Student’s report

On Economics

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# Silicon Valley - what is that?

This question may have occurred to many people's minds when they came across the term Silicon Valley. What hides behind it is mostly unknown to them, although the revolutionary inventions and developments, which have been made in this «Valley», affect everyone's daily life, and it is hard to imagine our modern civilization without them. Silicon Valley is the heartland of the microelectronics industry that is based on semiconductors.

Geographically, it is the northern part of the Santa Clara County, an area stretching from the south end of the San Francisco Bay Area to San Jose, limited by the Santa Cruz Mountains in the west and the northern part of the Diablo Range in the east. It covers a thirty- by ten-mile strip extending from Menlo Park and Palo Alto, through Los Altos, Mountain View, Sunnyvale, Cupertino and Santa Clara, down to San Jose.)

The name Silicon Valley was coined in 1971 by Don C. Hoefler, editor of the Microelectronics News, when he used this term in his magazine as the title for a series of articles about the semiconductor industry in Santa Clara County. "Silicon" was chosen because it is the material from which semiconductor chips are made, which is "the fundamental product of the local high-technology industries.")

Silicon Valley saw the "development of the integrated circuit, the microprocessor, the personal computer and the video game") and has spawned a lot of high-tech products such as pocket calculators, cordless telephones, lasers or digital watches.

Looking at our high-tech society in which the PC has become indispensable - both in business and at home, replacing the good old typewriter by word processing - the crucial role of Silicon Valley as the birthplace of the microelectronics and then the PC revolution becomes even more evident.

Silicon Valley is also seen as a place where many entrepreneurs backed by venture capital have made the American Dream come true as "Overnight Millionaires."

This makes Silicon Valley a philosophy saying that everything which seems impossible is feasible and that improvements in our society can take place daily, as Thomas McEnery, the mayor of San Jose, the capital of the Santa Clara County, puts it.)

Thomas Mahon calls it the "economic and cultural frontier where successful entrepreneurship and venture capitalism, innovative work rules and open management styles provide the background" for the perhaps "most profound [...] inquiry ever into the nature o f intelligence" which might, together with "bioengineering and 'artificially intelligent' software, [...] affect our very evolution.")

On the following pages I would like to convey the image of Silicon Valley as the nucleus of modern computing, presenting the most important events, which comprise the developments of the three major companies Hewlett-Packard, Intel and Apple.

# Stanford University

The story of the Silicon Valley starts with Stanford University in Palo Alto, which has been of fundamental importance in the rise of the electronics industry in Santa Clara County.

In the 19th century, Spanish settlers, who have been the first white visitors to California, founded civilian communities and gave them Spanish names such as San Francisco, Santa Clara or San Jose. They liked the Mediterranean climate in the Santa Clara Valley, which was very hospitable. This area came to be used by farmers and ranchers cultivating orchards, for it provided "some of the world's finest farming soil.")

In 1887, Leland Stanford, a wealthy railroad magnate who owned a large part of the Pacific Railroad, decided to dedicate a university to his son's memory who had died due to a severe disease shortly before he intended to go to a university.

Leland Stanford and his wife built Leland Stanford Jr. University on 8,800 acres of farmland in Palo Alto and also donated 20 million dollars to it. The university opened in 1891 and "would in time become one of the world's great academic institutions.")

In 1912, Lee De Forest, who had invented the first vacuum tube, the three-electrode audion, discovered the amplifying effect of his audion while working in a Federal Telegraph laboratory in Palo Alto. This was the beginning of the Electronics Age, and "amateur radio became an obsession") at Stanford University.

Frederick Terman, who was the progenitor of the initial Silicon Valley boom, changed the state of this university fundamentally. Today he is also known as the "godfather of Silicon Valley.") Terman was born in 1900, and as the son of a Stanford professor (who developed the Stanford-Binet IQ tests) he had grown up on the campus. After his graduation from Stanford University he decided to go East to the Massachusetts Institute of Technology (MIT), which was the leading university in technology then. He studied under Vannevar Bush, who was one of America's leading scientists, and was offered a teaching position at MIT after receiving his doctorate in 1924.

He returned to Palo Alto to visit his family before he intended to start at MIT, but he was caught by a severe case of tuberculosis, which forced him to spend one year in bed. This made him finally to decide to stay in Palo Alto and teach at Stanford University because of the better climate in California.)

Terman became head of the department of engineering by 1937 and established a stronger cooperation between Stanford and the surrounding electronics industry to stop the brain drain caused by many students who went to the East after graduation, as they did not find a job in California then.)

The Varian brothers are an example of such cooperation between university and industry. After graduation they founded a company upon a product they had developed at the Stanford laboratories. Their company, Varian Associates, was settled 25 miles from the university and specialized on radar technology.

After World War II, the Stanford Research Institute (SRI) was founded. Its aim was to provide the industry with more skilled students and to increase the number of companies in Santa Clara County.

Terman wanted companies to settle next to the university. In 1951, he founded the first high-technology industrial park, the Stanford Research Park, "where business, academic and government interests could come together in a synergistic vision of the future.") Portions of this land would be leased to companies, because the "original Stanford family land gift forbade the sale of any of its 8,800 acres.") These companies were offered close contacts to the SRI and could lease land for 99 years at a fixed price, which they had to pay in advance. The first firm to settle in this park was Varian Associates leasing land for $4,000 an acre, which was a good deal as there was no inflation clause in the agreement making this site today worth several hundred thousand dollars.

More and more firms - among them Hewlett-Packard as one of the first residents - settled their Research and Development (R&D) departments in this park, and they were to become the "core of the early explosive growth of Silicon Valley.") Today, there are m ore than 90 firms employing over 25,000 people.

During the Korean War the US government placed Stanford with a great deal of their projects, which made more, and more electronics companies (among them IBM and Lockheed) open R&D departments in Santa Clara County.

Due to his prepaid leasing program Terman received more than $18 million and, moreover, many companies endowed the university with gifts, which Terman used to hire qualified professors from all over the USA. Thus, he had created a mechanism which increased the settlement of the electronics industry.

The successful Stanford Research Park has served as a worldwide model for a lot of other high-technology parks.)

# Hewlett Packard - the garage myth

Hewlett-Packard was one of the first companies to be founded in the Silicon Valley and has today become the largest one to be seated there. Its story is typical for this Valley and has had a great impact on many firms founded later on.

## HP: Foundation and first years

Bill Hewlett and David Packard met at Stanford University in 1934. Bill Hewlett was the "son of the dean of the Stanford Medical School, while Dave Packard had come to Stanford from Pueblo, Colorado,") and was an enthusiastic radio ham.

They both were very interested in electronic engineering and spent a lot of their free time experimenting in Terman's lab who supported them. After graduation in 1934, Packard went to Schenectady, New York, where he worked for General Electric (GE), while Hewlett went on studying at the MIT. In 1938, Terman called them back to Stanford where they would earn electrical engineering degrees after their fifth year of study.

During this year they decided to work on a project professor Terman had suggested to them in his course at university: In the garage next to their rented apartment in Palo Alto they developed a variable frequency oscillator, which was much better than existing products but cost only a "fraction of the existing price ($55 instead of $500).") Terman was very convinced by this product, so he encouraged them to try to sell it. He himself loaned them $538 for the production and arranged an additional loan from a bank in Palo Alto.

The new firm Hewlett-Packard (HP) was founded in 1939, and its first big sale were eight audio oscillators to Walt Disney Studios, which used them for the soundtrack of "Fantasia.")

From now on, they concentrated on highly qualified products and innovative electronic instruments for engineers and scientists. This main product line has been kept till today.

By 1942, five years after its foundation, HP already had 60 employees and reached annual sales of about $1 million. So it became necessary to construct the first HP-owned building in Palo Alto. The two Stanford graduates had successfully built up their own company which had been founded upon an idea during their studies and was to rise from a "garage-headquartered firm") to a leading company in the world. This phenomenon was typical for Silicon Valley and would be imitated by many following companies such as Apple.

