmillan.

Ohmae, K. (1985). Triad Power. New York, Free Press.

_____ (1990). Borderless World. London: Collins.

Okimoto, D.I. et al (eds) (1984). Competitive Edge., Stanford: Stanford University Press.

Peled, A. et al (1987). "The Next Revolution in Computers". Scientific American, 257, 4, October (Special Issue).

Sobel, R. (1986). IBM vs Japan, New York: Stein & Day.

Soma, J.T. (1976). The Computer Industry, Lexington, MA: D.C. Heath & Co.

Sweeney, M.T. (1981). "The Case for ICL", Management Today, September, p.92-98.

Turner, L. (1987). Industrial Collaboration with Japan, London: Routledge & Kegan Paul.

Vogel, E.F. (1985). Comeback, New York: Simon & Schuster.

Wilmot, R.W. (1987). "Change in Management and the Management of Change." Long Range Planning, 20,6, December, p.23-28.

Yamaguchi, N. (1989). "Letter to the Editor", Harvard Business Review, July-August, p.180.

Yoffie, D. (1987). "The Global Semiconductor Industry, 1987" (mimeo), Harvard Business School Note No.9-388-052 Rev 4/89.

Zemke, R. (1989). The Service Edge, New York: New American Library.