## The rise of HP up to the present

During World War II the demand for electronic products brought HP many orders, and the company could grow constantly in the subsequent years. HP continued to invent new devices such as the high-speed frequency counter in 1951, which greatly reduced the time required (from 10 minutes to one or two seconds only) to accurately measure high frequencies. Radio stations used it, for example.

The net revenue went up to $5.5 million in 1951 and the HP workforce was at 215 employees. So, in 1957, the stocks were offered to the public for the first time. The additional capital due to the stock offering was invested to acquire other companies and t o expand globally such as into the European market. As a consequence, in 1959, the first manufacturing plant outside Palo Alto was built in Böblingen, West Germany.

HP entered the Fortune magazine's list of the top 500 U.S. companies in 1962, and established the HP Laboratories in 1966, which were the "company's central research facility") and became one of the world's leading electronic research centers.

In the 1970s, the company's product line was shifted from "electronic instruments to include computers"), and the world's first scientific hand-held calculator (HP-35) was developed in 1972, making the "engineer's slide rule obsolete.")

In the 1980s, HP introduced its LaserJet printer (1985), which became the company's successful single product ever, and moved into the top 50 on Fortune 500 listing with net revenues of more than $10 billion (1988).)

Today, HP has total orders of $16.7 billion and employs more than 92,000 people in the whole world.) Annually, The company spends over 10 percent of its net revenues in R&D. These investments are fundamental to keep up with the "state-of-the-art" technology, which uses the most modern inventions. New products have always played a key role in HP's growth, therefore more than half of 1992's orders were for products introduced in the past two years.) HP's more than 18,000 products include "computers and peripheral products, test and measurement instruments and computerized test systems, networking products, electronic components, hand-held calculators, medical electronic equipment, and instruments and systems for chemical analysis.")

Bill Hewlett and Dave Packard today rank with America's richest men ($1.7 and $0.85 billion) and are widely respected, especially in Silicon Valley where they are viewed as the two "most successful entrepreneurs in America.") They have spent millions of t heir profits for social welfare and have established the Hewlett-Foundation.)

Hewlett and Packard have set a pattern of an outstanding company against which every new high-technology firm "must be measured.")

## The HP Way - an example of corporate culture for a whole industry

From the beginning the two founders have developed a management style, which had never occurred in a large company before. They coined a new type of corporate culture, which was to be called "the HP way."

HP always renounced the "hire and fire" mentality, which meant to employ many workers for a single big order and to dismiss them afterwards. Instead, the company offered its employees "almost perfect job security.") Even in 1974, when the U.S. economy was in a profound crisis and many people were unemployed, HP avoided layoffs by a four-day workweek, which was a unique measure in corporate America.

The two founders trusted in the "individual's own motivation to work") and treated their employees as family members; hence the custom to call each other by the first name - even the two chiefs were only known as Bill and Dave.

The HP workers were participated in the company with stock options and were even paid additional premiums when HP was successful - today known as profit sharing. These measures served to identify the employees with their work and to encourage them.

Moreover, the HP way included extensive employment benefits such as scholarships for the employee's children.

At the end of the 1950s Bill and Dave decided to write down the company's objectives, which were to serve as guidelines for "all decision-making by HP people,") since the company had grown ever larger. With some changes, those objectives are still valid today. They cover as follows: "Profit, Customers, Fields of Interest, Growth, Our People, Management, and Citizenship.") And these objectives are to be achieved through teamwork.

HP's strategies nowadays comprise mainly the "Management by Objectives", "Management by Wandering around" meaning informal communication within the company, and "Total Quality Control" which aims at producing highly qualified products.)

The HP way is seen as model for corporate culture in many countries.

The roots of many subsequent companies are located in HP, e.g. Steve Wozniak, who worked at HP and later co-founded Apple. This has led to the establishment of a new corporate culture in Silicon Valley and many firms have tried to imitate the HP way and ad opted measures such as stock options, innovative work rules, teamwork, and profit sharing.

## HP today.

**Business Summary PALO ALTO, Calif., Nov. 13, 2000 -- Hewlett-Packard Company (NYSE: HWP) today reported 17% revenue growth (20% excluding currency effects) in its fourth fiscal quarter ended Oct. 31, 2000. Excluding extraordinary other income and restructuring expenses, diluted earnings per share (EPS) was up 14% from the year-ago quarter.**

During the quarter, HP completed its previously announced 2-for-1 split of its common stock in the form of a stock dividend. Share and per-share amounts have been adjusted to reflect this split.

Net revenue was $13.3 billion, compared with $11.4 billion in last year's fourth quarter. EPS for the quarter was 41 cents on a diluted basis,(1) excluding investment and divestiture gains and losses, the effects of stock appreciation rights and balance sheet translation, and restructuring expenses. Including these items, diluted EPS on a reported basis was 45 cents per share on approximately 2.05 billion shares of common stock and equivalents outstanding. This compares with diluted EPS of 36 cents in the same period last year(2).

"We are pleased that revenue growth is accelerating, but very disappointed that we missed our EPS growth target this quarter due to the confluence of a number of issues that we now understand and are urgently addressing. I accept full responsibility for the shortfall," said Carly Fiorina, HP chairman, president and chief executive officer.

"Issues that reduced profitability included margin pressures, adverse currency effects, higher-than-expected expenses, and business mix. The good news is that our business is healthy, demand is strong, and we are making good progress against our strategic objectives as we continue the hard work of reinventing hp. We are determined to succeed and are not backing away from our growth targets," Fiorina said.

HP also announced it has terminated discussions with PricewaterhouseCoopers (PwC) regarding the potential acquisition of its consulting business.

Fiorina said, "We are disappointed that we have not been able to reach a mutually acceptable agreement to acquire PwC's consulting business. This is a high-quality operation, and we believe the strategic logic underlying this acquisition is compelling. However, given the current market environment, we are no longer confident that we can satisfy our value creation and employee retention objectives -- and I am unwilling to subject the HP organization to the continuing distraction of pursuing this acquisition any further. We remain committed to aggressively growing our consulting capabilities, organically and possibly by acquisition, and are open to other business arrangements to achieve our goals."

Business Summary

Net revenue in the United States was $6.0 billion, an increase of 13% from the year-ago quarter. Revenue from outside the U.S. rose 20% (26% in local currency) to $7.3 billion. In Europe, revenue was $4.5 billion, an increase of 15% (27% in local currency). In Asia Pacific, revenue was $1.9 billion, an increase of 36% (34% in local currency). In Latin America, revenue increased 11% to $0.6 billion.

Imaging and Printing Systems

The imaging and printing systems segment -- laser and inkjet printing, and imaging devices and associated supplies -- grew 6% in revenue year over year (9% in local currency) against a very strong quarter last year. Internet printing and a migration to color are driving strategy and growth. Strong sales of supplies, scanners, all-in-one (AiO) products, and consumer imaging devices, as well as overall strength in Europe and Asia, partially offset softness in the U.S. business printing market and continuing price erosion in inkjet printers.

Nearly 12 million printing and scanning devices were shipped during the quarter. HP's color LaserJet market share continues to grow and new products began shipping in October. Imaging revenues grew 31% over the year-ago period, driven by strong performances in all product lines: AiOs up 31%, scanners up 12% and digital cameras and printers up 137%. AiO units were up 53% and PhotoSmart printer units were up 208%. Supplies revenues grew 15% against a strong quarter last year.

Operating margin was 13.4%, up from 13.2% last year.

Computing Systems

The computing systems segment -- a broad range of Internet infrastructure systems and solutions for businesses and consumers, including workstations, desktops, notebooks, mobile devices, UNIX(R) and PC servers, storage and software solutions -- grew 29% in revenue year over year (32% in local currency) with strong performances across all product categories.

UNIX server revenues rose 23% year over year, with orders up 43%, driven by excellent performance in low- and mid-range servers. Superdome, HP's new high-end server introduced this quarter, is achieving stronger-than-expected market acceptance, and volume shipments remain on schedule for January. NetServer revenues were up 20%. Enterprise storage revenues were up 40% with the HP Surestore E Disk Array XP512, HP's flagship enterprise storage product, up 90% in revenues with strong backlog. Software revenues (excluding VeriFone) were up 18%, but down sequentially with strong order backlog at the end of the quarter. OpenView revenues were up 29% with orders up 60%. PC revenues were up 40%, with home PC revenues up 62%, notebooks up 164%, workstations up 11%, and commercial desktops up 8%.

Operating margin was 3.7%, up from 3.2% last year, but down sequentially from 7.3% in the third quarter primarily due to margin pressures, higher expenses and mix changes.

IT Services

The IT services segment -- hardware and software services, along with mission-critical, outsourcing, consulting and customer financing services -- grew 15% in revenue year over year (18% in local currency). HP's consulting business achieved in 46% revenue growth, with substantial new hires broadening and deepening the organization's capabilities.

Operating margin was 7.4%, essentially flat with 7.5% last year.

Costs and Expenses

Cost of goods sold this quarter was 72.5% of net revenue, up from 71.3% in the year-ago period. Expenses grew 15%. After adjusting for currency, expense growth was 17%. Operating expenses, as reported, were 20.3% of net revenue. This compares with 20.7% in the comparable period last year.

Asset Management

Return on assets for the quarter was 10.5% compared with 9.8% in the comparable quarter last year. Inventory was 11.7% of revenue compared with 11.5% in last year's fourth fiscal quarter. Trade receivables were 13.1% of revenue compared with 14.1% in the prior year period. Net property, plant and equipment was 9.2% of revenue compared with 10.2% in the year-ago quarter.

Full-year Review

Net revenue increased 15% to $48.8 billion. Net revenue in the United States rose 14% to $21.6 billion, while revenue from outside the United States increased 16% to $27.2 billion.

Net earnings from continuing operations were $3.6 billion, an increase of 15%, compared with $3.1 billion in fiscal 1999. Net earnings per share were $1.73 on a diluted basis, up 16% from $1.49 last year.

Outlook for FY 2001

For the 2001 fiscal year ending Oct. 31, 2001, HP expects to achieve revenue growth in the range of 15 to 17%, compared to 15% in FY 2000. Gross margin percentage in FY 2001 is expected to be in the range of 27.5 to 28.5%, compared to 28.5% in FY 2000, with improvements beginning in the 2nd quarter. Total operating expenses in FY 2001 are expected to be approximately 10 to 12% above FY 2000. Tax rate is expected to remain constant at approximately 23%.

The forward-looking statements in this Outlook are based on current expectations and are subject to risks, uncertainties and assumptions described under the sub-heading "Forward-Looking Statements." Actual results may differ materially from the expectations expressed above. These statements do not include the potential impact of any mergers, acquisitions or other business combinations that may be completed after Oct. 31, 2000.

HP will be discussing its fourth quarter results and its 2001 outlook on a conference call today, beginning at 6 a.m. (PST). A live Webcast of the conference call will be available at http://www.hp.com/hpinfo/investor/quarters/2000/q4webcast.html. A replay of the Webcast will be available at the same Web site shortly after the call and will remain available through 4:30 p.m. PST on Nov. 22, 2000.

# The rise of Silicon Valley

Hewlett-Packard was Silicon Valley's first large firm and due to its success one of the area's most admired electronics firms.

While HP was important for the initial growth of the area and at first was based on electronic devices, the actual Silicon Valley fever was launched in the mid-1950s with Shockley and Fairchild, and other semiconductor firms, and went on to the microelectronics revolution and the development of the first PCs in the mid-1970s, continuing till today.

## Invention of the transistor

One major event was crucial for this whole development. It was the invention of the transistor that revolutionized the world of electronics.

By the 1940s, the switching units in computers were mechanical relays, which were then replaced by vacuum tubes. But these vacuum tubes soon turned out to have some critical disadvantages, which impeded the further progress in computing technology. In contrast, transistors were much better. They could perform everything the vacuum tubes did, but "required much less current, did not generate as much heat, and were much smaller") than vacuum tubes.

The use of vacuum tubes, which could not be made as small as transistors, had meant that the computers were very large and drew a lot of power. For example the famous American ENIAC, built in 1946 and consisting of more than 18,000 vacuum tubes, had a total weight of 30 tons, filled a whole room of 500 square meters and consumed 150 KW per hour. The breathtaking development in computers can be seen, when comparing the ENIAC with today's laptops which are portable with about 5 kg, are battery driven and run some 100,000 times faster.)

This development was launched by the transistor (short for "transfer resistance") invention in 1947 by William Shockley and his colleagues John Bardeen and Walter Brattain. This "major invention of the century") was made at the Bell Labs in Murray Hill, New Jersey, which are the "R&D arm of the American Telephone and Telegraph Company (AT&T).") And in 1956, the three scientists received the Nobel Prize in Physics for their invention that had "more significance than the mere obsolescence of another bit of technology.")

The transistor is a "switch - or, more precisely, an electronic "gate," opening and closing to allow the passage of current.") Transistors are solid-state and are based on semiconductors such as silicon. The crystals of these elements show properties, which are between those of conductors and insulators, so they are called semiconductors. The peculiarity of semiconductor crystals is that they can be made "to act as a conductor for electrical current passing through it in one direction") only, by adding impurities or "doping" them - for instance, "adding small amounts of boron of phosphorus.")

## Shockley Semiconductor

In 1955, William Shockley, co-inventor of the transistor, decided to start his own company, Shockley Semiconductor, to build transistors, after leaving the Bell Labs. The new firm was seated in Palo Alto in Santa Clara County, California, where he had grown up. Shockley man aged to hire eight of the best scientists from the East Coast, who were attracted by his scientific reputation. These talented young men - "the cream of electronics research" - represented the "greatest collection of electronics genius ever assembled". Their names were: Julius Blank, Victor Grinich, Eugene Kleiner, Jean Hoerni, Jay Last, Gordon Moore, Robert Noyce and Sheldon Roberts.)

But however brilliant Shockley was, who was called a "marvelous intuitive problem solver" and a "tremendous generator of ideas" by Robert Noyce, it soon turned out that he was "hard as hell to work with", as his style was "oppressive" and he "didn't have trust and faith in other individuals.")

When Shockley refused the suggestions of his eight engineers who wanted to concentrate on silicon transistors, while their boss pursued research on four-layer diodes, they decided to quit and start their own firm in 1957.

Within several months Shockley had to shut down his firm, since he had lost his engineers, whom he called traitors and they are now known as "the Traitorous Eight".

Although Shockley was not very successful with his firm in Palo Alto, he "deserves credit for starting the entrepreneurial chain-reaction that launched the semiconductor industry in Silicon Valley,") since he had brought together excellent scientists there like Robert Noyce without whom there might never have been a Silicon Valley on the San Francisco Peninsula at all. Or as M. Malone calls it, "Shockley put the last stone in place in the construction of Silicon Valley.")

The father of one of those young men who left Shockley had contacts to a New York investment firm, which sent a young executive named Arthur Rock to secure financing for their new enterprise. Rock asked a lot of companies, if they were interested in backing this project, but has not been successful so far. The concept of investing money in new technology ventures was largely unknown then, and indeed the term "venture capital" itself wouldn't be coined until 1965") - by Arthur Rock, who should become Silicon Valley's first and most famous venture capitalist later on.

Finally, due to Rock's efforts, the "Traitorous Eight" managed to obtain financial support from industrialist Sherman Fairchild to start Fairchild Semiconductor in 1957.

Fairchild Semiconductor was developed by Shockley's firm, and as the "still existing granddaddy of them all") has itself spawned scores of other companies in Silicon Valley: Most semiconductor firms' roots can be traced back to Fairchild. The most famous ones of them are National Semiconductor, Intel, Advanced Micro Devices (AMD); and many well-known Valley leaders have worked at Fairchild, e.g. Charlie Sporck (National Semiconductor), Jerry Sanders (AMD's founder), Jean Hoerni, and last but not least Robert Noyce, who is considered the "Mayor of Silicon Valley") due to his overwhelming success.

Robert Noyce was born in southwestern Iowa in 1927. His father was a preacher in the Congregational Church and thus was "perpetually on the move to new congregations, his family in tow.") When the Noyces decided to stay at the college town of Grinnell, Iowa, for a longer period of time after many years of moving, this place meant stability in young Bob's life and thus would become his first and only real home, which he would later regard as important for his eventual success.

After high school, Robert studied at Grinnell College. His physics professor had been in contact with John Bardeen (one of the three inventors of the transistor) and obtained two of the first transistors in 1948, which he presented his students, including Bob Noyce. This aroused young Robert's interest in semiconductors and transistors, which made him try to learn everything he could get about this fascinating field of solid-state physics.

Having graduated from Grinnell College he continued his studies at "the premier school of science on the East Coast, MIT,") where he met famous scientists like Shockley. He received his doctorate, and decided to work at Philco until 1955, when he was invited by William Shockley to join a new firm named "Shockley Semiconductor" in Santa Clara County - together with seven other splendid scientists.

When the so-called "Shockley Eight" started a new venture with Fairchild Semiconductor, Robert Noyce began "his own transformation from engineer to business manager:") He was chosen to lead the new company as he seemed the best to do this job.

Fairchild Semiconductor focused on building a marketable silicon transistor applying a new manufacturing process called "mesa". Despite being the smallest company in electronics business then, it attracted public attention, particularly in 1958, when "Big Blue" - as dominant IBM is nicknamed - ordered the "first-ever mesa silicon transistors") for memory drivers in its computers.

This order contributed to the early success of Fairchild Semiconductor, and indicated the beginning of a long relationship between IBM and Silicon Valley.

## Importance of military funding

Before switching over to the events at Intel, the aspect of military funding is to be dealt with, since it has played an important role in the early days of Silicon Valley.

During World War II, after the Japanese attack at Pearl Harbor in 1942, a great deal of the U.S. military forces and of the military production was moved to California. Within a few years, California - formerly an agricultural state - became a booming industrial state and the military center of the USA.)

After the war, in the time of the Cold War and the arms race, the Korean conflict, the "missile gap" and the space program, the Pentagon kept ordering high-technology products from the armament factories in California. Many companies established R&D departments and production facilities in Santa Clara County near Stanford University, which provided them with bright engineers and scientists, and were largely supported by the Pentagon's demand for electronic high-tech products.

Examples for such firms are FMC, GTE, Varian Associates, Westinghouse, and finally Lockheed, which opened its R&D department in the Stanford Research Park in 1956, and started Lockheed Missiles and Space Company (LMSC) in Sunnyvale. Lockheed's move to Northern California was crucial for the developments in Santa Clara County; today the company is Silicon Valley's largest employer with more than 24,000 people.)

Military funding for high-tech products was responsible for the early growth of Silicon Valley in the 1950s and 1960s. The U.S. Department of Defense was the biggest buyer of these products, e.g. its purchases represented about 70 percent of the total production of ICs in 1965.)

While this share in chip demands has dropped to 8 percent today, the Pentagon remains the biggest supporter of new technologies and accounts for most of the purchases of the latest developments.

# Intel Corp.

After the transistor and the integrated circuit, the invention of the microprocessor in the early 1970s represents the next step towards the modern way of computing, providing the basis for the subsequent personal computer revolution.

It was at Intel where the first microprocessor was designed - representing the key to modern personal computers. With its logic and memory chips, the company provides the basic components for microcomputers. Intel is regarded as Silicon Valley's flagship and its most successful semiconductor company, owing its worldwide leading role to a perpetually high spending on research and development (R&D).

## Foundation in 1968

It all started in 1968, when Bob Noyce resigned as head of Fairchild Semiconductor taking along Gordon Moore and Andy Grove, to embark on a new venture. They had decided to leave the company, because they wanted "to regain the satisfaction of research and development in a small, growing company,") since Fairchild had become big with lots of bureaucracy work to be done. Gordon Moore had belonged to the famous Shockley Eight and was in charge of the R&D team at Fairchild. Andy Grove, a young Hungarian émigré, who had earned a doctorate in chemical engineering at U.C. Berkeley, had joined Fairchild in the early 1960s.

Intel (short for Integrated Electronics), a typical Fairchild spin-off, was financially backed by venture capital from Arthur Rock, who had been in contact with Noyce since 1957. The company was founded upon the idea of integrating many transistors on a chip of silicon, after Noyce had developed a new photochemical process. The three engineers initially focused on building the first semiconductor chips used for computer memory, which should replace the dominant memory storage technology at the time, called "magnetic core". Intel's task was to drive down the cost per bit by increasing the capacity of memory chips dramatically.

## First products - Moore's Law

Within a year, Intel developed its first product - the 3101 Schottky bipolar 64-bit static random access memory (SRAM), which was followed soon after by the 1101. This chip (1101) was a 256-bit SRAM and had been developed on Intel's new "silicon gate metal -oxide semiconductor (MOS) process," which should become the "industry's process technology of choice.") With the first two products, the young company started with 12 employees and net revenues of $2,672 in 1968, had already gained the technological lead in the field of memory chips.

Intel's first really successful product was the 1103 dynamic random access memory (DRAM), which was manufactured in the MOS process. Introduced in 1970, this chip was the "first merchant market LSI (large-scale integrated) DRAM," and received broad acceptance because it was superior to magnetic core memories. So, by the end of 1971, the 1103 became "the world's largest-selling semiconductor device" and provided the capital for Intel's early growth.)

Until today, semiconductors have "adhered to Moore's Law," which has been framed by the "cofounder of Fairchild and Intel" when the first commercial DRAMs appeared in the early 1970s. This law predicts that the price per bit (the smallest unit of memory) drops by 30 percent every year. It implies that you will receive 30 percent more power (speed/capacity) at the same price, or that the "price of a certain power is 30 percent less.")

Moore's Law applies to both memory chips and microprocessors, and shows the unprecedented rapid progress in microelectronics. This "astonishing ratio" has never occurred in "the history of manufacturing" before. Applied to automobiles, it means that "a Cadillac would have a top speed of 500 miles per hour, get two hundred miles to a gallon of gas and cost less than a dollar" - almost incredible.)

1971 was a crucial year at Intel. The company's revenues surpassed operating expenses for the first time, and the company went public, raising $6.8 million.

Moreover, the company introduced a new memory chip - the first erasable, programmable read only memory (EPROM). Invented by Intel's Dov Frohman, the new memory could store data permanently like already existing ROMs, but besides could be erased simply by a beam of ultraviolet light and be used again. The EPROM was initially viewed as a "prototyping device" for R&D. The invention of the microprocessor in the same year, however, showed the real significance of the EPROM, which could be used by original equipment manufacturer (OEM) customers (they build the end-products) to store microprocessor programs in a "flexible and low-cost way." The "unexpected synergy" between the EPROM and the microprocessor resulted in a growing market for both chips and contributed a great deal to Intel's early success.)

## "Ted" Hoff's first microprocessor

The invention of the microprocessor marked a turning point in Intel's history. This development "changed not only the future of the company, but much of the industrial world.")

The story to this technological breakthrough began in 1969, when a Japanese calculator manufacturer called Busicomp asked Intel to design a set of chips for a family of programmable calculators. Marcian "Ted" Hoff, a young and "very bright ex-Stanford research associate") who had joined Intel as employee number 12, was charged with this project. However, he did not like the Japanese design calling for 12 custom chips - each of them was assigned a distinct task. Hoff thought designing so many different chip s would make the calculators as expensive as minicomputers such as DEC's PDP-8, although they could merely be used for calculation. His idea was to develop a four-chip set with a general-purpose logic device as its center, which could be programmed by inst ructions stored on a semiconductor memory chip. This was the theory behind the first microprocessor.

With the help of new employee Stan Mazor, Hoff perfected the design of what would be the 4004 arithmetic chip. After Busicomp had accepted Hoff's chip set, Frederico Faggin, one of the best chip design experts, who had been hired recently, began transforming the design into silicon. The 4004 microprocessor, a 4-bit chip (processes 4 bits - a string of four ones or zeroes - of information at a time), contained 2300 MOS transistors, and was as powerful as the legendary first electronic computer, ENIAC.

Soon after the first 4004s had been delivered to Busicomp, Intel realized the market potential of the chip, and successfully renegotiated with the Japanese to regain the exclusive rights, which had been sold to Busicomp.

In November 1971, Intel introduced the 4004 to the public in an Electronic News ad. It announced not just a new product, but "a new era of integrated electronics [...], a micro programmable computer on a chip.") The microprocessor is - as Gordon Moore call s it - "one of the most revolutionary products in the history of mankind,") and ranks as one of 12 milestones of American technology in a survey of U.S. News and World Report in 1982. This chip is the actual computer itself: It is the central processing u nit (CPU) - the computer's brains. The microprocessor made possible the microcomputer, which is "as big as it is only to accommodate us." For "we'd have a hard time getting information into or out of a microprocessor without a keyboard, a printer and a terminal," as Th.Mahon puts it.)

However significant Hoff's invention, nevertheless, it was hardly noticed in the public until early 1973. The microprocessor had its own instruction set and was to be programmed in order to execute specific tasks. So Ted Hoff had to inform the public and t he engineers about the capabilities of the new device and how to program it.

## Cooperation with IBM in the 1980s

Intel's measures in the late 1970s as a reaction to increasing competition from other chip manufacturers paid off greatly and resulted in a remarkable technological lead against its competitors. The most significant consequence, which was a landmark in the company's development, was IBM's decision to rely on the Intel 8088 microprocessor for its PCs in 1980.

IBM (short for International Business Machines) has been the world's leading company in the big mainframe computers since the 1950s. Due to its dominance, it was often compared with a giant and referred to as "Big Blue." Surprisingly, it was not before 198 1 (the PC revolution had already been on for a few years) that IBM introduced its own Personal Computer.

Because of IBM's dominance and worldwide reputation, its PCs soon became industry standard and penetrated the office market: other established computer companies followed and introduced their own PCs - the so-called "clones" - which were compatible to IBM' s models. To maintain compatibility, all these manufacturers were forced to rely on Intel's microprocessors, which thus were bootstrapped to industry standard, too.

As well as for Intel, the CPU manufacturer, IBM's decision has been crucial for a company in the software field: Microsoft's (Redmond, Washington) MS-DOS was chosen as the IBM PC's operating system and became industry standard. It is essential to every IBM compatible PC. Microsoft, a small company in 1980, grew explosively, and is today's superior software giant.

At the beginning of the 1980s, IBM was concerned about Intel's ability to keep investing in R&D and therefore decided to support Intel by buying $250 million (=12%) of the company's stock. This endorsed Intel's position, and, in 1987, IBM sold the last of its shares in a strong Intel.

## Intel today

***Annual report 2000***

Today, Intel supplies the computing and communications industries with chips, boards and systems building blocks that are the "ingredients" of computers, servers, and networking and communications products. Industry members to create advanced computing and communications systems use these products. Intel's mission is to be the preeminent building block supplier to the worldwide Internet economy.

**Intel® Architecture platform products** Microprocessors, also called central processing units (CPUs) or chips, are frequently described as the "brains" of a computer, because they control the central processing of data in personal computers (PCs), servers, workstations and other computers. Intel offers microprocessors optimized for each segment of the computing market:

Intel® Pentium® III Xeon™ processors for mid-range to high-end servers and workstations

Intel® Pentium® 4 and Pentium® III processors for entry-level servers and workstations and performance desktop PCs

Intel® Celeron™ processors for value PC systems

Mobile Pentium® III processors for performance in mobile PC systems

Chipsets perform essential logic functions surrounding the CPU in computers, and support and extend the graphics, video and other capabilities of many Intel processor-based systems.

Motherboards combine Intel microprocessors and chipsets to form the basic subsystem of a PC or server.

e-Business solutions enable services and channel programs to accelerate integration and deployment of Intel Architecture-based systems and products.

**Wireless communications and computing products** These products are component-level hardware and software focusing on digital cellular communications and other applications needing both low-power processing and high performance. These products are used in mobile phones, handheld devices, two-way pagers and many other products. For these markets, Intel offers Intel® Flash memory, application processors based on the Intel® StrongARM processor core, and base band chipsets for cellular phones and other wireless devices.

**Networking and communications products** Communications building blocks for next-generation networks and Internet data centers are offered at various levels of integration. These products are used in communications servers, network appliances and computer telephony integration equipment.

Component-level building blocks include communications silicon such as network processors and other board-level components, software and embedded control chips. These products are integrated in communications hardware such as hubs, routers, switches and servers for local and wide area networking applications. Embedded control chips are also used in laser printers, imaging, automotive systems and other applications.

**New business products** These products and services include e-Commerce data center services as well as connected peripherals.

Intel's major customers include:

**Original equipment manufacturers** (OEMs) of computer systems, cellular phone and handheld computing devices, telecommunications and networking communications equipment, and peripherals.

**Users of PC and network communications products** including individuals, large and small businesses, and Internet service providers—who buy Intel's PC enhancements, business communications products and networking products through reseller, retail, e-Business and OEM channels.

**Other manufacturers** including makers of a wide range of industrial and communications equipment.


# The emergence of the PC industry

Until the early 1970s, computers were huge machines - from the largest ones, the supercomputers, to mainframes and minicomputers - and were mainly used for scientific research in universities and in military institutions, and for business calculations in major companies. Surprisingly, when the first microprocessors appeared, none of the established companies such as IBM, DEC or HP had the idea to build small, personal computers. They just did not see any market for them and could not imagine what those machines should be needed for. None of these large companies anticipated the possibilities of PCs, which are today used in almost every office, in the home, in the school, on airplanes, etc. and can act as typewriters, calculators, accounting systems, telecommunications instruments, libraries, tutors, toys and many the like.

So, it was the hobbyists, single electronics wizards who liked tinkering with electronic devices that constructed their own computers as the first PCs. These "computer nuts" ignited the "fire in the valley;") they launched the personal computer revolution in Silicon Valley "out of their own fascination with the technology. The personal computer arose from a spirit of sharing "hard-won technical information" with other computer freaks who developed their devices for the fun of tinkering around in this fascinating field of electronics. Some of these frequently young hobbyists found themselves almost overnight as millionaires, after they had sold their devices in a newly founded firm.

Before dealing with the story of Apple, which is typical of Silicon Valley and responsible for the breakthrough of the personal computer, some information about the first PC and the emergence of the PC industry shall be given.

## Altair - the first PC

Altair is often regarded as the first personal computer, although it was one of those switches and lights computers - programming is done by arranging a set of switches in a special order, and the results appear as different combinations of lights. In other words, such a machine is a genuine computer, but absolutely useless, as Steve Wozniak, one of the PC pioneers, put it.)

After the first microprocessors had come onto the market, Ed Roberts, an engineer at MITS, a small calculator company in Texas, decided to build a kit computer, which he intended to sell to hobbyists. He chose Intel's 8080 as the CPU for his computer, since this chip was the most advanced and powerful at the time. As Roberts wanted to sell his computer for less than $500 and the official price for the 8080 was already at $360, he contacted Intel and could finally receive the chip for only $75 apiece.

By the end of 1974, Roberts finished his computer, which was named Altair. When the Altair was introduced on the cover of the January 1975 issue of Popular Electronics as the first personal computer, which would go for $397 only, the market response was in credible. The low price was the actual sensation, because it was largely known that the price for the Intel 8080 CPU powering the Altair was already at $360. So many hobbyists, engineers and programmers who had keenly waited for their own personal computer, which they could experiment on at home, welcomed the new product and ordered "their" Altair on the spot.

Roberts had never expected such a great response and his small firm was flooded by those immediate orders (more than 4000). He boosted up the production, but still could not meet the huge demand. The Altair was a success at first, and Roberts sold many of them.

However, he had increased production at the expense of quality and further refinement of his computer, so the Altair brought along a lot of trouble and was finally supplanted by other computers, which were superior.

Nevertheless, the Altair as the first successful microcomputer, contributed a lot to the PC revolution, since it encouraged other people to build personal computers (e.g. IMSAI, Apple).

## The first computer shops

During this time, the mid-1970s, the first computer shops came into existence. Pioneering in this field was Paul Terrell who came to the idea of running such a shop, after the Altair had been put onto the market. His first Byte Shop opened in Mountain View (located in the heart of Silicon Valley) by the end of 1975.

Initially, Terrell sold the Altair and accessory products such as additional memory boards and other devices, which came onto the market. With the arising microcomputer industry, he could offer his customers - mainly hobbyists and engineers - more and more products, and his shop became a success. Other Byte Shops were opened and Terrell's computer shop chain expanded beyond the Silicon Valley. The computer shops provided its customers with a variety of devices around the computer and also with service and help.

The Altair was shipped as a kit computer and was to be assembled first, and then it was still not difficult to work with it. The hobbyists helped each other with advice. It was this spirit of sharing solutions and the common interest in microcomputers that led to the foundation of the first computer club.

## Homebrew Computer Club

The legendary Homebrew Computer Club was the first of its kind, and provided an early impetus for the development of the microcomputer industry in Silicon Valley. Its first meeting in March 1975 was held in one of its members' garage in Menlo Park in Santa Clara County. The Homebrew members were engineers and computer enthusiasts who discussed about the Altair and other technical topics. The club attracted many hobbyists and was attended by nearly 750 people one year after its foundation. The Homebrew Computer Club had its own philosophy. People meet, because they were interested in computers and liked tinkering with them, but not for commercial reasons - at least in its early times. Its members "exchanged information about all aspects of micro computing technology") and talked about devices they had designed. From its ranks came the founders of many microcomputer companies - for example Bob Marsh, Adam Osborne, or Steve Jobs and Steven Wozniak - the famous Apple founders.

The Homebrew Computer Club is the place where the roots of many Silicon Valley microcomputer companies are located. It has "spawned a revolution in micro processing") and represents an "important step in the development of a multi-billion dollar industry.

# The Apple Story

Apple provides one of Silicon Valley's most famous stories. It shows features that are typical for most start-up firms in the valley, however, it is unique and its early success and its contribution to the personal computer are unmatched.

## "Woz" and Jobs - the two "Steves"

Apple's history starts with the story of two young and exceptional people who began building a computer in their garage and "launched the microcomputer revolution,") changing our daily life in many respects.

The Apple story is the story of the two "Steves". Stephen G. Wozniak was a typical Silicon Valley child. Born in 1950, he had grown up with the electronics industry in Silicon Valley, and had been intrigued by electronics from the start, since his father w as an electronics engineer. Wozniak, known to his friends as "Woz", was bright and was an electronics genius. At the age of 13, he won the highest award at a local science fair for his addition-subtraction machine. His electronics teacher at Homestead High School recognized Woz's outstanding talent and arranged a job for him at a local company, where Steve could work with computers once a week. It was there that Wozniak saw the capabilities of a computer (it was the DEC PDP-8 minicomputer) and studying the manual, it became his dream to have a computer of his own one-day. He designed computers on paper. Many other students who grew up in Silicon Valley shared this dream.

In 1971, Wozniak built his first computer with his high-school friend Bill Fernandez. This computer (they called it Cream Soda Computer) was developed in his friend's garage and had "switches and lights just as the Altair would have more than three years later.")

Bill introduced Woz to a friend of his named Steven P. Jobs. Jobs was born in 1955, and his foster parents were - unlike most other people in Silicon Valley - blue-collar workers. However, growing up in an environment full of electronics, Steve came in con tact with this fascinating technology and was caught by it.

Jobs was a loner and his character can be described as brash, very ambitious and unshakably self-confident. With his directness and his persistency he persuaded most people. He had the ability to convey his notions and vision to other people quite well. An d he was not afraid to talk to famous people and did never stop talking to them until they gave in and did what he wanted. His traits could already be observed in his adolescence, for instance when he - at the age of thirteen - called famous Bill Hewlett, president of HP, and asked him for spare parts he needed for his frequency counter.

Although Steve Jobs was five years younger than Wozniak, "the two got along at once." Apart from their common fascination with electronics, they "shared a certain intensity." Whereas Woz was intense in digging "deeper into an intellectual problem than anyone else," Jobs's intensity was in ambition. Moreover, both were genuine pranksters, and often they fooled others with their technical knowledge.)

When they heard of "phone-phreaking" - making free long-distance telephone calls with a device called "blue box" - the two started their first business venture, building those blue boxes.

In 1972, Steve Jobs went to Reed College in Oregon; however, there he became more interested in Eastern religions, dropped out a year later and returned to Silicon Valley, where he took a job with Atari (a young video game company) until he had saved enough money to go on a trip to India for some months. Then he went back to California and to his work at Atari.

After attending three different colleges, Wozniak had begun work for Hewlett-Packard in summer 1973. When Atari planned to develop a new game called "Breakout," Jobs boasted he could design it in only four days - quicker and better than anyone else. Jobs t old his friend Woz about it, and the two designed the game in record time, working four nights and days, and were paid the promised $700 for it. This experience showed them that they could work together on a tough project and succeed.

## The first Apple

When the Homebrew Computer Club came into existence, Wozniak began attending its meetings. As he later would recall, Homebrew was a revelation for him and changed his life. He met people who "shared his love for computers") and learned from them as well a s he encouraged them with his technical expertise. Others brought along their Altairs, which Wozniak was interested in but could not afford. He realized this computer resembled the Cream Soda Computer he had built some time ago.

Soon after, Chuck Peddle at MOS Tech released his new 6502 microprocessor chip for only $20, which was a sensation compared to the usual price of $400 for those chips then. Suddenly, Woz saw his chance and decided to write the first BASIC for it, which was the most spread programming language. After finishing with the BASIC, he made a computer for it to run on. The other hobbyists at Homebrew were impressed by Wozniak's kit, which actually was a board with chips and interfaces for a keyboard and a video monitor.

Steve Jobs saw the opportunity of this machine, which they named Apple, and finally persuaded Wozniak to start a company in April 1976. The two raised the money for the prototype model with a printed circuit board by selling Jobs' VW microbus and Wozniak's HP calculators. With the Apple I, Steve Wozniak had designed a "technological wonder") and made his dream of owning a computer come true. His friend Steve Jobs played the role of a salesman and his ambitious promotion made the Apple I "a star in the tight world of computer freaks.")

The breakthrough for the two Steves came in July, when Paul Terrell ordered 50 Apples for his Byte Shop, however on condition the computers were fully assembled in a case and equipped with a cassette interface to enable external data storage.

Jobs could "obtain net 30 days credit") for the parts they needed for their computer. Working hard in Jobs parents' garage, they managed to construct the 50 Apples within those 30 days.

The Apple I was continuously refined by Wozniak, and its sales made the young company known, partly because the company's name appeared on top of computer lists, which were published by electronics magazines in alphabetical order.

## Building up the company

While the first Apple was being sold, Steve Wozniak had already begun work on another computer, the Apple II. This machine would have several special features which had not appeared in any microcomputer before and would make it "the milestone product that would usher in the age of the personal computer.")

Jobs and Wozniak sensed the market potential their new computer would have, but realized they did not have the necessary capital for constructing the machines. So they tried to sell their computer to several established companies such as Atari, HP and MOS Tech, which, however, rejected. Looking out for some venture capital to produce the new computers by themselves, Steve Jobs met with Mike Markkula, who had been a marketing manager at Fairchild and Intel.

Markkula was at the age of 38, but had already retired, since he had made a fortune of many million dollars by his stock option at Intel. He visited Jobs's garage and became interested in their project. Markkula, the former marketing wizard at Intel, thought it "made sense to provide computing power to individuals in the home and workplace" and offered to help them "draw up a business plan.") Finally, he decided to join the two Steves. He offered $250,000 of his own money and his marketing expertise for on e third of the company, which was incorporated as Apple Computer in January 1977. Markkula's decision marked the turning point in Apple's history; he took care of the business side and arranged all the things necessary to create a successful company. Markkula's know-how was crucial for Apple, since Woz and Jobs did not have any business expertise. This knowledge is very important for new firms. A lot of other start-ups in Silicon Valley failed as their founders were only engineers, who lost control over their enterprises when they could not meet the skyrocketing demand for their products.

In 1977, Markkula hired Mike Scott, who had worked for product marketing at Fairchild, as the company's president, because he felt Apple needed an experienced person to run the company.

Jobs, who wanted only the best for his company, also persuaded Regis McKenna, who ran the biggest and most influential agency in Silicon Valley, to do public relations and advertising for Apple. McKenna, who worked for successful Intel and many other companies, brought Apple legitimacy and, among other things, designed the famous Apple logo. Another important contribution was the fact that he made Apple the first company to advertise personal computers in consumer magazines to "get national attention" and " popularize this idea of low-cost computers.")

Steve Jobs's persistency had persuaded Wozniak, the electronics genius who designed the machine, McKenna, and Markkula, the business expert. Jobs himself was the driving force that brought the key components together to build up a successful company.

## Apple II - starting the personal computer boom

In April 1977, the Apple II was introduced to the public at the West coast Computer Faire (market), where Apple had rented the largest booth just opposite the entrance. Wozniak's "technological wonder") was a great success and the first orders were already made. The Apple II was the "first true personal computer.") It was the first microcomputer able to generate color graphics and the first with BASIC in ROM and included a keyboard, power supply and an attractive lightweight and beige plastic case, which would become standard for subsequent PCs. The Apple II was more sophisticated than any microcomputer before, and represented a machine, which could be worked with effectively. Steve Wozniak had put all his "engineering savvy") into it, and had created a computer he would like to own.

The Apple II was given a rapturous welcome in the public. In 1977, the company sold more than 4,000 computers, which were priced at $1,300, and grew rapidly.

Programs and data for the Apple II were stored on cassette tapes. But this common way of storage turned out to be quite unreliable and awkward. Mike Markkula saw the future in floppy disks, which had been developed by IBM in the early 1970s, and asked Wozniak to design a disk drive for the Apple II. Woz took the challenge and finished in record time (only one month). His final design was brilliant: he developed a new technique ("self-sync") and created the fastest minifloppy disk drive. It was shipped in June 1978 and proved vital for Apple's further growth. It made possible the development of serious software such as word processors and data base packages,") which increased the practical use of the computer decisively.

In 1979, Daniel Fylstra, a programmer from Boston, released VisiCalc for the Apple II. This spreadsheet was a novelty in computer software. It relieved business calculations considerably and could be used to do financial forecasting. It was the first application that made personal computers a practical tool for people who do not know how to write their own programs. VisiCalc was very successful and contributed to the skyrocketing sales of the Apple II.

The same year, marketing wizard Mike Markkula made another important decision for Apple future growth. His idea was to create a new market in the field of education and schools. The Apple Education Foundation was established, which granted complete Apple systems equipped with learning software to schools. This market should account for a major part of the company's sales in the subsequent years, since Apple II soon became the most popular machine for students.

## Turbulences in the early 1980s

The successful stock sale provided Apple with an "extravagant amount of capital ($1 billion)," which could be spent on developing the "company's next computer generation.") This time, however, was quite turbulent for Apple and was marked by crises and inner power struggles.

Designing on Apple III began in 1978. This computer was to be the successor to Wozniak's Apple II, and was finally introduced to the public in 1981. But it was not successful - a "disaster" or "fiasco,") since it had too many faults and did not work properly. Nevertheless, the company was without any financial troubles, since sales of the Apple II continued to increase rapidly.

Concurrently, Steve Jobs became the company's visionary and thought about the next computer generation. Such a visionary is a "person who has both the vision and the willingness to put everything on the line, including his career, to further that vision. Jobs became a perfect visionary and convinced everyone around him with his vision.

In 1979, he and some other Apple employees visited the Xerox PARC (Palo Alto Research Center), which was known for its advanced research in computing. What they saw was revolutionary and had never appeared on any personal computer before. The "environment of the screen was graphically based" with icons (representing files or programs), with a mouse for pointing and moving at them, windows and pull-down menus. Thus, the user could "interact easily with the computer [...] without ever typing a single letter.

Jobs was quite impressed and wanted to transfer this concept on a new PC called Lisa, which was intended for the business world. Steve, however, came up with ever-new ideas for the designers of this project. He "created chaos because he would get an idea, start a project, then change his mind two or three times, until people were doing a kind of random walk, continually scrapping and starting over.")

Markkula and Scott were concerned about the further progress of Lisa. So, in the course of a reorganization of the company, they decided to put John Couch, a former software designer at HP, in a charge of the Lisa project. Jobs was made chairman of the boa rd to represent Apple in the public. However, Steve was shocked that he was taken the chance to fulfill his vision, and relations between him and Scott deteriorated.

In February 1981, Wozniak, the technological brains behind the Apple I and II, crashed his four-seated airplane. He hit his head badly and suffered from a case of temporary amnesia. For some time, he retired from the company and he finished his undergraduate degree at U.C. Berkeley.

The company had grown rapidly to 2,000 employees, and some of them had joined Apple in the hope of a safe job. Setting an example, president Mike Scott laid off 42 people on a day which came to be called "Black Wednesday". Apple was shocked since some of t hose people seemed to have been chosen arbitrarily. Scott's management style became more and more disliked, and finally Mike Markkula decided to fire Scott and took over his position until a new president was found.

## The Lisa project

Meanwhile, Steve Jobs had discovered his new project. Soon he had taken control of the Macintosh project, which had been started by Jeff Raskin in 1979 to design a small and handy personal computer. Steve dedicated all his power to the Macintosh, which was to be a smaller and cheaper Lisa and was to revolutionize the way of computing.

The company was now separated into three divisions, Apple II, Lisa and Macintosh, which began competing against each other - particularly between the latter two.

Lisa was developed by a number of experienced engineers and programmers who had been recruited from HP, DEC and Xerox. This project was "the most professional operation ever mounted at Apple") and was in contrast to Steve's bunch of young hackers at Macintosh.

When Lisa was introduced to the public in August 1983, it was "ahead of its time:") Lisa was easy to use because of the mouse, graphical interface and windows, and had additional features such as multitasking. Though is was first welcomed by the press as revolutionary, Lisa failed. One problem was Steve's "lack of self-discipline:") When introducing Lisa he talked about "his" Macintosh which would come out soon and with features like Lisa but cost only a fraction ($2,000 instead of $10,000 for Lisa). The other strategic mistake was the announcement that the two computers were not compatible. So it is no wonder many people waited until the Macintosh would come.

Finally, Lisa, which was intended for the business market at its price of $10,000, lacked the ability to communicate with other computers - a fact which was decisive for this market.

In the meantime, IBM had entered the personal computer market with its first IBM PC in 1981, and already dominated a large part of it. Its first PC "wasn't an earth-shattering machine technically") and was much harder to use than the forthcoming Apple machines. But the fact that it was built by IBM was enough to make it successful, and many software companies wrote applications for it. Apple had bravely run a full-page ad saying "Welcome IBM, Seriously", but it soon seemed to have lost the battle. Nevertheless, IBM's entry brought Apple a lot of publicity as the only real competition to Big Blue.

Thus, Lisa was not very successful and the second failure after the Apple III. Still, Apple's sales increased - only because of the successful Apple II. But the company needed a successor, and all its hopes were now placed in the Macintosh.

## The Macintosh revolution

The Macintosh was to fulfill Steve Jobs' vision of "computer to the people". He created a personal computer, which was easy to use and at a low cost. Steve thought of a tool for all people to broaden their mind - a revolution towards the modern way of computing.

His Macintosh team was made up of teenagers and self-taught hackers - "idiot savants, passionate plodders and inspired amateurs" - who "loved to cut code.") They followed his vision and passionately designed this outstanding computer. Jobs continuously drove his team to ever-greater feats. He "kept thinking up crazier things, or more aggressive goals if they were doing good, or if they were achieving their goals he wanted them to do more. He couldn't just stop, he had to push you to the edge.") Steve "gave impossible tasks, never acknowledging that they were impossible,") he "doesn't have any boundaries, [...] because he has always been able to do anything he wanted" due to "his early success.") As a consequence, people usually worked 80 hours a week or more for their project.

Steve's most brilliant hackers were Andy Hertzfeld, Bill Atkinson and Burrell Smith. The Macintosh was equipped with Motorola's 68000 CPU, a 3.5-inch floppy disk drive, a detachable keyboard, and the amount of space it took up from the desk should not be larger then a telephone book (this meant a revolution in size). The computer was meant to be an open system, and software applications were to be programmed by other companies, the work of which was supported by a standard modular toolbox. This box made sure that all applications were easy to use and appeared in a standardized way. As well as other fundamental software the standard toolbox was available from the computer's ROM (Read Only Memory).

Influenced by robotics assembly lines in Japan, Steve decided to "build the most advanced assembly plant in the world") for the production of the Macintosh. It was fully automated and the labor component accounted for only one percent of the total cost.

Simultaneously to feverish efforts to finish the Macintosh, Apple succeeded in finding a new president. Thanks to Steve's visionary powers of persuasion, John Sculley, top manager at PepsiCo, finally agreed to join Apple in April 1983.

The introduction of the Macintosh, which was Steve's revolutionary machine to change the world, was dated to January 1984 and was to be accompanied by a massive ad campaign in the media. Chiat/Day agency was asked to create a commercial referring to the fact that 1984 was the year of Orwell's famous novel. They produced the sixty-second ad, which was really exceptional, and proposed running it only once - during the Super Bowl, the most watched television event of the year.

It would be a million dollar minute, which was to capture public attention. Macintosh was presented as a milestone product that would revolutionize the way of computing, breaking IBM's, the "Big Brother's" dominance and conformity it was about to establish by its IBM PCs.

When the commercial was broadcast, it reached 46.4 percent of America's households. People were stunned about this outrageous ad, which was "unlike anything they had seen before.") Suddenly, millions of people knew something called Macintosh. The "commercial sparked widespread controversy"), and won the highest advertising awards (more than 30).

The Macintosh (priced at $2,495) was a success from the start. Steve Jobs, the visionary, compared it to Graham Bell's invention of the telephone a hundred years ago. It was the "most approachable") and sophisticated personal computer of the time, which ushered in a new era of easy computing with a graphical interface and mouse. This feature would be taken over by many software companies in the subsequent years, particularly by big Microsoft, which developed Windows. This graphical user interface, which ha s been established as the industry standard today, is quite similar to Macintosh’s and makes possible the easy use of IBM PCs.

In the first 100 days, an industry record of more than 70,000 Macintosh computers were shipped - a number that went up to the total of 250,000 sold units by the end of the year.

## John Sculley and Steve Jobs

Despite the astonishing figures of sold Macintosh computers and a boost in sales to more than $1.5 billion in 1984 (up 55% from 1983),) Apple soon fell into its most severe crisis, which would only be overcome by Sculley's hard measures and led to the firing of its visionary Steve Jobs.

John Sculley had been vice-president at PepsiCo where he had successfully made Pepsi the number one brand in the Cola Wars. Actually, there was no reason for him, one of America's top managers with a secure and highly paid position at PepsiCo, to join a bunch of young computer nerds at the West coast. The reason why he finally agreed yet is Steve Jobs who impressed him by his visionary ideas and asked him a question to which he did have no answer: "Do you want to spend the rest of your life selling sugared water or do you want a chance to change the world?") This question told him that his "entire life was at a critical crossroads.")

Sculley and Jobs became close friends. They could "complete each other's sentences" because they "were on the same wavelength.") The "dynamic duo", as they were called in an issue of Business Week in October 1983, was esteemed highly in the press and contributed significantly to Apple's good reputation in the public at the time.

The downfall came soon, however, when their largely overestimated expectations of the Macintosh sales could not be met. In their euphoria about the revolutionary Mac, they thought they would ship 80,000 units by the end of 1984, and had produced them in advance. When the reality brought "merely" 20,000 with a falling tendency, the crisis was evident. Reasons for that decline were that the Macintosh was not as "perfect" as expected - with its 128 KByte RAM (they were then mounted to 512 KB) it was not powerful enough, and there were hardly any software applications available yet. Moreover, at the 1985 annual meeting, Jobs and Sculley neglected the fact that 70 percent of the company's sales were still due to the Apple II, whereas the Macintosh accounted for only 30 percent. Many sophisticated Apple II designers were annoyed and left the company.

Steve Jobs became more and more angry and aggressive because of the continuing drop in Macintosh sales (merely 2,500 units in March 1985).) He blamed everyone for it, except for himself. Steve just did not see that the "problem was with him.") In the end, he blamed even Sculley for the crisis and wanted to lead the company himself. But this seemed impossible to everyone else: "Steve was a big thinker, an inspirational motivator, but not a day-to-day manager. What was sad was that he could not see it.")

When Sculley was informed that Jobs intended to remove him insidiously from the company, he was quite concerned, but then decided to choose the company's welfare over his friendship to its visionary co-founder. Supported by Markkula and the other members of the board, in May 1985, he dismissed Steve from his positions as the vice-president and as the leader of the Macintosh division; Jobs did not have any managerial power anymore.

Steve Jobs was quite depressed and made trips to Europe and the Soviet Union. Finally, he decided to leave Apple in December 1985, and sold all his Apple shares. He took along some of the best employees to start his new venture - NeXT. He intended to design a workstation for the university sector. In February 1987, billionaire Ross Perot invested $20 million for 16 percent of NeXT. The new computer was introduced to the public in October 1988, priced at $6,000.

At Apple, John Sculley took several measures to save the company, which had become chaotic. In the course of a major reorganization he dismissed 1,200 employees (20% of the total workforce) and put the broken parts of the company together to form one unified Apple. His restructuring saved a lot of costs and consolidated the company.

1986 was Apple's worst year with a decline in net sales from $1.92 (1985) to $1.90 billion. Gradually, Sculley could persuade software companies, which had turned away from Apple, to write applications for the Macintosh.

Apple found its new market in desktop publishing (DTP), for which the Macintosh was predestined. By the time, the Macintosh became a serious tool for the business market and its sales increased again.

Until today, Apple has grown steadily and now reaches net sales of more than $7 billion. Although the Macintosh lost the battle against Big Blue, today it is a successful product and was sold over 2.5 million times worldwide in 1992. Apple remains the second-biggest personal computer manufacturer after IBM and has released innovative products such as QuickTime, an easy to use multimedia software combining sound, video and animation. Its latest development is Newton, a personal digital assistant (PDA), which serves as an electronic notepad and "integrates advanced hand-writing recognition, communication and data-management technologies.")

## Apple today.

CUPERTINO, California—December 5, 2000—Apple® today announced that it has experienced significantly slower than expected sales during October and November, which will result in revenues and earnings for its quarter ending December 30, 2000 being substantially below expectations.

The company expects to report revenue of about $1 billion and a net loss, excluding investment gains, of between $225 and $250 million.

The $600 million revenue shortfall from previous expectations is due to lower than expected channel sell-through across all geographies and unplanned sales promotions and pricing actions. The net loss is the result of the revenue shortfall and cancellation charges related to decreases in forecasted component purchases for current products.

“The swift industry-wide decline in PC sales will result in Apple’s first non-profitable quarter in three years,” said Apple’s CEO Steve Jobs. “We’re not happy about it, and plan to return to sustained profitability next quarter. We are committed to reducing our channel inventories to normal levels by the end of this quarter, and remain very excited about the new products and programs Apple will be rolling out in 2001.”

“In light of the lower results anticipated for the December quarter, we now expect revenues for fiscal 2001 to be in the $6 to $6.5 billion range,” said Apple’s CFO Fred Anderson.